E15799

Fingal County Council
Comhairle Chontae Fhine Gall

M50 *SECOND LIFFEY VALLEY BRIDGE*

ENVIRONMENTAL IMPACT STATEMENT

DECEMBER 1998

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ARUP

Fingal County Council

Second M50 Liffey Valley Bridge

Environmental Impact Statement

December 1998

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1. INTRODUCTION

1.1 Background to the Environmental Impact Statement

This Environmental Impact Statement (EIS) has been compiled to describe the findings of an Environmental Impact Study of the proposed second M50 Liffey Valley Bridge. The proposed scheme is located approximately 8 km west of central Dublin (Figure 1.1), at the point where the River Liffey flows eastwards past Strawberry Beds. The proposed bridge, which is being promoted by Fingal County Council and South Dublin County Council, would be almost identical in size and form to the existing Liffey Valley Bridge. An aerial perspective of the Liffey Valley is shown in Figure 1.2.

Included in the proposals are revisions to the existing N4 Palmerstown Interchange and a widening of the existing Toll Plaza. The Roads Act 1993 stipulates that projects of this nature require an EIS to describe the schemes environmental effects, and to describe the mitigation measures necessary to minimise the impact of significant effects. Accordingly, this EIS has been prepared to inform decision-makers and members of the public about the nature and scope of the schemes interactions with human beings, material assets and environmental resources.

A Non-Technical Summary, summarising the environmental effects of the scheme in non-technical language, is available as a separate document to the EIS.

1.2 Background to the Proposed Scheme

The Northern Cross Route, linking Blanchardstown with the M1 Airport Road, was opened in December 1996. Since the opening of this route, it has been increasingly clear that there is a pressing need to provide a second bridge over the Liffey Valley at Palmerston to accommodate significant traffic growth. The existing Liffey Valley Bridge is now carrying on average over 55,000 vehicles per day (April '98). This figure rises to over 60,000 on Fridays. The existing bridge is a four lane divided facility with no hard shoulders and reduced carriageway width.

In spite of recent capacity improvements to the Toll Plaza north of the bridge, which have helped to ease queuing, there are still regular traffic build-ups to the north and south of the Plaza. Calculations by National Toll Road's (NTR) independent traffic consultants show that the ultimate capacity of the current bridge is as low as 68,000 vehicles per day, 25% less than the adjoining sections of the M50 motorway. The existing bridge therefore represents a significant capacity constraint on the M50, in relation to other sections.

With the continuous growth of traffic in Dublin, the imminent opening of the Quarryvale Shopping Centre, the new developments by IBM at Mulhuddart, continuing expansion of Hewlett Packard and Intel at Leixlip, and the potential development of the Lucan / Clondalkin Centre, it is clear that the existing bridge will become a severe bottleneck on the M50 motorway within the next three years. Coupled to these developments, the construction of the Southern Cross and Southeastern motorways and the Dublin Port Tunnel will generate additional trips over the bridge.

At the time when the current bridge was being designed and planned, consideration was given to the need for the second bridge and a third lane in each direction. At the time of the Public Inquiry into the (Western Parkway, Galway to Navan Road) Motorway Scheme, 1985, the Planning Officer, in his evidence gave a brief description of the scheme as *"The scheme has a typical reservation of 53 m plus side slopes and consisits of a provision for two lanes of traffic*

in each direction with the usual hard shoulders, hard strip, grass margins and a wide central median which can provide for a third lane in each direction. The long term scheme commences with a grade separated interchange at the Galway Road. The Motorway will be taken over the Liffey at Strawberry Beds Road by twin 5 span bridges.....".

The environmental impact report prepared at that time for the first Liffey Valley Bridge, was prepared with the construction of the second bridge at this location in view. Its findings were presented at the Motorway and Bridge Inquiry in 1985 and were incorporated into the Bridges Preliminary Report.

The Dublin Transport Office (DTO) has prepared a computer model of Dublin's road network. This model has been used to predict the future impacts brought about by implementation of DTI schemes. In the DTI model of the C-ring, the crossing of the Liffey Valley along the M50 has always comprised a two-bridge scenario.

For this reason, the alignment of the M50 at the point where it traverses the Liffey Valley was designed to cater for two parallel bridges. The landtake and Compulsory Purchase Orders instigated at that time were sufficient to accommodate a second bridge in the future, without the need to seek additional land for construction of a parallel bridge. (Western Parkway, Galway - Navan Road, Motorway Scheme 1985).

The EIS for the second bridge has therefore been undertaken within the framework of a scheme which will not require any further landtake, and where the tie-ins at either end of the bridge can be accommodated readily. Details concerning the nature, scope and extent of the construction works, and operational aspects of the scheme, are presented in Chapter 5.

1.3 Financing and Provision of the Proposed Scheme

National Toll Roads Plc has submitted proposals to the National Roads Authority regarding financing and provision of the second bridge. Fingal County Council and South Dublin County Council have already approved the proposed second bridge, in principle. They also both have approved entering into an agreement pursuant to Section 59, Local Government Act 1955. This empowers Fingal County Council to carry out all the work, including preparation of an Environmental Impact Statement, Motorway Scheme, Bridge Order, service of notices etc., which may be necessary for provision of the second bridge.

In its letter dated 25 February 1998, the National Roads Authority conveyed its agreement that planning to provide a second Liffey Valley Bridge at Palmerston should proceed, and noted the arrangements for the undertaking of this Environmental Impact Study. The terms of reference for this study have subsequently been agreed through detailed discussions with Fingal County Council and the National Roads Authority.

It is intended that the Southern Cross Route will be open in the Spring of 2001. It is important, to avoid unacceptable levels of congestion, that the second Liffey Valley Bridge should be ready to open at this time. On the completion of the Environmental Impact Study, all of the financing, design, tender and construction procedures will now be fast-tracked.

1.4 Description of the Scheme

The project involves the construction of a second post tensioned concrete bridge over the river Liffey adjacent to and approximately 4 m to the east of the existing Liffey Valley Bridge. The new bridge will be identical in form to the existing bridge and will differ only in the length of its spans and the configuration of its piers. The proposed configuration was selected following

a masterplanning study for the initial scheme, and is that which was passed through the initial Public Inquiry.

The new bridge will be 385 m in length across the valley, and will have four load-bearing piers supporting the spans of 66 m, 78 m, 89 m, 90m and 62m from south to north respectively. In addition to the provision of the bridge, there will be a number of associated works that will be carried out in conjunction. There will be a realignment of the southbound off-ramp onto the N4 Interchange, a straightening out of the north bound on-ramp off of the N4 Interchange to remove the priority junction and an expansion of the existing Toll Plaza to the north of the site.

The alignment of the existing bridge is shown in Figure 1.3. Figures 1.4 and 1.5 illustrate, respectively, the horizontal and vertical alignments of the proposed bridge.

The method of lighting the new bridge is expected to be identical to that which is currently used on the existing bridge. This method is currently the most effective in terms of providing the lighting on the bridge deck necessary to meet the required safety standards. If in the future lighting technology allows for a reduction in the number of masts required to adequately illuminate the bridge deck or for strip lighting to be installed in the parapets of both bridges, it is hoped that consideration will be given to these options at that time.

1.5 Regulatory Background and Scope of the Study

The scope of the EIS undertaken in support of this document was governed by both current legislation and national guidelines. The key legislation which governs both the need for an EIS to support a planning application, and which sets out the issues that must be addressed within the document, are stipulated in the Roads Act 1993 (referred to hereafter as the *Roads Act*). In the context of the Second M50 Liffey Valley Bridge, the Roads Act forms the enabling legislation for the European Council Environmental Assessment Directive (85/337/EEC). Sections 50 (2) and (3) of the Roads Act specify the information that must be presented in an EIS, and these have acted as the basis for structuring the EIS as follows:

- A description of the proposal, comprising information about the site, design, size, physical characteristics and land-use requirements of the development
- The data necessary to identify and assess the main effects which the proposed structure and associated infrastructure are likely to have on the environment
- A description of the likely significant effects, both direct and indirect, of the proposed development upon the environment, explained by reference to its possible effects on:
  - Human beings
  - Fauna
  - Flora
  - Soil
  - Water
  - Air
  - Climate
  - Landscape
  - Material assets

- Cultural heritage
- The interaction between any of these factors

- Where significant adverse effects are identified with respect to any of the matters above, a description of the measures envisaged to avoid, reduce and if possible, remedy, those effects
- Where appropriate, an outline of the other scheme options (if any) and an indication of the main reasons for choosing the preferred option, taking into account the environmental effects
- A summary of the above information in non-technical language.

The general guidance offered by the Environmental Protection Agency (EPA) in its two advisory documents relating to the preparation and content of an EIS (EPA, 1995(a) & 1995(b)) was also considered. The EPA Advice Notes stipulate the potential significant impacts likely to arise from a highway scheme, and how these may in turn affect those features and resources listed above.

The structure of the EIS was therefore governed by legislative requirements and the EPA guidance notes, with these requirements tailored to reflect more closely the particular environmental setting of the proposed Second M50 Liffey Valley Bridge. Ove Arup & Partners Ireland in-house experience of designing the first Liffey Valley Bridge also assisted greatly in scoping the study. These guiding principles led to the issues examined for the EIS being arranged as follows:

- **Land Use, Land Ownership and Development**: Existing land uses adjacent to the application site; land ownership patterns; zoning objectives and committed developments adjacent to the application site and along the M50 corridor
- **Project Description**: Description of the way in which the original bridge was built, and design options for constructing the new one; land take requirements; construction traffic and access to the construction area; construction programme; wastewater management; materials and labour requirements
- **Planning Policy Context**: Review of national and local transportation and planning policy documents; evaluation of the proposed scheme's conformity with stated planning policies and land use zoning objectives
- **Traffic Evaluation**: Existing traffic volumes for the Liffey Valley Bridge; review of projected traffic growth rates; current and future performance of the N4 Palmerston Interchange; Evaluation of the proposed scheme's interactions with traffic flows along the M50 corridor and at the N4 Interchange
- **Landscape**: Landscape character and quality; visual intrusion; landscape treatment proposals
- **Noise and Vibration**: Existing road traffic noise at four key locations; prediction of noise level increases at design year; construction noise and vibration control
- **Archaeology and Cultural Heritage**: Description of recorded archaeological features and finds within the study area; listed buildings and their setting

- **Nature Conservation**: Effects of the scheme on the ecological resources of this part of the Liffey Valley; mitigation measures to incorporate with the landscape treatment proposals
- **Air Quality**: Existing and future air quality, based on computer modelling techniques
- **Hydrology and Drainage**: Potential sources of water pollution and mitigation measures during the construction phase; stormwater run-off and foul drainage management during the operational phase
- **Recreation and Amenity**: Liffey Valley Special Amenity Area Order (SAAO)1993 Management Plan; recreational activities; amenity resources; effects of the scheme on recreation and amenity
- **Interaction of Effects and Cumulative Impacts**: Summary of the scheme's key environmental effects; interaction of effects between different topics; cumulative environmental effects on similar locations or resources

Material Assets is a term which has been defined by the EPA (1995 (b)) in its Advice Notes on Current Practice as relating to the physical resources which may be of either human (e.g. infrastructure, utilities, settlements) or natural origin (e.g. non-renewable resources such as mineral reserves and fossil fuels). The objective of including material assets within an EIS is to ensure that the principle of *sustainability* enters the decision-making process. This EIS considers the effects upon material assets within sections dealing with property, land use and transportation infrastructure. Material assets in the form of utilities are presented in Section 3, which examines the engineering design and construction activities associated with the proposals.

The viability or feasibility of options and alternatives to the proposed scheme were reviewed as part of the Environmental Impact Study. Given the need to provide increased traffic capacity across the Liffey Valley to bring the capacity up to that existing on the M50 motorway, alternatives other than an additional bridge are not feasible.

In terms of the bridge location, the scheme proposes to provide an additional roadway across the river valley that will be consistent with, and tie into the existing geometric layout of the M50 approaches to the Liffey Valley Bridge. As the plans for a second bridge at this location are concordant with the detailed design of the M50 to date and the design of the original bridge, the option of providing such a high grade river Liffey crossing at an alternative location can be considered not to be viable.

Given the landscape and visual sensitivity of the site, and the original design for a twin bridge, the type of structure and form could not reasonably be substantially different from the existing bridge. The alternative methods of bridge construction are covered in Chapter 5.

1.6 Structure of the EIS

The EIS is presented in 16 chapters. The structure and content of these chapters reflect the regulatory requirements, guidelines and professional judgement used to scope the EIS. Within the EPA guidelines, social and economic effects are mentioned under the headings of: human beings, economic activity, and social patterns. The guidelines state that the EIS shall concentrate on those topics which are manifested in the environment, such as new land uses, more buildings or greater emissions. Within this EIS (as indicated in Table 1.1) these issues are dealt with in detail under the relevant specific headings of air quality, noise, recreation and amenity, and require no further discussion or elaboration under the heading of socio-economic effects. The guidelines further state that *issues such as employment, commercial competition, zoning and*

other social and economic issues are dealt with by more specific instruments (such as the Planning Acts). Therefore, while there is no specific requirement to address these issues within the EIS, the socio-economic issues of economics, transportation, commerce, employment and material assets are broadly addressed under the headings indicated in Table 1.1.

To clarify the way in which the mandatory topics have been incorporated into the EIS, Table 1.1 summarises where each of these issues may be found in the document.

Table 1.1

Content and Scope of the Environmental Impact Statement

Topic	Chapter in which the topic is assessed
Human Beings	4, Land use ownership and development; 6, Policy Context; 7, Traffic Evaluation; 9, Noise and Vibration; 14, Recreation and Amenity
Flora	11, Nature Conservation
Fauna	11, Nature Conservation
Soil	No significant impacts on soils are anticipated, therefore, this Environmental Impact Statement contains no detailed description of impacts on, or mitigation measures for, soil resources. However, the management of construction spoil is examined in Chapter 5, and the need to maintain an archaeological watching brief over soil stripping is identified in Chapter 10.
Water	13, Hydrology and Drainage; 11, Nature Conservation
Air	12, Air Quality
Climate	3, The Site and Its Location
Landscape	8, Landscape and Visual Effects
Material Assets	3, The Site and Its Location; 4, Land use ownership and development; 7, Traffic Evaluation
Cultural Heritage	10, Archaeology and Heritage; and 14, Recreation and Amenity
Interaction of Effects	15, Interaction of Effects
Socio-economics	Economics, Employment, and Material Assets: 5, Construction Issues; Commerce, Transportation: 7, Traffic Evaluation

The EPA guidance notes advise that a proposed scheme's effects on human beings should also be addressed within an EIS. People may be adversely affected by projects in a variety of ways, such as noise, amenity conflicts, poorer air quality and land severance. People can also derive positive benefits from a scheme, for example, better community facilities, improved provision

of goods and services, less congestion and lowered noise levels. To ensure that the principal effects on human beings are described in a systematic, transparent and consistent manner, they are considered on a topic-by-topic basis. There is therefore no separate chapter within the EIS entitled *Human Beings*, because this could lead to repetition of sections within other chapters which also encompass effects on human beings.

1.7 The Study Team

This Environmental Impact Statement is based on an EIS of the proposed bridge and associated infrastructure carried out by Ove Arup & Partners Ireland (Arup) and its sub-consultants. Arup specialists in environmental sciences, environmental engineering, geotechnics and civil engineering provided technical inputs into the EIS. Arup was also responsible for managing the wider EIS process, and editing the EIS. Inputs by Arup personnel were complemented by the specialist sub-consultants listed in Table 1.2, whose work was undertaken in accordance with specifications prepared by Arup.

Table 1.2
Specialist Studies Undertaken for the EIS

Subject Area	Consultant
Archaeology and Cultural Heritage	Margaret Gowen & Co. Ltd.
Ecological Resources	Natural Environment Consultants
Noise	Forbairt
Water Quality	Forbairt
Air Quality	Forbairt
Landscape Evaluation and Visual Impact	Brady, Shipman & Martin

The environmental impact study was undertaken with due regard to both the detailed engineering design of the bridge and its associated infrastructure, and the environmental design experience gained from the construction and operation of the first Liffey Valley Bridge.

1.8 Public Consultation

A copy of this Environmental Impact Statement is available for examination at Fingal and South Dublin County Planning Departments, and the Community Office at Palmerston. The Environmental Impact Statement is also available for purchase at the price of IR £30.00 and a non technical summary is available free of charge, from Fingal County Council, South Dublin County Council and Ove Arup & Partners Ireland at the following addresses:

Fingal County Planning Department
46-49 Upper O'Connell Street
Dublin 1

South Dublin County Planning Department
South Dublin Headquarters
Town Centre
Tallaght
Dublin 24

Ove Arup & Partners Ireland
10 Wellington Road
Ballsbridge
Dublin 4

2. STUDY METHOD

2.1 Introduction

This Chapter describes the way in which the EIS was undertaken. It describes the consultation and data collection process and the predictive techniques employed in the assessmen. Section 2.4 reviews the way in which environmental effects were assessed, while Section 2.5 describes the assumptions and limitations of the EIS.

2.2 Consultation and Data Collection

2.2.1 Consultations

Consultations have taken place with both statutory bodies and public organisations with responsibility for, or an interest in, the potential environmental issues surrounding the proposed second bridge. The consultation process generated a good level of interest, and a considerable two-way exchange of information. The assistance of those organisations which provided data and guidance is gratefully acknowledged. The statutory and non-statutory authorities, including local interest groups, consulted during the course of the EIS are listed below:

- Fingal & South Dublin County Councils
- An Chomhairle Ealaion (The Arts Council)
- An Ghniomhaireacht Um Chaomhnu Comhshaoil (the Environment Protection Agency)
- An Taisce (The National Trust for Ireland)
- Board Gais Eireann
- Bord Failte Eireann
- Commissioners of Public Works
- Department of Agriculture, Food and Forestry
- Department of Arts, Culture and the Gaeltacht
- Department of the Environment
- Department of Public Enterprises
- Dublin Transport Office
- Eastern Health Board
- Eastern Regional Fisheries Board
- Electricity Supply Board
- King's Hospital School
- Irish Aviation Authority
- Irish Canoe Union
- National Authority for Occupational Safety and Health
- National Monuments Advisory Council
- National Parks and Wildlife Service
- National Roads Authority
- Palmerston Residents' Association
- Strawberry Beds Residents' Association
- Telecom Eireann.

2.2.2 Data Collection

To supplement the information made available by the consultees, appropriately qualified sub-consultants conducted ecological and landscape surveys of the Liffey Valley. In addition, a baseline noise survey conducted in October 1997 was reviewed.

2.3 Predictive Techniques

The predictive techniques used to establish the environmental effects of the proposed scheme varied according to the topics being considered. Where established techniques exist, they have been used and the source documentation referenced. The main topics in which recognised forecasting models have been applied are the traffic, noise and air quality evaluations (Chapters 7, 9, 12 respectively).

2.4 Evaluation of Environmental Effects

2.4.1 Introduction

The potential environmental effects of a development can be either specific to a particular location, such as traffic noise affecting an individual property, or wide ranging such as a change in the landscape quality of an area. Environmental effects may also relate to the construction phase as well as the operational phase of a highway project. In addition, the effects may be either short-term or long-term, reversible or permanent, and may occur immediately or at some time in the future. Evaluating the environmental effects of the scheme in respect of each of the topics examined has therefore relied upon reasoned arguments and professional judgement, with the following questions being posed in arriving at a conclusion:

- Which risk groups would be affected and in which way?
- Is the effect reversible or irreversible, repairable or non-repairable?
- Do the effects occur over the short-, medium- or long-term?
- Is the effect continuous or temporary, and does it increase or decrease through time?
- Will the consequence be contentious because it breaches environmental standards and health objectives?
- Are mitigating and / or enhancing measures available and, if so, how costly are they?

Where standards, regulations or codes of practice are applicable, these have been used to aid the evaluation of significance. The advice contained in the EPA draft guidelines (EPA, 1995a and 1995b) regarding significance criteria has been used where appropriate.

2.4.2 EPA Draft Guidelines and Significance Criteria

The EPA draft guidelines present a glossary of terms for a range of impacts. These have been adapted to provide a basis for deriving the significance evaluation criteria used in this EIS. The draft guidelines make a distinction between *significant* impacts and other impacts which are not significant, namely *slight*, *imperceptible* and *neutral* impacts. Within the category of significant impacts, which may be either positive or negative, the glossary makes reference only to *profound* impacts.

The EPA draft guidelines note that significance is determined by a combination of objective (scientific) and subjective (social) concerns. Taking the first of these, the draft guidelines indicate that topics should be included in an evaluation if a development could cause *...significant impacts on an aspect of the environment which has been formally or systematically designated as being of importance*, or if the potential exists for the development to *...significantly alter the existing character of some aspect of an environment.*

To maintain clarity in defining the relative duration of environmental effects the following terms have been used:

- **Temporary** ~ up to 1 year
- **Short-term** ~ From 1 to 7 years
- **Medium-term** ~ From 7 to 20 years
- **Long-term** ~ From 20 to 50 years
- **Permanent** ~ A period in excess of 50 years.

To provide an aid to judging the importance of the different consequences of the proposed scheme, the above considerations have been employed to define a suite of significance evaluation criteria. The evaluation criteria comprise five ascending levels of importance to the decision-making process, namely:

- **Not significant**
- **Minor**
- **Moderate**
- **Major**
- **Severe.**

The *severe* level of impact is reserved for adverse effects only. It is important to recognise that a scheme can also have very positive effects. These would be designated a 'major positive'effect. Each of the five levels is accompanied by a definition of an assumed relationship to the decision-making process as presented in Table 2.1 prepared specifically for this scheme. For cross-referencing purposes, the relationship between the terms used in the EPA draft guidelines and the significance levels used in this EIS are also shown. Using Table 2.1 to provide generic guidance, more specific significance criteria have then been developed for some environmental topics considered in the EIS. Where a specific topic is insignificant or irrelevant to the decision-making process, subject-specific evaluation criteria have not been developed.

Table 2.1
Significance Evaluation Criteria

EPA Glossary of Impacts	Significance Level	Criteria
Profound Significant Impact: Negative Only	Severe	Only adverse effects are assigned this level of importance as they represent critical factors in the decision-making process. These effects are generally, but not exclusively associated with sites and features of national or regional importance. Severe effects can be predicted with a high level of certainty. Typically, mitigation measures are either unavailable, or unable to redress fully the losses which arise. The severe criterion is therefore either long-term or permanent in duration. In exceptional circumstances, it may be assigned to an intensity or extent of effect that is far in excess of what is normally experienced, even if the resources or assets affected are not of national or regional importance.
Significant Impact: Positive or Negative	Major	These effects are likely to be important considerations at a regional or district scale. If adverse, they constitute potential concerns to the project which are important factors in the decision-making process. Major effects are either medium- or long-term in duration, and have a medium to high level of probability of occurring. Mitigation measures and detailed design work although available, are unlikely to ameliorate all of the effects upon the receptor community or natural resource.
	Moderate	These effects may be important at a district or local scale, but are not likely to be key elements in the decision-making process. Moderate effects, if adverse, are likely to be of short- or medium-term duration. Nevertheless, the cumulative effects of such issues may lead to an increase in the overall impact on a particular resource or material asset. In turn, this may lead to their placement in the category of 'major' effect. They represent issues where effects will certainly be measurable and / or perceptible, but mitigation measures and detailed design work may ameliorate / enhance some of the consequences upon affected communities, features or assets. There is also likely to be a lower level of certainty attached to predicting the full nature, extent and scope of moderate effects.
	Minor	Minor effects, although peripheral to decision-making processes, may be justifiably raised as local issues by, for example, affected residents and interest groups. They are of relevance in enhancing the detailed design of the scheme, and in shaping mitigation and compensation proposals. Minor effects, if adverse, are likely to be only of a temporary or short-term nature. Their magnitude, although measurable, will be at the lowest end of the scale relating to magnitude, scope and intensity. Because minor issues are at the bottom margin of established prediction or detection limits, there is often a degree of uncertainty attached to anticipated consequences and the extent of the affected groups or resources.
Neutral, Imperceptible or Slight Impact	Not Significant	No effects, or those which are below levels of perception, within normal bounds of variation, or within the margin of forecasting error.

2.5 Assumptions and Limitations

Every reasonable effort has been made to obtain data concerning baseline environmental conditions, and to predict accurately the effects of the proposed development. Where limitations have been identified, or it has been necessary to make assumptions, these have been documented in the appropriate section.

The assumptions adopted are clearly of importance to both the EIS process, and the conclusions that are drawn from it. The approach adopted in this EIS is one of clearly stating reasoned assumptions where they have been made, so that they may be critically reviewed by external parties.

Only in the case of the air quality, noise and traffic evaluations have recognised forecasting techniques been used to predict environmental conditions at the opening and design years. For all other environmental topics it has been necessary to assume that local plan proposals are implemented and policies remain unchanged. It has also been assumed that existing trends in environmental conditions would continue. In respect of the air quality appraisal (Chapter 12), it has been assumed that improvements in exhaust gas emission rates from vehicles will arise from ongoing technological enhancements to the vehicle fleet. These improvements will be implemented in response to increasingly stringent legislative requirements.

3. THE SITE AND ITS LOCATION

3.1 Introduction

This chapter describes the site and its location within the Liffey Valley over which the proposed bridge is aligned. The topography and landscape characteristics of the valley are summarised in Section 3.3 to provide a setting against which specific topics in the following chapters can be assessed. A description is given in Section 3.4 of the geology and soils that are to be found in the valley where the construction will take place. The climate that is experienced in the locality is addressed using historical data. Finally, a summary is provided of the existing infrastructural services in the vicinity of the site.

3.2 The Site and Its Location

The site is located along a section of the M50 Western Parkway, to the west of Dublin city, at National Grid Reference O 070 358. The proposed bridge is at a point where the Western Parkway crosses the Liffey Valley in an area known as *Strawberry Beds*. The River Liffey flows along the valley in an easterly direction, towards Dublin. The bottom of the valley is approximately 13 m above ordnance datum (AOD). The plateau to the north, where the toll plaza is located 55 m AOD, rises gently northwards above the steep-sided north slope of the valley.

This length of the Liffey Valley is bounded to the west (upstream) by the village of Lucan and to the east by Knockmaroon. To the south of the existing bridge is the grade separated intersection of the M50 and the N4. At this junction, residential property is situated within its north-east quadrant on the Old Lucan Road, while King's Hospital School is located in its north-west quadrant. These properties are considered further in Chapter 4. The Toll Plaza is situated within an area of agricultural land to the north of the bridge.

3.3 Topography and Local Landscape Features

The Liffey Valley has an asymmetrical cross-section at the bridge crossing. The southern slopes of the valley are gently inclined and slightly concave in profile, with large fields, hedgerows and tree belts extending along the valley floor. The northern slopes of the valley are substantially steeper than the southern slopes, and are generally covered in extensive, mature, deciduous woodland.

The river in this section of the valley follows a course close to the foot of the north slope. A former mill race runs parallel to the river as far as Palmerston, but has fallen into disuse. The river is approximately 25 m wide at the point where it flows below the bridge. The 4 m wide millrace is located to the south of the river and is separated from it by a 25-30 m wide corridor of level land. The river and millrace are relatively small elements within the context of the overall valley width of 480 m between the tops of the north and south slopes. Their presence is, however, emphasised by their parallel courses forming a definite line through the valley floor and by the associated tree vegetation (for example, alder and willow) along the river's banks.

The intrinsic landscape quality and amenity value of the Liffey Valley is recognised through its statutory designation under a Special Amenity Area Order (SAAO). A background to the Order and the implications of this status, are considered further in Chapters 6 and 8. It is important to note that the proposed scheme was part of the initail scheme which was passed through the initial Public Inquiry. This Public Inquiry took place prior to the 1990 designation of the Liffey Valley as a Special Amenity Area (SAA) through a SAAO.

3.4 Geology and Soils

A detailed understanding of the geology and soils of the site has been gained from the investigations undertaken in support of the first bridge's design and construction.

There was a geotechnical site investigation carried out for the first bridge in 1984. The investigation undertaken at that stage was prepared in the context of a two bridge scheme being developed. Therefore the level of information gathered would have facilitated the construction of both bridges simultaneously. The site investigation itself consisted of 19 cable percussion boreholes across the valley to a maximum depth of 26 m. Ten of these boreholes were cored to prove the quality of the underlying rock. In addition, 10 trial pits were excavated to depths of 2 to 4 m. The geology of the site, as well as its topography (refer to Section 3.3), are strongly influenced by glacial action. Large deposits of glacial material (boulder clay, sands and gravels) are much in evidence at varying depths across the site.

The geotechnical investigations previously undertaken, combined with the knowledge of the area's geological history, indicate the following sequence of events. Firstly, morainic deposits of sands, gravels and boulder clays were laid down by a retreating glacier. This effectively infilled an earlier valley which had been formed by the erosive action of a young River Liffey cutting into the original Carboniferous limestone geology. A second glaciation was responsible for removal of some of the earlier deposits, and in turn for consolidating the remainder. On retreating, this second glacier deposited a layer of dense black boulder clay which is today found extensively over the Dublin area. Post glacial erosion has cut into the black till to form the current valley profile.

The depth of glacial deposits varies considerably across the valley. At the gently-sloping southern end, there is a thin deposit of black till approximately 3 m deep. This deposit increases considerably in thickness, however, near the far southern end by the M50/ N7 Interchange. In the area where the slope meets the valley floor, the bedrock level dips quickly and the depth of the overlying moraine and boulder clay increases to some 15 m. The northern slopes contain very deep boulder clay layers interspersed with sands and gravels. Exact rock level at this location has not been established, but has been surmised from the evidence of nearby excavations. At the points in the valley where the rock has been recorded, the top 2 m to 3 m of surface was found to be weathered and fractured. This fact would need to be taken into account in any chosen foundation solutions which bear on the rock.

In summary, therefore, there are no geological or soil resources which pose a constraint to the proposed scheme. The glacial origins of the soils and the boulder clay deposits from which they are derived are very common in the Dublin area. Any loss of soil resources, therefore, would not pose a constraint to development or compromise the availability of a non-renewable resource. Cut and fill soil balances are described further in Chapter 5. A geological section through the site is illustrated in Figure 3.1.

3.5 Climate

Climatic data, comprising monthly and annual averages over a 30 year period between 1968 and 1998, were obtained from the Meteorological Service. The data were recorded at Casement Aerodrome, to the south-west of the Liffey Valley Bridge. Although the airport data provide a fair representation of the anticipated climatic characteristics at the Liffey Valley, the local topography is likely to exert an influence on the micro-climate of the site.

Indeed, the steep south-facing slopes to the north of the River Liffey have higher rates of insolation (exposure to the sun's rays) and lower incidences of frost than the rest of the valley, and were traditionally a source of soft fruit and vegetables for the Dublin markets.

In general, the site is open but not exposed. The mean annual average temperature is 9.3 °C, with the warmest month being July (average 16.2 °C) and the coldest, February (4.6 °C). Monthly average extremes of temperature are not marked, with the maximum average temperature of 19.9 °C recorded in August and a minimum average of 1.7 °C recorded in February. The average daily sunshine duration ranges from 1.4 hours in December to 5.8 hours in June.

Rainfall levels at Dublin are lower than the average for Ireland; the annual average at Casement is 711 mm. Rainfall is fairly evenly distributed throughout the year. December is the wettest month (73 mm), although roughly similar levels are experienced from August to January. The driest month of the year is April (49 mm). Rainfall intensities and return periods naturally influence the drainage design of the bridge. Surface run-off considerations and drainage design are considered in more detail in Chapter 13, Hydrology and Drainage.

The annual average wind speed of some 11 knots is derived from a relatively even distribution of monthly values. Information from older meteorlogical sources at Dublin Airport show that winds blowing from a westerly and south-westerly direction predominate, occurring on average for over 40 % of the time during the course of the year. Winds blowing from other directions are relatively evenly distributed, although south-easterlies from the Irish Sea are slightly more frequent than the remainder. On average, there is a likelihood of there being 6.6 days a year when gale force winds are blowing. The elevated position of the bridge as it traverses the valley, and its alignment in relation to the dominant westerly winds, increases the risk of strong cross-winds.

A snow or sleet shower occurs on average a total of 17 days per year, although there are only 5.3 days a year when snow is lying on the ground at 9 a.m. Fog is recorded at Dublin Airport on a total of 26 days per year, although its occurrence is evenly distributed on a monthly basis. The incidence of fog within the Liffey Valley could be greater on account of moisture-laden air cooling as it descends towards the river.

In summary, there are no meteorological extremes experienced at Dublin which could exert a fundamental influence on the design of the bridge and its associated infrastructure. However, the cross-winds which occur over the bridge from time to time do require specially-designed wind barriers.

3.6 Infrastructure

This section describes the utilities in the immediate area of the proposed bridge. From this review of utilities, it is concluded that there are no existing buried or overhead services which would be affected by the proposals. Further, the proposed scheme would not place any significant additional demands on existing utilities. Therefore, the current capacities of services in the area would not be exceeded through implementation of the scheme, and no new infrastructure would be required.

3.6.1 Surface Water Drainage

The surface water drainage system for the existing and proposed bridge is independent of all others in the area. This independent system is described in Chapter 13. All other existing surface water drainage systems will be unaffected by the proposed scheme.

3.6.2 Foul Drainage

On the southern side of the site, there are foul sewers serving both the King's Hospital School and the residences on the Old Lucan Road.

A pumping line runs from the King's Hospital School grounds to a rising main under the M50 and then into a discharge manhole (100 mm diameter) located in the eastern side of the motorway. At this point it changes from a pressure main to a gravity main and links up with the foul manhole outside No. 6 Hollyville Terrace (the Old Lucan Road). While the School is serviced by this pumping line and it lies partially within their lands, it is owned and maintained by South Dublin County Council.

There are ten existing manholes along the Old Lucan Road between the church at the east end of the road, and No. 1 Hollyville Terrace at the bus turning bay at the end of the *cul de sac*. The pipe connecting these manholes is 225 mm in diameter. These systems are currently adequate and will not be affected by this development.

On the northern side of the River Liffey, foul sewerage systems are in place to serve the residents and businesses on the Lower Road through the Strawberry Beds. The Lower Road foul water sewer is a 375 mm diameter drain and runs in an east-west direction. This is known as the Strawberry Beds sewer. At present Fingal County Council has no plans to alter the capacity or alignment of the existing pipeline in light of the proposed bridge.

The foul drainage from the Toll Plaza is disposed of into a septic tank, located adjacent to the plaza.

3.6.3 Potable Water Supply

South of the bridge site, cast iron pipes of 150 mm diameter serve the houses on the Old Lucan Road. These pipes run in both directions from No. 1 Hollyville Terrace and are divided by a duck foot hydrant (DFH). These pipes then run west under the M50 to the school grounds and east on the Old Lucan Road towards Palmerston. Another DFH lies on the western side of the bridges. These cast iron pipes were laid around the 1920s and at present there are no plans to replace or extend them. A potable water supply exists on the Lower Road, north of the River Liffey. The capacity of this supply is currently thought to be adequate.

3.6.4 Electricity

Live ESB underground cables run southwards in ducting from the main King's Hospital School building until meeting the Palmerston Interchange. At the Interchange the cables follow the curve of the roundabout before crossing the N4 and heading west along the boundary to the Quarryvale Development. As these cables are not in the immediate area of the proposed development it is not anticipated that they will be affected.

To the north of the existing bridge, underground cables run through the Toll Plaza. These live 38 kV cables terminate at an ESB substation on the east side of the Toll Plaza.

Also north of the existing bridge, there are overhead 38 kV cables running roughly parallel to the M50 on its east side. These cables pass southwards down into the valley, across the river and up to the southern plateau. At this point the cables are directed underground. From this point the cables traverse the old Lucan Road and then the N4 east of the Palmerston Interchange. It is understood that the ESB is planning to re-route the overhead lines that presently traverse the Liffey Valley through the hollow core of the existing bridge. These plans have no implication on the proposed scheme.

3.6.5 Gas

Bord Gais Eireann has indicated that the only gas main in the vicinity of the development is on the Old Lucan Road and runs east-west into the King's Hospital School. This 300 mm gas main was laid in 1964 and runs along the Old Lucan Road at a depth of 0.7 m. At No. 1 Hollyville Terrace it is connected to a 200 mm diameter ductile main laid in 1985 at a depth of 900 mm. A ball valve northwest of No. 1 Hollyville Terrace connects this to a 250 mm polyethylene main which crosses the M50 into the King's Hospital School grounds. It is unlikely that the existing lines will be changed due to the development of the proposed second bridge.

3.6.6 Telecommunications

Telecom Eireann's existing services will not be affected by the proposed scheme on the north or south of the Valley.

4. LAND USE, OWNERSHIP AND DEVELOPMENT

4.1 Introduction

This Chapter presents an evaluation of the impact on land use and development as a result of the proposed development. Existing land uses adjacent to the proposed bridge are described. Land ownership patterns in the vicinity of the site are reviewed in Section 4.3, and some of the important traffic-generating developments in the locality are described in the following section. The interactions of the scheme with each of these variables are then addressed, and the significance of these effects are described. The Chapter concludes with a review of mitigation measures and the residual effects of the scheme in relation to land ownership and committed developments.

4.2 Existing Land Uses

Land use zones in proximity to the development site are described below. For consistency, the titles given to land use zones in this section are carried through to other sections of the EIS.

4.2.1 Houses on the Lower Road

The Lower Road passes along the northern bank of the River Liffey, through the Strawberry Beds area. In places, the Lower Road passes within tens of metres of the river's edge, and tends to follow the meandering line of the river along the valley. The houses on the north side of Lower Road run parallel with the foot of the steep northern slope, and form a very low density linear development within Strawberry Beds. There are no houses on the south side of Lower Road, because of the constraints imposed by the proximity of the land to the Liffey.

On the west side of the existing bridge there is a cluster of houses within 200 m of the existing bridge. A public house and associated car park represent the only commercial activity in the area. On the east side of the existing bridge, there is one dwelling called 'Oaklands House' in close proximity (70 m) to the alignment of the proposed bridge. Opposite the entrance to this house, and on the south side of Lower Road is the clubhouse of The Irish Canoe Union. This clubhouse is an important location for watersports activity during the Summer and Autumn. (refer to Chapter 14).

4.2.2 Houses on the Old Lucan Road

To the east of the N4 Interchange, on the southern plateau above the valley, lies Palmerston village. The elements of Palmerston that are in the closest proximity to the site are the residential developments of Hollyville and Riversdale on the Old Lucan Road. Hollyville Terrace forms a *cul de sac* which runs along the Old Lucan Road up to a bus turning bay, next to the N4 Interchange. On the north side of the Old Lucan Road a row of six houses back onto the valley and have a view of the existing bridge. The land to the rear of these houses, towards the ridgeline, comprises agricultural land.

4.2.3 King's Hospital School

King's Hospital School is located to the west of the northbound on-ramp to the M50, and south of the valley's ridgeline. The school buildings comprise residential blocks, teaching blocks, a gymnasium with adjoining swimming pool and a school chapel.

The external grounds include recreation and amenity facilities for the students and a dwelling called Brooklawn to the northern edge of the site.

4.2.4 Special Area Amenity

The inherent amenity and landscape value of the Liffey Valley has been recognised through its designation as a Special Amenity Area. There is South Dublin County Council Parkland to the east of the bridge. The Parkland includes the site of a former landfill, which has been restored for use an informal recreational area by residents of Palmerston. The Parkland includes paths and trails for people to walk along. It is planned to extend this area to create a Linear Park in the future.

4.2.5 Luttrellstown Road

There is a motorway Toll Plaza on the plateau to the north of the Liffey Valley. While the lands adjacent to the Toll Plaza are currently under agricultural use, they have been zoned for the provision of a service area for the motorway. The Dublin County Development Plan 1993 confirms through a zoning objective that these lands are suitable for motorway, restaurant and leisure uses associated with the motorway.

4.3 Property Ownership in the Locality

4.3.1 Lower Road

On the north side of the river and Lower Road, the titles of the land are divided between three different owners. Under the existing bridge, Fingal County Council owns the land within the development site. To the east of this are lands associated with Oaklands House. To the west are lands owned by private home owners.

Between the Lower road and the river are lands spreading from the west across the site and to the east, which are owned by Fingal County Council, The Irish Canoe Union, and a private individual, respectively.

4.3.2 Houses on the Old Lucan Road

The residential properties on the Old Lucan Road are privately owned.

4.3.3 King's Hospital School

The Governors of the school own the land on which the school is sited, and the land spreading northwards to the ridgeline of the valley.

4.3.4 Special Area Amenity Order

A private individual owns the main expanse of land within the SAAO, south of the mill race and in proximity to the construction site. On the south side of the river, spreading east from approximately 300 m to the east of the site, and occupying the gently sloping area between the valley ridgeline and the southern bank of the river Liffey, are South Dublin County Council-owned lands. West Park Bridge Company owns the lands between the river and the Mill race.

4.3.5 Luttrellstown Road

The lands adjacent to the Toll Plaza east and west are in private ownership.

4.4 Development Trends in the Locality

4.4.1 Manufacturing and Industrial Development

The M50 corridor is presently a significant target location for manufacturing industry and inward investment into Ireland. Some of the existing industries along the M50 corridor have indicated in the past few years their plans to expand their current operation, or setting up new facilities. Both options will give rise to new employment demand. Most of these developments are occurring in and around Blanchardstown, and are in the fields of information technology and electronics.

Two IBM investments at Mulhuddart will employ 1,200 people within two years, and are projected to increase employment to 2,850 by 2001. IBM's International Customer Support Centre at Ballycoolin Business Park is already employing 500 of the 750 jobs announced in connection with the investment. 3 Com Ireland established in Blanchardstown in 1991, and embarked on a second phase of development in October 1996. The combined workforce for these two phases will reach 1,150 by the year 2001. Sanmina Corporation is setting up its European Headquarters at Blanchardstown Industrial Park over the next three years. This inward investment is anticipated to generate 470 new jobs. Kingston technology is the latest electronics company to locate in Blanchardstown. A predicted 300 jobs will be created over a five-year period by this company.

Bristol-Myers Squibb, the world's fourth largest pharmaceutical manufacturer, proposes to construct a new bulk pharmaceuticals plant at Cruiserath, near Mulhuddart, West Co. Dublin. The new plant will involve the investment of £225 million and some 400 jobs by 2004, at which time the plant will be in full production.

4.4.2 Retail Sector

Three major retail developments are in different stages of development along the motorway corridor. One new shopping centre called the Blanchardstown Center opened last year in Blanchardstown. The Center represents the first phase of a masterplan for the 90 acre site. The developer is at the appeal stage of a planning permission for an eight unit 72,000 square foot retail park adjacent to the Blanchardstown Center. Further planned stages of the scheme include a hotel, commercial office space, and retail housing.

Quarryvale is the largest shopping, leisure and business park in Ireland, and is presently being constructed on a 300 acre site immediately to the south-west of the N4 Interchange. The scheme will eventually comprise 1.5 million square feet of shopping space, an international trade and exhibition centre, and residential property, together with a 35 acre business park. The first phase of Quarryvale, comprising 350,000 square feet of retail development, will open in October 1998.

Full planning permission is currently being sought for another scheme at Lucan / Clondalkin town centre at Neilstown. The development would include 235,000 square feet of shopping, retail warehousing, commercial and residential property and a multiplex cinema. It is understood that funding for the development is already in place and that development work can begin at short notice should planning approval be obtained.

4.4.3 Dublin Airport

Dublin Airport constitutes a major traffic generator on the M50. Passenger numbers have increased significantly in recent years, from six million in 1986 to an actual number of 10 million in 1996. In August 1996 Aer Rianta announced a £97 million upgrading of the airport. It is expected that the capacity of the airport terminals will be increased to 15 million passengers per year on completion of the works. In addition, a private company is seeking permission to build a second terminal on 52 acres of land adjacent to the existing airport's runways, and to construct link runways with the new buildings. Air cargo handling has also increased significantly in the past few years, growing by some 50 % over the two year period to 1996.

4.4.4 Dublin Port

Dublin Port represents a significant source of traffic generation within the greater Dublin area. Since 1990 the throughput of freight at the port has more than doubled and the port has increased its share of the total national freight market. Current throughput stands at 15 million tonnes per year. It is anticipated that freight tonnage handled by Dublin Port will continue to grow at a rate of 7 to 10 % in the next three to five years, at which time the port will have reached its present capacity. Aside from freight, the two ferry services operating from Dublin handled 837,000 vehicle movements in 1996.

4.4.5 Summary

It is apparent that there are considerable industrial, retail, leisure and transport-related developments along the M50 corridor. Some of these development proposals are already underway, and the remainder are likely to be completed over the next few years. Inevitably, the traffic generated by these developments will place an additional burden on the capacity of the M50 corridor. Existing pinch points in the road network, such as the Liffey Valley Bridge, will be subject to further congestion in the absence of schemes to alleviate these problems. Chapter 7, the traffic evaluation, examines the interactions of the proposed scheme with the behaviour and performance of journey patterns on the local road network.

4.5 Effects of the Scheme

4.5.1 Effects on Land Use

The proposed scheme will not sterilise or sever any land designated for development in either the Dublin County Development Plan 1993 or the South Dublin Draft County Development Plan 1998. Further, the second bridge will not affect any committed development. The scheme will therefore not compromise any land uses adjacent to the application site. A description of the policy context of both of these plans is given in Chapter 6.

4.5.2 Effects on the Special Amenity Area

The scheme will cause minor additional adverse effects on the amenity value of the Liffey Valley. The significance of these effects is considered in detail in Chapter 8, the Landscape and Visual Appraisal.

4.5.3 Land Acquisition

All of the lands necessary to construct the M50 Second Liffey Valley Bridge were included in the previous scheme for the original bridge.

4.5.4 Development Trends

The increased demands placed on the M50 by the expanding manufacturing and industrial development in the vicinity, are set to continue into the future. The proposed scheme will have no direct effect on this progressing development as the primary contributors are located away from the site of the bridge. Therefore the construction of the second Liffey Valley Bridge will not affect any of the ongoing development along the M50 corridor, and indeed will have a beneficial effect by improving access to these employment sites.

4.6 Mitigation

No measures are required to mitigate the neutral effects of the scheme in regard to land use and development.

4.7 Residual Effects

There will be no residual effects on land uses or property ownership adjacent to the application site. The residual effects of the scheme on the recreation and amenity value of the Liffey Valley are examined elsewhere in the EIS.

5. CONSTRUCTION ISSUES

5.1 Introduction

This Chapter presents a description of how the proposed bridge will be built. Background data on the construction of the existing bridge are provided as a back drop to the proposed scheme. The form of construction summarises the technical options available to construct the second bridge and describes the likely foundation solutions. The scheme's landtake requirements are discussed in Section 5.4, while the following section examines load haulage and plant access to the various construction areas. Measures to protect the aquatic environment from surface run-off are described in Section 5.7, while construction materials requirements are considered in 5.8. The chapter concludes with a projection of the likely economic effects and labour demand generated by the development.

5.2 Design and Construction of the Existing Bridge

Construction of the West-Link section of the M50 motorway started in January 1988 and was completed in March 1990. West-Link comprises a 3 km section of dual two-lane carriageways extending northwards from the N4 Interchange to connect with the N3 Navan Road. The current Liffey Valley Bridge, which forms a part of the West-Link, is a 385 m long pre-stressed concrete viaduct which carries the M50 over the Liffey Valley, just north of the N4 Interchange.

5.3 Form of Construction

5.3.1 Possible Bridge Construction Methods

The following construction options are presently under consideration in the detailed design of the structure:

- ***In-situ* Balanced Cantilevering**: This was the method of construction for the original bridge. This technique would comprise deck construction in a sequential segmental operation. Out-of-balance overturning moments would be limited to within the capacity of a specially-designed stabilising structure, to ensure that the bridge remained stable as it was being assembled.
- **Balanced Cantilevering using Pre-cast Concrete Segments**: This method would be similar to in-situ balanced cantilevering except that deck construction would comprise pre-cast concrete matchcast segments erected in sequence while limiting out-of-balance forces as described above. Use of this method requires a purpose-built casting area or factory. The method offers programme advantages over the in-situ method, but can generate additional costs.
- **Incremental Launching (In-situ Concrete)** Using this method, deck construction would be undertaken by means of casting segments at one or other end of the bridge and launching the constructed deck forward by means of special jacking equipment. A specially-built pre-fabricated steel launching nose would be fixed to the leading edge of the girder to enable the deck to span onto each pier or temporary support in turn. The span configuration selected for the bridge would require temporary piers to facilitate the launching arrangement.

5.3.2 Foundation Solutions

Based on site investigations undertaken in 1984 (refer to Section 3.4) the following solutions are currently envisaged for the new structure:

- **South Abutment** Steel H-piles driven into rock with an approximate load-bearing capacity of 180 tonnes per pile. (A spill-through abutment, similar to that at the south abutment, is also currently under investigation.)
- **Pier 1** Pad foundation on limestone bedrock
- **Pier 2** Pad foundation on limestone bedrock
- **Pier 3** Driven steel H-piles each with an approximate load-bearing capacity of 180 tonnes
- **Pier 4** Pad foundation on dense glacial till
- **North Abutment** Driven steel H-piles with an approximate load-bearing capacity of 180 tonnes per pile.

These foundations are shown on the geological section, Figure 3.1.

5.4 Land Take Requirements

The land acquired through Compulsory Purchase Order by the (then) Dublin County Council for the construction of the original West-Link scheme lie within the proposed construction zone boundary, shown in Figure 5.1. It is considered that these lands are sufficient to accommodate the construction of the second bridge and ancillary works. There are some exceptions to this rule, however, and these are listed within this section.

5.4.1 Toll Plaza

Access to the Toll Plaza would be either directly from the existing motorway or from an existing purpose-built road leading off Luttrellstown Road to the east of the Toll Plaza. It is proposed that a similar road, albeit temporary, be built on the west side of the plaza to facilitate access from both sides. This would prevent interference with day-to-day West-Link vehicle movements within the Toll Plaza during construction of the additional toll booths. The construction of these temporary access roads would require the acquisition of approximately 0.13 ha of land. The temporary acquisition of approximately 1.5 ha of land beyond the two access roads would enhance the efficiency of construction operations at the Toll Plaza.

5.4.2 Oaklands House

The proximity of Oaklands House to the proposed bridge has required careful consideration in the design process. NTR has entered into negotiations with the owners of Oaklands House. NTR is keen to ensure that the owners are adequately compensated for the inevitable disruption that would arise from the new bridge. Further details of this land use issue are presented in Chaper 4.

5.4.3 Valley Floor

The lands acquired for construction of the first bridge on the floor of the valley, are of sufficient size to permit construction of foundations, piers, abutments and deck, if *in situ* balanced cantilevering is adopted as the preferred construction method. Should the pre-cast segmental option be selected, however, suitable additional land would have to be secured to allow construction of a concrete pre-casting area, unless an existing facility can be used.

There is sufficient space available on the valley floor to accommodate ongoing foundation and pier construction, and simultaneous deck segment construction. A potentially suitable site for a concrete pre-casting area is the land adjacent to the Toll Plaza. However, to avoid a requirement to secure additional lands for this purpose, the Contractor may opt to construct a pre-casting facility at a location remote from the site or to use an existing facility. Notwithstanding, the site would have to have good access to the motorway. Optimal locations for such sites would need to consider the possible impact of construction vehicle movements through the Toll Plaza. For this reason, a site to the south of the bridge might be preferred, if such an option is to be considered.

5.4.4 Southern End of Bridge / N4 Interchange

The lands already in the possession of South Dublin County Council are sufficient for construction operations in this area, irrespective of the construction method adopted.

5.4.5 N4 Access

Lands in the possession of South Dublin County Council, to the rear of Hollyville Terrace and north of the eastbound carriageway if the N4, will be utilised as a temporary construction access into the site. These access arrangements are shown on figure 5.2 and will allow for construction traffic approaching the site from any direction, to enter the site.

5.5 Construction Traffic and Access to the Construction Area

The M50 and N4 will be used as the primary route for construction traffic. On the existing Lower Road and Luttrellstown Road, an increase in traffic can be expected due to deliveries of construction plant and materials to the various parts of the site.

The management of construction traffic onto and off the site will be arranged to minimise disruption to both local residents and traffic on the local network. The minimisation of HGV construction traffic movements along the Old Lucan Road will be a key consideration in this design. Similarly, the minimisation of construction vehicle movements along the Lower Road will be a design objective. The main traffic management procedures during the construction phase will be centred around the south end of the bridge. These procedures will be linked to a phased construction programme, the aim of which will be to minimise traffic disruption.

Figure 1.4 illustrates the alignment of the current Liffey Bridge, and the proposed final configuration. Figure 5.2 indicates the first phase of construction, which includes the tie-in to the south of the proposed bridge. Under this first phase, the following traffic management procedures will be implemented:

- Southbound traffic on the existing bridge will be channelled onto the existing southbound carriageway using appropriate measures such as pre-cast concrete or water-ballasted barriers. This arrangement will allow construction vehicle access to the southbound off-ramp leading to the N4
- Construction access to the southern part of the Liffey Valley, to facilitate bridge construction, and also to Area A, will be from the southbound off-ramp.
- Construction access for vehicles arriving from the south, east or west, will be via a specially constructed access road off the east bound lane of the N4 on the east side of the Palmerston Interchange, as shown in Figure 5.2
- Construction access out of the site will be *via* a dedicated 'out'-lane on the east side of the off-ramp. This lane will run within the off-ramp as far as the lights at the Interchange, where it will end. This is also shown on Figure 5.2.

The second phase of construction, comprises the completion of the revised southbound off-ramp, together with the re-aligned northbound on-ramp. The following traffic management procedures will be a feature of the second phase of works:

- Mainline southbound traffic will continue to use the coned-off area referred to in Phase 1. A revised coned-off access will service the southbound off-ramp, using water-ballasted barriers
- Construction access to the southern part of the valley, to facilitate ongoing bridge construction activities, will be as for Phase 1, except that entrance to the site will be *via* a revised access road leading off the newly-constructed carriageway to the south of the second bridge
- Completion of the realignment of the northbound on-ramp will be facilitated by construction of a temporary access immediately to the west.

Construction access to the northern part of the bridge is indicated in Figure 5.1. It is envisaged that temporary bridges over the River Liffey and the culverting of the mill race will be required, downstream of the proposed location of the second bridge. During construction of the current bridge, the design chosen for the temporary construction access bridge was a system of steel beams and a deck supported on large diameter driven steel tubular piles. Figures 5.3 comprises a photograph of the existing bridge under construction, while Figure 5.4 provides a photograph of the completed structure. It is likely that a similar solution for a temporary bridge deck will be adopted for the proposed bridge over the river Liffey.

The mill race will be culverted in a steel helicor type pipe culvert for the duration of the construction, which will be removed on completion of the works, and the area restored to its original state.

It is anticipated that traffic disruption will occur during periods of integrating the lateral extensions to the Toll Plaza with the existing configuration. This would allow pavement tie-ins and revision to the road markings. It is anticipated that some temporary reduction in throughput at the toll booths may occur at this time. Further consideration of the traffic implications of the scheme are considered in Chapter 7.

Prior to the commencement of construction on site, a condition survey will be undertaken to establish the existing state of repair of features in the vicinity of the site. Features such as ditches, hedgerows, low walls, buildings and properties will be assessed and reported on. Following the completion of the construction phase of the development, a similar condition survey will be commissioned and reported upon. At that stage, a comparative evaluation will be made between the pre-construction and post-construction reports. Remedial measures will be implemented to reinstate, as necessary, in the event of damage that is attributable to the construction activities.

5.6 Construction Programme

On the basis of the experience gained from construction of the first bridge and its ancillary infrastructure, estimates concerning the length of the construction programme have been made. The overall duration of the programme would be in the order of two years. A typical suitable construction programme is presented in Figure 5.5.

5.7 Wastewater Management

5.7.1 Surface Water Disposal

Run-off from the construction area will be channelled to the mill race on the south side, and to the Liffey on the north side. The run-off from the construction area could be contaminated with elevated levels of suspended solids, arising from the erosion of exposed sub-soils.

All run-off will therefore be directed to sediment ponds or to holding tanks before entering either the Liffey or the mill race. The sediment ponds and holding tanks would serve to reduce the levels of suspended solids in the run-off before it is discharged to one of the two watercourses. Any spillages of petroleum products within the construction area would be captured in oil interceptors prior to the run-off being discharged.

5.7.2 Foul Effluent Disposal

Portable chemical toilets would be provided within the construction area for use by the construction workers. These would be supplied and serviced with strict control and removed from the site on completion of the work, by a sub-contractor. No foul drainage would be directed to either the Mill race or the river Liffey.

5.8 Materials Requirements

A scheme of this magnitude will inevitably generate considerable demand for construction materials. Within the context of an EIS, it is important to examine whether the materials requirements for a construction project will place a demand on presently unexploited reserves. In turn, there is a need to assess whether the materials requirements for a scheme will give rise to unsustainable off-site impacts.

Within the Greater Dublin area, there is substantial materials availability for large construction projects. For example, bituminous materials are readily available, Readymixed concrete is well-served in the area, with Belgard and Huntstown being the two plants closest to the site. Based on the Consultant's experience of similar highways and bridge contracts, it is unlikely that a contractor would wish to set up a concrete batching plant on site. This is, however, an option under one of the bridge construction options (refer to Section 5.3).

There will be a requirement for approximately 42,000 m^3 of imported fill material in the widened embankment at the southern end of the scheme. This could be readily sourced from suitable borrow pits in the Greater Dublin area. Additional sources of suitable material for embankment construction include the arisings from foundation excavations. Unsuitable material, should any occur in the works, can be tipped at a local authority disposal site or other suitably licenced area that the contractor opts for, subject to staturory planning and waste management regulations. It is anticipated that there will be no contaminated material arising from any of the excavations on site.

5.9 Employment

The economic and social benefits arising from construction of the second bridge, in terms of job creation, are considerable. The employment generated will arise in two ways:

- Employment arising from creating a new asset
- Employment arising due to having the completed asset available for use.

There are four main sources of employment arising from such a scheme:

- Direct employment on the site
- Direct employment off the site
- Indirect employment
- Induced employment.

The differences between each of these four sources of employment are as follows:

- Direct on-site employment includes on-site personnel such as planners, engineers, supervisors, tradesmen and labourers associated with constructing the works
- Direct employment off-site is generated by the project for planners, designers, consulting engineers and their staff, sub-contractors and suppliers
- Indirect employment arises especially in firms providing the relevant services and materials required for the works on site
- Induced employment refers to those jobs created as a result of the injection of wages and purchasing power from the project into the economy. The main industries to benefit from this form of employment include local shops, the food industry, the clothing industry and so forth.

To estimate the direct employment on site three differing methodologies have been put forward by the Confederation of Irish Industry (CII):

- Method 1 Experience on projects
- Method 2 Output per worker
- Method 3 Cost per worker.

Each of these methods estimates the number of employment man years generated in roadworks for every £1 million spent. These methods estimate that 28 (method 1), 17 (method 2) and 12 man years (method 3) are generated per £1 million spent (CII Roads Policy Committee Report *Roads Infrastructure, Key to Economic Development*, October 1987).

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Indirect employment, both secondary and induced, is usually estimated by use of a multiplier which is then applied to the direct figure to give an estimate of the total employment generated for the project. From studies carried out by the University of Edinburgh in 1975, the range of indirect employment multipliers applicable to direct employment projections for major capital works ranges from a low of 1.2 to a high of 1.9.

In July 1991 the CII suggested that a multiplier of 1.5 should be used for such projects. This multiplier effect (illustrated in Table 5.1) gives the range in the total number of jobs per £1 m per year spent.

Table 5.1

Estimated Total Man Years' Employment

Method	Direct Man Years	Indirect Man Years	Total Man Years
1	28	5.6 to 25.2	33.6 to 53.2
2	17	3.4 to 15.3	20.4 to 33.6
3	12	2.4 to 10.8	14.4 to 22.8

Thus, depending on the method adopted, and there are precedents for the use of each method, a figure for employed generation ranging from 53.2 man years down to 14.4 man years may be postulated.

The average from the whole range of Table 5.1 is 29.67 jobs per year per £1 m spent. This amounts to 119 jobs, over the four year period of planning, tendering and construction of the bridge.

5.10 Economics

The currently estimated capital cost of constructing the second bridge and associated road and toll facility works, including all professional fees, costs, etc., is in the order of IR£15.5 million, VAT inclusive. The existing bridge and tolling facility were funded, constructed, and are operated by the private company National Toll Roads, under agreement with Dublin County Council, the responsible local authority in existence at the time of construction. On the reconstitution of Dublin County Council the agreement passed to Fingal County Council. The existing bridge and tolling facility will continue to be operated by NTR until handover to Fingal County Council after 30 years of operation.

The new bridge and expanded toll facility is intended to be similarly funded, constructed and operated over a fixed timescale by NTR. The new bridge will be handed over to the responsible local authority after a fixed period of time.

The construction of the new bridge involves the investment of significant private funding and the long-term generation of revenue from tolling. The economic and financial arrangements for the new scheme will be developed as part of a new *Tolling Scheme*, which is outside the scope of this EIS. However, it is clear that in the long-term, the new scheme's enhanced revenue will generate significant income to the Exchequer.

5.11 Material Assets

As stated in Section 1.4, material assets, as defined within the EPA's EIS guidelines, are considered within the specific sections dealing with property, land use, transportation infrastructure and construction (utilities). Within the context of socio-economic effects, the effects of the scheme on material assets can be listed as follows:

- Provision of a significant element of road infrastructure in accordance with the original design
- The requirement for no additional land-take or demolition/removal of existing structures for construction of the scheme
- No removal of important physical/material assets such as rare or protected flora or fauna of archaeological/heritage importance
- No significant effects on the soils, geology or hydrogeology of the site
- No significant generation of waste materials or disposal issues
- No requirement for scarce or protected natural resources.

These issues are considered in further detail within topic-specific chapters of the EIS. In summary, however, the proposed scheme will result in a significant effect through the addition of a new bridge to the transportation infrastructure, and no significant effect upon other material assets. The issue of the designation of the Liffey Valley as a Special Amenity Area is noted and must be considered in the light of the proposed bridge being constructed alongside the existing and almost identical bridge. This topic is dealt with in more detail in Chapters 8, 11, and 14 of the EIS.

6. POLICY CONTEXT

6.1 Introduction

This Chapter outlines the national and local planning policy context in which the scheme has been developed and proposed. Consideration is given to the way in which the scheme interacts with the current planning policy framework, and with transportation planning frameworks. In turn, the conformity of the scheme with the planning authorities' stated policies, land use zoning objectives, and specific objectives are assessed.

The implications of guidance provided in national planning documents are summarised, before an appraisal of the statutory development plan at a Dublin level is provided. The former Dublin County Council's stated planning objectives and specific objectives are given, before the overall policy context of the scheme is evaluated.

Two national planning documents - *the National Development Plan 1994-1999* and the *Operational Programmes for Transport 1994-1999* - set out the context for the development of the national economy and transport investments in relation to EU financial assistance.

At a city-wide level, the *Dublin County Development Plan 1993* is the statutory five year adopted development plan inherited by Fingal and South Dublin counties. South Dublin County Council has recently (Spring 1998) published its *Draft Development Plan*. Once formally adopted, this development plan will supersede the 1993 Dublin County plan. Fingal is presently drafting its own development plan to replace the 1993 publication. It is understood that this will not be issued in draft form until after the planning consent procedures for the second Liffey Valley Bridge have started.

In addition to these strategic and local planning documents, the Dublin Transport Initiative (DTI) has also been reviewed in the context of the proposed Liffey Valley Bridge. The DTI report was published to provide a foundation on which to develop the City's public and private transport infrastructure. The proposed scheme is included in all DTI modelling scenarios, and is there for an integral part of the Initiative.

6.2 The Ireland National Development Plan 1994-1999

The Ireland National Development Plan 1994 - 1999 was published five years ago (Government of Ireland, 1993). It is a plan for employment. Its central objective is to ensure the best long-term return for the economy by increasing output, economic potential and long-term jobs. The Plan is based on the principles of sustainable development and protection of the environment. This is reflected in major investment in direct environmental services and in the approach to economic infrastructure, such as increased investment in public transport. Under the sectoral objectives and strategy for infrastructure, the primary objective of transport investment in the period 1994 to 1999 is stated as being to support sustainable economic development and employment creation by:

- Improving internal and access transport infrastructure and facilities on an integrated basis, thereby reducing transport costs and offsetting the negative effects on the economy of peripherality
- Improving the reliability of the transport system by removing bottlenecks, remedying capacity deficiencies and reducing absolute journey times and journey time variance (Chapter 9, p.98).

The National Development Plan continues by stating that these objectives will be achieved through an integrated transport investment programme, the key features of which include:

- Substantial investment in implementation of Dublin Transport Initiative
- Development of Dublin, Shannon and Cork Airports to ensure the provision of adequate infrastructure for the national and international aviation links required by the traded economic sector and to meet projected increases in these requirements
- A selective and carefully-targeted investment programme in ports.

In relation to the environmental consequences of these infrastructure investments, it is stated that the transport investment proposed in the Plan will have a 'positive environmental impact'. This not only reflects the DTI's emphasis on public transport, but also the proposed investment in the road network. The M50 corridor, which includes the Liffey Valley Bridge, is identified as a *Strategic Corridor* within the National Development Plan (refer to Figure 6.1).

6.3 Operational Programme for Transport

The objective of the Operational Programme for Transport 1994 - 1999 (Government of Ireland, 1994) is to *...provide essential infrastructure support for the economic objectives of the Community Support Framework and to assist in the aims of achieving the national and European Union goal of economic and social cohesion.* In essence, the document is an application for financial assistance from the European Regional Development Fund and involves an *integrated package of investment in roads, public transport, ports and airports.* (Page 5)

The Programme (Page 16) identifies the following among the key features of the Irish transport system in relation to economic and regional development:

- The relatively underdeveloped nature and poor quality of the internal transport system
- Roads being the dominant mode of internal transport accounting for 89 % of freight traffic and 96 % of passenger traffic
- A review of long-term development needs for the road network's estimated total investment requirements over a 20-year period at £10 billion (1993 prices), of which £3 billion related to strategic national primary roads.

The Programme (Page 23) also makes reference to the DTI and the background problems which led to the study being undertaken, in particular:

- Increasing congestion and poor public transport services making the City Centre and Inner City vulnerable to economic decline. Most industrial activity has already moved and other economic activities (especially retailing and leisure) could follow
- Congestion has gradually spread outwards into the suburbs and is no longer confined to the peak travel periods. This has led to rat running and adverse environmental impacts (noise, pollution, accidents) in residential areas
- Congestion has been estimated to add 15 % to the average cost of operating a commercial vehicle
- The transport system does not provide adequate access to employment for people living in the Western New Towns and peripheral areas which are themselves not self-sufficient in jobs.

The key findings of the DTI, which seeks to address these problems, are listed in Section 5.3. However, the conclusions of the Programme as it relates to the DTI, should be noted:

> '...it is clear from the work of the Dublin Transport Initiative that an improved transport system is vital to the economic well-being of the Greater Dublin Area. Chronic traffic congestion is already slowing the economic life of the city, affecting almost one third of the national population. If urgent remedial action is not taken, there will be increased travel (more of it by private car than today), worse congestion (particularly affecting buses), poorer accessibility (especially to the City Centre) and increased road accidents and pollution. This will serve to place obstacles in the path of economic development and regeneration in the Dublin area. (Chapter 2, p.23)

From these position statements and identification of current concerns, it can be concluded that the scheme is in line with the Operational Programme.

6.4 The Dublin Transport Initiative

The Dublin Transport Initiative (DTI) was set up by the Government in 1991 to, among other aims:

- Develop a long-term transportation strategy for Dublin and its hinterland, covering a 20 year period from 1991 to 2011
- Establish an ongoing transportation planning process.

The DTI strategy is to implement a series of infrastructure and transport policy initiatives. The principal aim of these integrated initiatives is to relieve Dublin's chronic road traffic congestion problems. The Initiative places emphasis on decreasing the public's dependency on cars, and making public transport a more attractive and viable option.

At the same time, the initiative identifies a series of strategic road schemes, some of which have already been completed. The aim of these strategic road schemes is to ensure that the commercial viability of existing commerce and industry are not compromised through congestion, delays and poor access, and that the Dublin region remains an attractive area for inward investors.

The strategy also examines traffic restraint and management proposals in sensitive areas, and improved facilities for cyclists, pedestrians and mobility-impaired people.

The Dublin Transport Office (DTO) has prepared a computer model of Dublin's road network. This model has been used to predict the future impacts brought about by implementation of DTI schemes. In the DTI model of the C-ring, the crossing of the Liffey Valley along the M50 has always comprised a two-bridge scenario. Another important point is that the DTI report states (Section 7.5.2.1) that the C-ring as modelled is expected to reach capacity well before the year 2011. More recent analyses suggest that this situation will arise as early as 2004.

The government has agreed that the recommended strategy should provide the policy framework for the future development of transport systems in the Dublin region. The DTI report does not refer specifically to the second Liffey Valley Bridge as a DTI scheme. However, the proposed bridge does not conflict with any of the proposals prepared under the DTI. Further, it serves to satisfy the policy of meeting the projected capacity demands on the M50, thereby maintaining this road corridor as a strategic route of national significance. This point is emphasised in Section 7.5.2.2 of the DTI report, which seeks to further enhance road capacity by widening the C-ring.

6.5 Dublin County Development Plan

6.5.1 Introduction

The Dublin County Development Plan 1993 forms the principal statutory document setting out environmental and planning policies within Fingal and South Dublin counties. The Development Plan was published to provide a statutory planning framework for the five year period through to 1998. The document comprises a Written Statement and supporting land use zoning maps. Following an introductory chapter, the Written Statement is divided into three principal sections:

- **Policy**: This sets out the aims of the planning authority and its guidelines for the development, conservation and renewal of its administrative area
- **Land Use Zoning Objectives**: This section indicates the planning control objectives of the authority for all lands in its administrative area. It deals with the standards which must be applied to all development and to regulate the environmental effects in pursuance of the declared Specific Objectives
- **Specific Objectives**: This sets out the work that the planning authority intends to undertake during the five year lifespan of the Plan.

The policies and objectives of the Plan reflect the growing awareness of environmental issues. The Plan seeks *to create a good physical environment in which the residents of the County can live, work and play and where communities can evolve and develop.* The policies, zoning objectives and specific objectives which are pertinent to this application are considered below.

6.5.2 Development

The Development Plan proposes to accommodate the bulk of projected population growth in the Western Towns, (including Lucan / Clondalkin and Blanchardstown) in line with the previous County Development Plans of 1972 and 1983 (2.2.1.i).

6.5.3 Employment

The policy framework seeks to ensure that full cooperation is given to external agencies tasked with promoting economic and social development, and in assisting the provision of employment opportunities. Employment policy specifically highlights the Western Towns as being areas of high unemployment in which a range of job opportunities should be made available (2.4.1.i). A similar policy is reflected in the Draft South Dublin Plan (Policy E1).

6.5.4 Transportation

It is stated policy to promote a balanced and integrated transport system for the Dublin area, and to participate actively in the Dublin Transportation Initiative (2.5.1.i). Subject to the availability of capital, it is the policy of the Council to provide a road system that is suitable for the type and density of traffic expected, ranging from motorways to exclusive pedestrian paths or cycleways (2.5.2.i). The Draft South Dublin re-confirms this policy (Policy T1 refers), and identifies the requirements for the environmental impact assessment and sensitive landscape treatment of highway schemes (Policies T5 and T11, respectively). In this respect, the proposed scheme conforms with stated objectives.

6.5.5 Preservation, Conservation and Renewal

The Development Plan promotes the policy (2.8.1.i) of protecting the rural and urban environment and cultural heritage, and in this respect policies of preservation and conservation extend to:

- Buildings of artistic, architectural or historical interest including.....the environs of such buildings
- Features...and other objects of archaeological, geological, historical or scientific interest
- Views, prospects and amenities of and from places and features of natural beauty, high amenity and other special interest
- Renewal and renovation of buildings or sites of architectural, artistic or historical interest.

Policy 2.8.1.ii seeks to conserve areas or features of outstanding natural beauty, recreational value or archaeological, historical or scientific interest. It is stipulated that this policy relates in particular to (among others) the valleys of the larger rivers. In development areas, such features will be employed in enhancing amenity value, subject to the carrying capacity of the features or resources in question. Special Amenity Area Orders and Tree Preservation Orders are discussed in the context of promoting and strengthening the policies of preservation, conservation and renewal.

A Special Amenity Area Order (SAAO) for the Liffey Valley between Lucan Bridge and Palmerston was confirmed in 1990. It is the policy (2.8.9.ii) of the Council to preserve and enhance the character and special features of that area as particularly set out in the Schedules to the Order (refer to Appendix A). The interactions of the proposed scheme with the SAAO, and policies 2.8.1.i & ii are examined in Chapter 8, the landscape appraisal.

The Draft South Dublin Plan re-states these policies throughout Section 2.7, *Built and Natural Heritage*. Within this Chapter of the Draft Plan, Policy H21 comprises the stated intention of extending the Liffey Valley SAAO to the Kildare border, and to preserve and enhance the Valley's resources through the schedules to the Order (refer to Appendix A). Policy H28 relates to Natural Heritage Areas. The conformity of the scheme in relation to the wildlife interests of the Liffey Valley proposed NHA are considered further in Chapter 11.

6.5.6 Planning Objectives

The Plan also contains Land Use Zoning Objectives and Specific Objectives which are identified on Map 15 of the Plan. Objectives which are directly relevant to the consideration of the development proposal are outlined below.

Figure 6.2 presents the Land Use Zoning objectives in the environs of the Liffey Valley bridge. The area is dominated by land falling under Objective G, *to protect and improve high amenity areas*. Those sections of the Valley which fall within the SAAO are highlighted within this broader designation. The Objective G designation covers not only the river valley itself, but the agricultural land, demesnes and woodlands on the northern plateau, up to and in some places beyond the Lutrellstown Road. Palmerston to the south-east of the bridge encompasses two main zoning objectives, Objective A, *to protect and improve residential amenity*, and Objective C1, *to protect, provide for and / or improve neighbourhood / local centre facilities*. The

agricultural land to the west and east of the Toll Plaza falls under the specific local objective 12, which identifies this area as suitable for motorway-related activities, for example, a service area. The Quarryvale site to the south-west of the N4 Interchange has a C and E zoning objective, i.e., partly Town / District Centre, partly Industrial. Since publication of the Plan, Quarryvale's first phase of construction has started, and is due to be completed in 1998.

6.5.7 Specific Objectives

Specific objectives for the lands and material assets adjacent ot the application site are stated in two parts of the 1993 Plan; Section 5.3, *Blanchardstown Scheduled Town*; and Appendix D, Schedule 1 of the Special Amenity Area Order. Both sets of specific objectives centre on preserving and enhancing the Valley's amenity value. The Blanchardstown Scheduled Town specific objectives, as they relate to amenity resources, are considered further in Section 14.5 and Table 14.1. Schedule 1 of the SAAO is presented in Appendix A of the EIS.

Specific objectives within the Draft South Dublin Plan which could interact with the scheme as proposed include the following:

- Proposed cycle network ~ Lucan Road (Lucan Bypass to Leixlip Road)
- Recreation and amenity ~ to create additional public rights of way as and when appropriate, in particular to: gain general access to the River Liffey from ... Mill Lane, Palmerston and Main Street and Chapel Hill, Lucan to the Liffey Weir / river bank; and investigate the feasibility of providing public paths along the banks of the River Liffey...
- Provide for amenity development of the Liffey Valley ~ South Dublin will consider in detail the need for all highway proposals in the context of the special amenity value of the Liffey river valley, and this is ongoing with the proposed scheme (Draft Plan, p. 194, *Notes Regarding Schedule 1*).

6.6 Evaluation of Planning Policies in Relation to the Development

Table 6.1 presents an evaluation of the proposed scheme in relation to the area's planning policy context. The purpose of the table is to illustrate the way in which the proposed second bridge interacts with the adopted or proposed planning policies and objectives shaping development in the region, both at a national and local level. This table should be examined in the context that:

- Fingal County Council has conveyed its approval in principle for the proposed scheme. The Council acknowledges the clear role of the second bridge in alleviating traffic congestion capacity problems on the M50, and ensuring that the economic development of the district is not constrained by capacity limitations to transport infrastructure
- There is limited coverage only of the proposed second M50 Liffey Valley bridge within the national and county development plans. The scheme is addressed briefly in the Draft South Dublin Plan, and the DTI report. It is therefore more difficult to assess the conformity of the scheme in a general planning context. Reference to the bridge in the Draft South Dublin Plan is made solely in relation to the authority's stated intention of evaluating the scheme's impact upon the amenity status of the SAAO. However, the scheme is an integral element of the modelling scenarios considered in the DTI report.

The main conclusions that can be drawn from Table 6.1 are as follows:

- Fingal County Council and South Dublin County Council have both approved the establishment of a Section 59 agreement. Fingal County Council is the leader on this project and is progressing the scheme through the necessary channels
- The proposed scheme either conforms to, (or in cases where the scheme is not mentioned specifically, does not contradict), a broad range of national and local transportation and planning policies and stated objectives
- The key area in which the scheme is non-conformant with stated policies and objectives is the prescribed amenity status of the Liffey Valley. The introduction of a structure of this scale into a river valley designated for its inherent landscape qualities and amenity resources inevitably represents a significant departure from the Local Plan. The significance of this impact is, however, ameliorated by several factors. These are discussed in detail in Chapter 8, but in essence relate to the visual integration of the proposed structure with the existing bridge.

Table 6.1
Conformity of the Proposed Scheme in Relation to Planning Policies and Objectives

Development Plan / Strategy	Stated Policy / Objective	Scheme Conformity
Competent authorities	Both Fingal and South Dublin County Councils have approved entering into a Section 59 agreement.	The planning authorities to which the planning application will be submitted have indicated their approval in principle for the scheme.
National Development Plan 1994 - 1999	Improving internal and access transport infrastructure...	The proposed scheme is not listed within the National Development Plan, because the National Plan is a strategic guidance document rather than a statement of project-specific objectives. However, the nature of the proposed scheme does concur with the general objectives of the Plan, and therefore does not represent a non-conformance with stated national policy.
	Improving the reliability of the transport system by removing bottlenecks, reducing absolute journey times and journey time variance	
Operational Programme for Transport 1994 - 1999	...to provide essential infrastructure support for the economic objectives of the Community Support Framework...and to achieve an integrated package of investment in roads, public transport, ports and airports.	The operational programme is not a development plan *per se*. However, the proposed scheme does assist in promoting the national transport infrastructure needs identified in the Programme.
Dublin Transport Initiative	The aim of the strategic road schemes listed in the DTI is to ensure the commercial viability of existing commerce and industry is not compromised by traffic congestion, and that the Dublin region remains an attractive target for inward investors.	This scheme is inexorably linked with highways projects in the Initiative. Such projects include the southern cross and south-east motorways, and the port tunnel access. The implementation of these highway schemes would inevitably place additional capacity demand on the existing M50 Liffey Valley bridge. The DTI model scenarios all assume provision of a second Liffey Valley bridge.

Development Plan / Strategy	Stated Policy / Objective	Scheme Conformity
1993 Dublin County Development Plan	**Development** ~ no policy / objective directly applicable to the scheme	No interaction ~ permanent, neutral effect
1993 Dublin County Development Plan	**Employment** ~ assistance in the provision of employment opportunities; promote job opportunities in the Western Towns	Positive conformity during the construction phase ~ approximately 30 jobs created per year over a four year period of planning, tendering, and construction of the bridge. No interaction during the operation phase ~ permanent neutral effect
	Transportation ~ to promote a balanced and integrated transport system; to provide a road system that is suitable for the type and density of traffic expected; to undertake EIS in support of road proposals (SDCC, 1998); and promote the sensitive landscape treatment of road schemes	Conformity with the provision of appropriate roads to meet capacity demands Conformity with the preparation of an EIS in support of the proposed scheme Conformity with the requirement for an appropriate landscape treatment strategy for the second bridge

Development Plan / Strategy	Stated Policy / Objective	Scheme Conformity
	Preservation, Conservation and Renewal ~ to promote protection of the rural and urban environment and cultural heritage, extending to: • Buildings of ... architectural or historical interest, and their settings • Features of ... archaeological ... or historical interest • Views, prospects and amenities of and from places and features of natural beauty, high amenity and other special interest.	The proposed scheme will intrude into the setting of several listed structures of historical and / or architectural interest. This will represent a non-conformity with the stated policy in this regard, and will represent a permanent, moderate adverse effect. The second bridge would not directly compromise any known archaeological site or historical building, and there represents a conformity with this stated objective.
1993 Dublin County Development Plan	The Liffey Valley Special Amenity Area Order incorporates objectives which seek to preserve and enhance the amenity, landscape, and wildlife resources within the Valley.	The bridge would have varying degrees of adverse impact upon the amenity and landscape value of the Liffey Valley. The degree of this impact would depend on where the bridge was being viewed from. Given the nationally-significant status of the Liffey Valley, including its prescription as a SAAO and proposed Natural Heritage Area, the scheme represents a significant negative effect in relation to relevant planning policy and objectives. The significance of this non-conformity is likely to extend to a **major adverse** effect, at least in the medium-term. However, the landscape treatment proposals will serve to reduce the level of this impact in the medium to long-term, but not from all affected properties or from all viewpoints

Development Plan / Strategy	Stated Policy / Objective	Scheme Conformity
1998 Draft South Dublin Development Plan	**Specific Objectives** ~ (SDCC, 1998) Cycle path from Lucan Bypass to Leixlip Road; to create public rights of way to, and along, the banks of the River Liffey; to provide for the amenity development of the Liffey Valley	The proposed scheme would not affect any of the stated objectives relating to the provision of better public access to the river from points within the SAAO designated zone. Therefore, the scheme is neutral in this regard. During the construction phase, the proposed designated cyclepath could be affected by construction vehicle movements at the N4 Interchange. This would represent a minor, short-term adverse effect in relation to a specific objective. The scheme's impacts upon the amenity value of the Valley have been described above.

7. TRAFFIC EVALUATION

7.1 Introduction

This Chapter considers the implications of the proposed scheme in relation to road traffic issues on the M50 and at the N3 and N4 Interchanges. The traffic analysis provides an evaluation of the existing road network, the volumes of traffic currently using this network and the capacity considerations associated with it. The future traffic characteristics of the network are considered, with traffic predictions given for an opening year of 2001 and a design year of 2016, under both a 'do minimum' and 'do something' scenario. The evaluation also examines the effects of the scheme on the road network, and mitigation measures are described to reduce any adverse effects.

7.2 The Existing Situation

The current Liffey Valley bridge is an integral section of the partially completed C-ring road around Dublin known as West-Link. West-Link has experienced very significant growth in traffic since it opened in 1990. Table 7.1 shows the growth in Annual Average Daily Traffic (AADT) over the last seven years, as measured at the Toll Plaza serving the existing bridge.

Table 7.1
AADT Figures for the M50 Liffey Valley Bridge

Year	AADT
1991	12034
1992	13990
1993	15825
1994	17706
1995	18676
1996	23885
1997	45525

Table 7.1 demonstrates that much of the increase has occurred since the completion of the Northern Cross Motorway in late 1995. This highway scheme resulted in the 1997 traffic flows nearly doubling the 1996 flows. Capacities on all other sections of the M50 motorway are greater than those on the existing bridge. As traffic volumes continue to increase on the M50 in general, congestion and safety-related problems will also increase along the Liffey Valley bridge section. At present, the C-ring is only partially completed. When the Southern Cross and Southeastern motorways are constructed, it will exacerbate the growing congestion on the existing bridge.

The current single bridge span is operating as a four-lane facility. However, narrow lanes reduce the capacity of the existing bridge in comparison with the rest of the M50 motorway.

In addition to the completion of the C-ring, the proposed Dublin Port Tunnel will contribute to an increase in traffic over the Liffey Valley bridge. This increase in traffic will include a large number of HGVs because plans contained in the DTI strategy which restricts the movement of goods vehicles on Dublin's streets are assumed to be implemented.

At present theToll Plaza associated with the bridge is located north of the Liffey Valley bridge at which there are vehicle delays during peak periods. Plans to construct more toll booths and introduce electronic toll collection will increase capacity and eliminate any queuing in the future. This will isolate the existing bridge as being the main capacity constraint on the M50.

Various sources of information were used in the traffic evaluation to establish current and historical traffic counts. These sources included the National Roads Authority and National Toll Roads plc. The AM peak hour flows and the AADT values for all the links within the study area for 1997 are illustrated in Figures 7.1 and 7.2 respectively.

7.3 Production of Traffic Data

The bridge is currently planned to open at the same time as the Southern Cross section of the M50. The upgrading of the Liffey Valley crossing will provide a good quality orbital route around Dublin when the Southern Cross and Southeastern Motorways are constructed, each section comprising at least a dual twin lane motorway standard. The results of traffic flow analyses indicate that the bridge will not generate any significant extra traffic, except during the construction phase. However, the increased capacity will support an increase in traffic volumes over the Liffey Valley bridge.

7.3.1 Sources of Traffic Data

A traffic analysis was carried out for both the base year (2001) and the design year (2016). A series of sources were used to obtain the input data required for this traffic analysis. These are listed below.

7.3.1.1 Dublin Transportation Office (DTO)

The DTO was consulted on the applicability and efficacy of the DTO traffic model in the context of the proposed scheme. It was agreed that the DTO model traffic figures should be used only as a reference/benchmark. This is because the current DTO model could not be applied to site-specific traffic variables unique to the Liffey Valley bridge, for example:

- The latest version of the traffic model was prepared in 1996. Traffic growth rates within the model do not reflect the increases that have occurred since 1996; current projections for future growth are now significantly higher that those contained within the 1996 model
- When compared with accurate traffic count figures recorded at the Toll Plaza, the DTO model significantly underestimates actual flows across the bridge
- In addition to the low growth rates, the DTO future year base model treats the Liffey Valley bridge as an optimum standard dual two lane motorway section in terms of traffic capacity. This is not the case in practice because the narrow lanes restrict the bridge's optimum capacity.

Given the above site-specific technical constraints to the DTO model, base year traffic flows and growth rates were derived from alternative sources. To incorporate 'worst-case' traffic conditions, higher traffic volumes were derived from alternative sources.

7.3.1.2 National Roads Authority (NRA)

Current and historical NRA traffic count data on the M50, N3 and N4 were reviewed. The current figures were used to provide base year traffic flows, while the historical figures were used to look at traffic growth and trends.

7.3.1.3 National Toll Roads plc (NTR)

Current and historical traffic flow data for the Toll Plaza are held by NTR. A high degree of accuracy can be attached to these flow figures. These were employed in a similar way to the NRA counts.

7.3.1.4 Wilbur Smith Associates (WSA)

As traffic consultants to NTR, WSA has carried out extensive studies into traffic flows, growths and trends, and tolling associated with West-Link. The data available from work carried out by WSA were used to assist in projecting future traffic growth rates, and defining the flow capacity of the Toll Plaza.

7.3.2 Production of 1997 Base Year Traffic Flows

Traffic count data obtained from the NRA were used to calculate the average weekday daily traffic in September. These data were calculated for all links at the N3 Blanchardstown Interchange and the N4 Palmerston Interchange. The AM peak traffic flows between 8 a.m. and 9 a.m. were also calculated for each relevant link in the study area.

The 1997 AADT figure for the Liffey Valley Bridge was obtained from NTR. This figure of 45,525 vehicles was used to adjust the calculated average weekday traffic flows for September. The AM peak hour flows in September are illustrated in Figure 7.1 and the AADT for 1997 is presented in Figure 7.2.

7.3.3 Traffic Growth

As stated previously, the DTO model underestimates traffic flows along and in the environs of the Liffey Valley Bridge. Therefore, traffic growth rates were obtained from other sources. WSA has undertaken an extensive review of potential traffic growth along the M50 corridor in general, and West-Link in particular. Their review concentrated on those factors which have a strong influence on traffic growth, for example: the national economy; major manufacturing and commercial developments along the M50 corridor; employment trends and forecasts; and population trends in the adjacent new towns.

Traffic growth rates were used to project future traffic volumes on the road network within the study area for the years 2001 and 2016. The growth rates projected by WSA also took into account the increase in traffic using the Liffey Valley bridge when the Dublin Port Tunnel, the Southern Cross Motorway and the Southeastern Motorway are opened.

7.3.4 Estimated Peak Hour Traffic Flows

WSA calculated the relationship between peak hour flow and annual average daily flows at the Toll Plaza. These relationships were used to estimate peak hour flows in the years 2001 and 2016 for both the 'do minimum' and 'do something' scenarios.

The following relationships were established by examining hourly data from April to June 1997. The peak hour occurs between 8 a.m. and 9 a.m. on weekdays at the Toll Plaza.

- Morning peak hour percentage of average weekday daily traffic = 8.9 %
- Average weekday daily traffic percentage of average annual daily traffic = 117 %
- Peak period directional split = 52. 8% southbound vs. 47.2 % northbound.

It was not possible, however, to use these data directly in determining the two-way peak hour flow for each link. This was because the projected future flows were greater than the actual capacity of the road. In turn, this would lead to peak hour *spreading* either side of the rush hour. This peak hour spreading was therefore represented by 'capping' the flows on links when they reached their theoretical capacity. The assumed capacities used were:

- National Routes N3 and N4 = 3,200 vehicles per hour/direction
- Existing Bridge = 3,570 vehicles per hour/direction
- New Bridge and 2 x 2 motorway = 4,200 vehicles per hour/direction.

(Source: IHT, 1997)

The AM peak hour traffic flows subsequently derived for both scenarios in 2001 are presented in Figures 7.3 and the 2016 peak hour traffic flows are summarised in Figures 7.4.

7.3.5 Estimated Annual Average Daily Traffic

The base year AADT value for the bridge was projected by WSA. The growth in traffic at the bridge was added to the other motorway sections in proportion to their current traffic volumes. The traffic on the national primary routes was increased using a growth factor of 3 %. Only traffic on the national primary routes which were not travelling to or from the motorway was increased in this manner; all motorway-related traffic was increased using WSA's projected growth rates.

The design year AADT value for the bridge section was obtained using the growth factor trend established by WSA. The growth in traffic was again added to the other motorway sections in proportion to their current traffic level. The non-motorway related traffic using the national routes was increased at a lower growth rate of 2% for the years between 2001 and 2016. This growth rate represents the increased congestion on the national routes and is similar to the growth of traffic experienced by the motorway, which is also approximately 2%. The projected 2001 and projected 2016 do-minimum/do-something AADT are illustrated in Figure 7.5.

7.3.6 Traffic Speeds

Traffic speeds for the links within the network under consideration were predicted by reference to speed/flow curves in Volume 13 of the Design Manual for Roads and Bridges (UK Department of Transport *et al.*, 1997).

7.3.7 Proportion Of Heavy Goods Vehicles

The proportion of HGVs on each link was derived by reference to empirical count data from the Toll Plaza records. It was assumed that the volume of HGVs will grow at the same rate as the general traffic growth. The proportion of HGVs on each link is indicated in Figure 7.3 and 7.4.

7.3.8 Palmerston On-ramp Northbound

At present, the N4's northbound slip road onto the M50 forms a priority junction with the motorway. It is assumed that this configuration would remain if the second bridge was not constructed.

Major delays could therefore be expected at this intersection due to the increase in traffic. This assumption was confirmed through the use of a UK Department of Transport computer model called PICADY. PICADY is designed to model priority junctions, queues and delays per vehicle. Table 7.2 lists the results obtained from this delay and queueing analysis.

Table 7.2
Predicted Queues for 'Do Minimum' Scenario at the N4 Interchange Access to the M50

Year	Maximum Vehicle Queue (pcu)	Queueing Delay (minutes/veh)	Average Vehicle Queue (pcu)
1997	48	2.3	27
2001	547	24.6	349
2016	743	28.5	448

The results of the analysis in Table 7.2 indicate that a priority junction will not be sufficient to accommodate projected traffic growth, and that the queues would be very large. This queueing would cause increased congestion at the Palmerston Interchange, and would force drivers to use alternative routes. The proposed scheme entails the removal of the priority junction, and the construction of a northbound slip road which merges with motorway traffic. This will help to reduce delays at the N4 Interchange considerably.

7.4 Traffic Impact Evaluation

The main conclusion that can be drawn from the analyses is that by the year 2001, the existing bridge will be within 3 % of its maximum capacity during the morning peak hour. This level of traffic will cause increased congestion and delays on the approach to the bridge. It will also reduce speeds along the bridge. Through construction of the second bridge, the capacity of this section of the M50 is projected to be at 83 % of its maximum value, resulting in a **moderate benefit** for road users.

In the design year it is predicted that the existing bridge will be at its design capacity. However, demand for use of the bridge will be greater that its capacity. This will lead to drivers choosing to use the bridge either side of the peak hour in an attempt to avoid delays. However, this change in drivers' preferences will cause an increase in the length of the rush hour.

The 2016 traffic flows on both bridges, should the scheme proceed, would be at 92 % of their combined capacity. Because there would be spare capacity on this section of the M50 during the peak hour, there would be a much reduced need for peak hour spreading. The peak hour

spreading that is predicted on the bridge under the 'do something' scenario would be the result of congestion on other parts of the highway network.

By the base year, it is projected that flows for Dublin-bound traffic approaching both the Blanchardstown and Palmerston Interchanges will have reached the capacity of the respective routes, regardless of whether the second bridge is built.

Similarly, the increased capacity achieved through construction of the second bridge would exert only a very slight influence on the total number of vehicles crossing the bridge.

This will provide a **minor beneficial** effect by removing the bottleneck, thereby enhancing traffic flow along this section of the M50.

From the analysis of the 'do minimum' scenario for the design year, it can be concluded that the capacity of the existing bridge would constrain the volume of traffic reaching other sections of the M50. Conversely, under the 'do something' scenario, the two bridges would not reach their design capacity. This is because the capacity of the Liffey Valley bridges would be limited by capacity constraints on other sections of the M50, and the east-bound national routes to the west of the N3 and N4 Interchanges.

The proposed scheme would include a merge access from the N4 Interchange to the northbound M50, rather than the present priority junction. This merge would reduce delays at this junction, compared with the existing and 'do minimum' situations. Without a merge access to the northbound M50, large queues would develop from the opening year onwards. This will provide a **major beneficial effect** in terms of continuity of traffic flow and safety.

7.5 Strategic and Local Transportation Effects

Provision of a second bridge will impact on transportation in terms of strategic traffic movements, road safety, and to a lesser extent local traffic movement.

In strategic traffic terms, the second bridge will raise the capacity of the existing facility up to that of the M50 Motorway in general. Therefore, the second bridge will provide **major beneficial** effect due to improved travel time for vehicles using the M50. Given its strategic importance within the road network of Dublin and within the National Motorway and National Primary Route network, the improvements in journey time will provide significant strategic transportation benefits.

As an essential link within the M50, the higher capacity Liffey Valley bridge will improve accessibility between national primary routes, and between the airport, and major centres of industry, commerce and retail developments. Further developments of the M50, such as the Southern Cross Section currently under construction, and the Southeastern Motorway, will enhance the strategic importance of the bridge. The proposed Dublin Port Tunnel, designed to provide a direct motorway link from the M50 to Dublin Port, will further add to the strategic importance of the bridge, particularly for heavy goods vehicles.

In terms of road safety, the proposed scheme which includes the second bridge, and improvements to the adjacent N4 Interchange will provide improvements over the existing situation. While the existing facility is designed to the required safety standards, the overall facility was designed as a two bridge system. Therefore, construction of the second bridge is essential to bring the facility up to the level of service for which it was originally designed. The modifications to the N4 Interchange will provide full motorway-standard slip lanes onto and off the bridge to the N4. The second bridge will provide a third lane in each direction which will provide ample space for the approaches to the slip lanes and the traffic manoeuvres involved.

The second bridge will also improve accessibility and provide faster journey times for local traffic. While the bulk of the traffic using the M50 is of a more strategic nature, there is an element of more localised use in linking major residential areas with existing shopping centres at Blanchardstown and Tallaght, and the Quarryvale complex currently under construction. In addition to the shopping centres, there is also significant traffic across the bridge to local industrial, commercial and other local centres of employment.

Overall, the improved journey times and resultant reduced vehicle operation costs, accessibility and road safety to be provided by the new facility will be a **major beneficial** effect in transportation terms.

7.6 Commerce

The M50 is used by a large volume of commercial vehicles, as well as private vehicles commuting to and from places of employment. The reduction in journey times that will result from provision of the second bridge will therefore be a **major beneficial** effect commercially to employment and industry in general. In particular, heavy goods vehicles (HGVs) will benefit, as Dublin Corporation is planning to introduce a HGV management plan for the city. One of the main objectives of this HGV management plan is to remove commercial vehicles from unsuitable residential and commercial streets within the city centre. The provision of an adequate motorway system around the city, with strategic links into the main industrial and commercial centres, is a key to this management plan. The improved Liffey Valley bridge will provide an essential link in the movement of goods and services, not only for Dublin, but for the entire country, and *via* airport and port access to international trade. The benefit of the second bridge in terms of trade and commerce is clear.

7.7 Mitigation Measures

Provision of the proposed bridge will upgrade the existing M50 motorway to a minimum of a dual two lane motorway, thereby ensuring consistent standards for users of the C-ring. The main constraints to the satisfactory flow of traffic on the M50 and adjoining roads are the Interchanges. This is a problem that is completely separate from the current scheme proposals, and which will probably require future mitigation in the form of additional capacity provision.

The proposed bridge will enhance the movement of the additional M50 traffic that is predicted to occur following completion of the Southern Cross and Southeastern Motorways. The proposed bridge will also have sufficient capacity to deal with the increase in traffic generated by the proposed Dublin Port Tunnel.

7.8 Residual Effects

The level of traffic using the existing M50 Liffey Valley Bridge would increase by approximately 67% if the proposed bridge was not constructed. The level of traffic using the proposed bridge during the morning peak in 2016 will be approximately 81 % greater than the 1997 traffic flows. This growth in traffic can be attributed to the opening of the Southern Cross and Southeastern Motorway, the opening of the Dublin Port Tunnel and normal traffic growth.

The proposed scheme would entail the removal of the existing priority junction on the northbound slip road merging with the M50, and its replacement with a merge lane. This slip road re-alignment would enhance road safety at the junction, and eliminate the projected queues

and delays that would arise should the existing junction remain in place. This will result in a **major beneficial** effect for road users.

The Toll Plaza located north of the existing bridge would be upgraded to include electronic toll counters, automatic toll counters and manual toll counters. The capacity of the Toll Plaza will be designed to exceed the projected traffic flows in the design year.

The present delays experienced by road users will be eliminated, again reducing transit times and reducing congestion. Again, the introduction of extra booths will result in a **major beneficial** effect by reducing the bottleneck effect at the Toll Plaza.

The removal of the bottleneck created by the existing bridge will increase safety for road users, decrease transit times and reduce traffic congestion on the approach to the bridge, thus providing a **major beneficial** effect.

Irrespective of whether the scheme proceeds, there will be longer queues at the N4 Interchange than at present. This would be because of the traffic growth that will occur independently of the second bridge.

Users of the Toll Plaza may in the future continue to experience some queueing from time to time. This queuing would not, however, result from insufficient capacity at the Toll Plaza. Rather, any queues at the Toll Plaza would occur because of the randomness of traffic arrivals within the toll zone, and to the deceleration, stopping and acceleration associated with paying tolls.

The effect of queues will introduce a **minor adverse** effect, however, these effects will be associated with both the 'do minimum' scenario and 'do something' scenario.

References

Institute of Highways and Transportation in the United Kingdom (1997), *Transport in the Urban Envrionment.*

UK Department of Transport *et al.*, (1997) *Design Manual for Roads and Bridges, Volume 13.*

8. LANDSCAPE AND VISUAL APPRAISAL

8.1 Introduction

This Chapter considers the implications of the proposed bridge on the existing landscape character and quality of the Liffey Valley. The landscape study was undertaken by Brady Shipman & Martin. A description of the landscape appraisal method is given before the basis for the landscape impact evaluation is described (Section 8.7.3). The planning policy context of the valley and the designations conferred upon it, are discussed in Section 8.4.

The significance criteria used to assess landscape and visual impacts are examined in Section 8.5, before the existing landscape character and quality of the valley are addressed. The landscape and visual impact evaluation is reviewed in Sections 8.9 and 8.10, while mitigation measures and the landscape treatment strategy are identified in the following section. The Chapter concludes with a summary of the scheme's residual effects upon the landscape quality and character of the valley.

8.2 Method Statement

The procedure used for the landscape evaluation entailed:

- A desk top study of the site in relation to its overall context both locally and regionally
- The use of aerial photographs of the Liffey Valley
- Visiting the site and environs to assess the following:
  - Quality and type of views towards the existing bridge
  - The character and quality of the surrounding landscape/townscape, including features of cultural heritage and architectural interest
  - The significance of existing vegetation both in proximity to the existing bridge, and from within the broader study area, in relation to contributing to landscape character and potential screening value
  - The extent of the visual envelope, i.e. the area of land within which the bridge can be viewed from adjacent land uses such as houses, schools, amenity areas and private land
- The character and quality of the surrounding landscape/townscape was assessed in relation to: the position of buildings around the application site; proportion of recreational and open space; proportion of residential, industrial and commercial development; special landscape features; cultural and historical associations; landform; and the contribution of mature vegetation.

8.3 Basis for the Landscape Impact Evaluation

The term *landscape* encompasses physical components of the environment, such as topography, vegetation, land-use, infrastructure and industrial and urban development. It is an inherent and integral feature of the whole environment.

However, the landscape also encompasses aesthetic/visual, cultural and amenity components which determine people's perceptions of their surrounding environment.

The EPA guidelines advise that a description of the existing environment is an essential part of an EIS. This approach provides an accurate description of the relevant aspects of the existing environment, which can be used as a reference point, or *baseline*, against which the development's impact upon the environment can be assessed. The baseline situation is summarised in Figure 8.1, which indicates the visual envelope within which the existing bridge is visible, and identifies viewpoints from which long distance views of the bridge are possible. To produce systematic, accurate and comprehensive descriptions the following headings are included in the description:

- **Landscape Context and Character**: The context gives a description of the existing environmental features which make up the landscape. It also indicates the extent of visibility, or zone of visual influence of the site. The character of the landscape is identified and described in terms of the natural and human features which create distinctive areas with their own particular character. The character of any landscape relies closely on its associations, its history and the perceptions of the public. The landscape context of land uses up to 1,000 m from the bridge is presented graphically in Figure 8.2.
- **Significance:** The significance of the proposed second bridge is described in regard to the way in which it may: intrude upon designated views; be within or adjacent to designated landscape amenity areas; or influence the quality of locations which have historical or cultural associations. Furthermore, the site or part thereof may be visible over a wide area or used for activities in which character and views are important. Finally, any trends or change which may be identified or reasonably inferred in the landscape are noted.

8.4 Designations and Planning Policy Context

The site and its environs are recognised to be of importance in the 1993 Dublin County Development Plan. A Special Amenity Area Order for the Liffey Valley was made in 1990 by the Minister of the Environment. The SAAO from Lucan Bridge to Palmerston was implemented by reason of:

- The valley's outstanding natural beauty
- The inclusion of areas therein which are of special recreational value
- The inclusion of areas therein which exhibit a need for nature conservation.

Policy 2.8.9ii of the development plan sets out *to preserve and enhance the character and the special features of that area as particularly set out in the Schedules of the Order.* A schedule of the specific objectives of the order is contained in Appendix D of the 1993 Development Plan. Objectives particularly relating to landscape and visual character include:

- Objective 1.2: The *Council will prepare Tree Preservation Orders where appropriate to protect trees of amenity value.* In the 1998 Draft South Dublin County Development Plan the hedgerows and belts of trees to the east of the bridge are protected by TPOs
- Objective 1.4: *the following items will be considered for inclusion in List 2 in the next review of the County Development Plan. In the interim it will an objective to secure their conservation*: Oatlands House; Luttrellstown Gate Lodge, Lower Road; Thatched Cottage, Summerton Lane; Brooklawn House, Palmerston; Riversdale House, Palmerston; Terrace of houses, Mill Lane; Mill Building, Rivermount House

and dwelling at foot of Mill Lane; Weirs at Anna Liffey Mills, Wren's Nest and Palmerston; Mill race from Wren's Nest Weir to Glenside Palmerston; Metal Bridge over River Liffey at Palmerston; Graveyard adjoining pre Norman Church at Palmerston; Wren's Nest Public House

Of these listed structures, Oatlands House, Brooklawn House, Riversdale House, the weir at the Wren's Nest, the Mill race and the Metal Bridge crossing are within the zone of visual influence of the existing bridge crossing.

- Objective 1.6: *It will be an objective of the Council to preserve and enhance views and prospects of special amenity value or special interest, in particular from Lower Road, Rugged Lane, Tower Road and from the Head of the Glen*
- Objective 1.7: *The Council will consider in detail the need to secure public control over some of the lands in the area covered by the Order with a view to the development of a Liffey Valley Park with public access to the river banks.*

8.5 Significance Evaluation Criteria

8.5.1 Degree Of Impact

The EPA guidelines recommend that topics should be included in a landscape and visual appraisal if the development could cause significant impacts on any aspect of the landscape:

- Which has been formally or systematically designated as being of importance, or
- If the potential exists for the development to substantially alter the existing character of some aspect of the environment.

Objective criteria can be used to determine whether an impact is of significance; these criteria have been addressed in Section 2.4.

Landscape impacts comprise two separate but closely related aspects. The first is *visual impact*, that is, the extent to which a new structure in the landscape can be seen. The visual aspect refers primarily to the appearance of the land, including shape, form and colour, and their interaction to create specific patterns and panoramas that are distinctive to particular localities. The second is *landscape character impact*, i.e. responses which are felt towards the combined effects of a new structure or development.

8.5.2 Visual Impact

The following objective scale is used to assess the significance of visual impact. Visual impact occurs by means of intrusion and/or obstruction, where:

- Visual intrusion is an impact on a view without blocking that view completely, and
- Visual obstruction is an impact on a view involving complete blocking of that view.

The degree of visual impact by means of intrusion or obstruction on a particular view, may be rated as indicated in Table 8.1.

Table 8.1
Visual Impact Evaluation Criteria

Level of Impact	Definition
Imperceptible or no impact	Arises where the proposal is adequately screened by existing landform, vegetation or the built environment.
Low/slight impact	Relates to situations in which views affected by the proposal form only a small element in the overall panorama.
Moderate impact	Moderate impacts cause an appreciable segment of the panorama to be affected, or occur where there is intrusion in the foreground. Generally, there will be open views into a site located in the mid-ground, with the site representing a significant proportion of the overall view. The development may interrupt the skyline. Existing vegetation / townscape provides partial screening except where existing views are elevated.
High/significant impact	Arises where a view is significantly affected, obstructed or so dominated by the proposal that it becomes the focus of attention. Generally, there will be open views of the development located in the foreground. The development will give rise to both visual intrusion and visual obstruction and may obstruct the skyline.
Severe/profound impact	Arises where a view of significance is completely obscured or altered.

N.B. Moderate impacts are not included in the EPA glossary of impacts. This impact rating has been included in this evaluation to bridge the substantial gap between slight/low impact and high/significant impacts as they relate to landscape evaluation.

Visual impacts may be viewed as neutral, positive or negative, where:

- *Neutral* represents a change which does not affect the quality of the landscape
- *Positive* represents a change which improves the quality of the landscape
- *Negative* represents a change which reduces the quality of the existing landscape

Further to the above, construction impacts which are temporary and generally of a negative nature are also assessed as high, moderate or low.

8.6 Timing of the Landscape Survey

The vegetation in the surrounding off-site areas is largely deciduous in nature. The visual impact evaluation was carried out in January 1998, when screening by deciduous leaf cover was not available. In this context, the landscape survey was undertaken under a 'worst-case' scenario in terms of evaluating the visual intrusiveness of the existing bridge.

8.7 Existing Landscape Character and Quality

The landscape character of the area varies depending on location. As part of the evaluation, the study area was divided into landscape character zones. The valley has an asymmetrical cross section. The southern slopes of the valley are gently inclined and slightly concave in profile, with large fields, hedgerows and tree belts extending along the valley floor. The northern slopes of the valley are steeper than the southern slopes and are generally covered in mature woodland. There are plateaux to the south and north of the valley. These and other areas are described below.

8.7.1 Southern Plateau

The southern plateau, in contrast to the northern plateau, is more developed. The road network and residential development tend to define the area's character. King's Hospital School is situated to the south-west of the bridge. The school building complex and the sports pitches are located on the southern plateau. There are views of the bridge's road deck from vantage points within the school grounds. The slopes of the valley immediately west of the bridge are grassed, but beyond this the slopes are cloaked in mature mixed woodland. To the south-east of the bridge there is the Old Lucan Road which is primarily residential in character, with retail premises in the nearby Palmerston village centre. Properties at the northern edge of the built development have open views over the valley and the existing bridge.

8.7.2 Southern Slopes

The southern slopes of the valley to the east of the bridge gently slope toward the river. The slopes comprise mainly improved grassland and scattered scrub (refer to Section 11.4.2), and are bisected by a number of very high quality hedgerows. The hedgerows are protected by a Tree Preservation Order. Much of the these lands to the east have been acquired by the Local Authority with the intention of creating a linear park along the Liffey Valley. There is also a general line of tree vegetation that extends along the northern slopes of the valley.

8.7.3 Lower Road and the River Corridor

The Lower Road and River Liffey corridor could be classified as tranquil, enclosed, sylvan and pleasant for much of their length. This confers a rural feel, particularly considering that there are large areas of residential and commercial activity nearby. The existing bridge, when fully visible from the road and river corridor, becomes very much the dominant landscape element.

The Lower Road runs parallel and close to the north banks of the river and is the only road along the base of the valley. The road links Lucan and Chapelizod and provides direct access to the smaller residential holdings located along the northern slopes of the valley at Strawberry Beds. For much of its length the Lower Road is bounded by mature hedgerows or by tree vegetation associated with the river, which prevents views of the existing bridge for much of its length. However, as one progresses nearer to the bridge it becomes more visible and indeed becomes the primary visual focus.

8.7.4 River Liffey and Mill race

The reach of the river at Palmerston follows a course close to the foot of the north slope. In the past, the river provided a power source for local mills through the mill race which runs parallel to the Liffey as far as Palmerston. In the vicinity of the existing bridge the river is approximately 25 m wide.

The 4 m wide millrace is located to the south of the river and is separated from it by a 25 - 30 m width of level land. The mill race is a listed structure in the draft South Dublin Development Plan. The river and mill race are relatively small elements within the context of the valley's overall width (480 m between the tops of the north and south slopes). The presence of these watercourses is, however, emphasised by their parallel courses forming a definite line through the valley floor and by the associated riverbank trees and vegetation.

8.7.5 Land Adjacent to the Existing Bridge

The existing bridge consists of a single, monolithic concrete structure some 16 m wide and approximately 480 m between the northern and southern ridgelines. The bridge is supported by four concrete piers at 66 m, 74 m, 85 m, 90 m and 70 m intervals from south to north. In plan, the bridge crosses the edge of the southern ridgeline of the valley at 90° to the fall of the slope, but to the northern slope it crosses at 70° to the slope.

At the southern end of the bridge an embankment was constructed to reduce the spanning distance of the bridge across the valley. Presently, there is rough grassland growing on the embankment. As the bridge adjoins the southern ridgeline the road widens to allow ramped slip roads from the M50 onto the N4. The road embankments associated with the N4 Interchange have been extensively planted with trees. Where the bridge ties in to the northern slope, there are extensive mature woodland areas. Immediately west of the northern abutment there is a large red brick residential property called 'Oatlands House', which is to be listed in the draft Development Plan. The road then widens into the Toll Plaza area.

8.7.6 Private Demesnes

Large private estates, predominantly under agricultural use, have long been a feature of the northern plateau (refer to Chapter 10). There is little residential or industrial development on the northern plateau, because much of the land has remained under private ownership. On the northern slope immediately east of the bridge, the extensive excavation and resultant erosion associated with two residential developments and former gravel extraction has denuded much of the slope and broken the general line of tree vegetation that extends along the northern slopes of the valley.

8.8 Zone of Visual Influence

The zone of visual influence includes all areas with open or partial views of the proposed bridge. The extent to which the proposed second bridge will be visible is primarily defined by the topography of the valley, vegetation and the built environment. This is indicated graphically in Figure 8.3, which also presents the significance of visual impacts at different locations. In general, public views of the bridge are restricted to a radius of approximately 500 m and are restricted to within the valley. There is, however, one long range view of the entire bridge some 1,500 m to the east at the top of Knockmaroon Hill on the Chapelizod-Castleknock Road.

8.9 Landscape and Visual Evaluation

8.9.1 Introduction

Using the criteria outlined in Table 8.1, the impact of the proposed bridge on each of the character areas identified was assessed. This evaluation considered:

- The visual impact of the first bridge

- The change to existing views and the extent to which the proposed bridge will be visible
- The effect on the character of the area and whether the changes will be positive, negative or neutral
- The effects of night lighting.

Construction of the second Liffey Valley bridge would inevitably lead to varying degrees of permanent impact on the landscape and visual character of the surrounding areas. These impacts will generally arise from the issues identified below:

8.9.2 Removal of Vegetation

At the northern abutment of the bridge there are a number of mature trees approximately 15 m east of the existing bridge. During the construction of the bridge, access will be required to allow for the construction of the bridge footings. This will necessitate the removal of a mature sycamore (13 m high in mediocre condition), a semi-mature beech (6 m high in good condition), a semi-mature yew (6 m high in mediocre condition) and a mature pine (13m high in good condition.

Because of the realignment of the slip roads on and off the N4 Interchange, certain portions of the screen planting originally implemented at the time the original bridge was constructed will need to be removed. The need for an access road for the construction traffic to the southern side of the River Liffey leading on and off of the N4, will necessitate the removal of a portion of the tree and shrub planting along the northern edge of the eastbound carriageway of the N4. It will be essential that this be kept to an absolute minimum so that these existing plantings will provide the maximum amount of screening for the residential properties whose rear elevations will back out onto the access road. Between the toll plaza and the northern end of the bridge, it will also be necessary to remove some of the existing ornamental tree and shrub planting.

8.9.3 Alterations to Ground Levels

The construction of the bridge footings will necessitate significant earthworks. However, original grades will be restored during the landscape restoration phase of the proposal. There will be a need to extend the width of the southern embankment, which was constructed when the first bridge was built.

8.9.4 Visibility of the Bridge Deck and Piers

The design of the second bridge will be identical to the existing bridge, with the exception of the span distances between the piers. The span distances will be offset from the original bridge piers to reflect the natural 'skew' of the valley, i.e. the piers would be in line at the south end of the valley, with increasing offsets towards the northern plateau. It is important to note that the proposed configuration of piers was discussed and passed at the original Public Inquiry. The visibility of the second bridge will be defined by the zone of visual influence. Where there are long distance views, the visual impact will be low as the two bridges will be observed as a single visual element. However, at closer quarters the impact of the bridge will increase significantly.

8.9.5 Lighting, Signage and Wind Barriers

The new bridge will be illuminated along its entire length. Lighting will be identical to that on the existing bridge. Signs will be placed at both sides of the two bridges at appropriate locations

for road safety and traffic management. Wind barriers identical to those on the existing bridge will be positioned on the parapet walls of the bridge deck.

These elements will have a low visual impact upon views from the valley floor. They will also give rise to a low visual impact from the surrounding ridgelines given their small size and scale in proportion to that of the bridge structure. At night there will be impact arising from the extra light diffusion from the lighting standards on the two bridges.

8.9.6 Specific Viewpoints

The visual impact from specific viewpoints are considered in the following sections:

8.9.6.1 Views from Properties

There will be a **high visual impact** upon the two residential properties east of the proposed bridge on the northern slope of the valley. This impact will arise because of their close proximity and open views of the bridge. The residential properties to the west of the bridge will experience a **low to medium impact** due to their aspect in relation to the bridge and the existing screen vegetation between these properties and the bridge.

There will be a **medium visual impact** upon the properties along the southern ridgeline of the valley at Palmerston. From affected properties at Palmerston, there will be views of the existing and proposed bridge decks and of all eight piers. The affected properties will include homes along the Old Lucan Road, the Riversdale estate and Riversdale House, now a nursing home. All these properties overlook the valley and have open views of the existing bridge.

During the construction phase of the project there will be high, negative impacts upon adjoining properties arising from the various construction activities that will be associated with the project.

8.9.6.2 Views from Roads

During the construction of the second bridge, there will be a **high to severe** visual impact upon those portions of the Lower Road which have views of the existing bridge. However, this will reduce to a **low to medium** visual impact upon completion of construction, after the scaffolding and cranes have been removed.

The long distance views of the bridge from the Lower Road will result in **low visual impact**. This is because of the offset alignment of the proposed bridge's piers in relation to the existing ones: the bridges will appear as an individual visual entity, rather than two separate ones. However, immediately east and west of the bridge, where the full extent of the proposed bridge will be visible, the visual impact will be **high**.

From the N4 Interchange and from the existing bridge the bridge deck and its associated wind barriers and lighting will be visible although their impact will be **low**.

8.9.6.3 Views from the River Liffey

Given the presence of the extensive riverside tree vegetation, the visual impact of the second bridge will be low for much of its stretch along this portion of the river valley. However, at close proximity and immediately under the bridge, the impact will be **high** because the bridge deck and piers will be fully visible.

8.9.6.4 Views from Public Open Space

The visual impact upon the lands under the ownership of South Dublin County Council to the east of the bridge will be variable. The excellent hedgerows that run along the base of the valley and through these lands will afford some screening of the second bridge. At close distances, and from more elevated positions, both the bridge deck and piers will be visible and will have a **medium impact.**

8.9.7 Conformity with Planning Objectives

This section summarises the landscape and visual aspects of the scheme in relation to the stated objectives of the planning authorities, especially in relation to the SAA.

The construction of the bridge will require the felling of four trees from the area immediately east of the northern abutment. These trees are on the edge of the woodland that is proposed to be protected under a Tree Preservation Order in the 1993 Development Plan. There will also be a need to remove some of the existing vegetation along the banks of the River Liffey to allow for construction of the temporary access bridge from Lower Road across the river.

The buildings and structures listed in Objective 1.4 will not be directly affected, for example through landtake or demolition, by the new bridge. However, the second bridge will visually intrude upon three listed buildings. There will be **medium visual intrusion** upon Oatlands House and Riversdale House, and there will be **low visual intrusion** upon views along the River Liffey from the Metal Bridge, which is approximately 1 km east of the proposed bridge.

Objective 1.6 states that *it will be an objective of the Council to preserve and enhance views and prospects of special amenity value or special interest, in particular from Lower Road.* It was anticipated at the time of the first bridge being planned and constructed that a second bridge would be built in a similar manner at the same location. Hence, the construction of this second Liffey Valley Bridge will not incur any negative visual impact of which the public was unaware, and which was not expected to arise when the building of the second bridge took place.

Long distance views of the bridge from the Lower Road will result in **low visual impact** only. This is because the carefully-designed pier arrangement between the two bridges will appear as a single visual entity. However, immediately east and west of the bridge, where the full extent of the bridge will be visible, the impact will be **high.**

8.10 Overall Landscape and Visual Impact Evaluation

Any changes to the landscape of an area has a corresponding impact on its character. However, the extent of the impact depends on the cultural associations, uniqueness and degree of change in the landscape and the nature of the surrounding land uses. Table 8.2 emphasises the range of visual impact the bridge will cause, depending on where it is viewed from.

This valley forms a scenic, attractive landscape on the outskirts of suburban Dublin. Its uniqueness is very much of significance to the greater Dublin area both in terms of visual character and amenity.

The existing Liffey Valley Bridge already has a high impact on the visual amenity and landscape character of the valleyand adjoining ridgelines. The construction of the second bridge will undoubtedly lead to high visual and landscape character impacts immediately adjacent to it., due to the sheer size and scale of the the bridge in relation to the viewer. During the construction phase the impacts will be high and adverse.

However, at more distant points, where the existing and proposed bridges will appear to merge visually as a single entity, the visual impact will be neutral and low and the existing character of the valley will not alter to any significant degree.

Table 8.2
Summary of Visual Impacts from Key Viewpoints

Degree of Impact	Location Impacted	Nature of Impact
Severe	Lower Road (Strawberry Beds)	Severe visual intrusion and disturbance during construction of the bridge.
	River Liffey	Temporary-short term
	Nearby residential properties	Will reduce to a low impact from long distances, and a high impact when immediately adjacent to the new bridge.
High	Two nearby residential properties to the east of the existing bridge on the northern slopes of the valley.	Severe visual intrusion and disturbance during construction phase
	Lower Road	Will reduce to a permanent high impact when landscape mitigation measures have successfully established
Moderate	Residential properties to the west of the bridge structures	Moderate visual intrusion
	Residential properties along the southern ridgeline of the Liffey Valley.	Permanent
	Public open space to the east of the bridge	Reducing to low to moderate visual impact as the distance increases
Low	Long distance views from elevated positions east and west of the proposed bridge	Some visual intrusion
	N4 Palmerston Interchange King's Hospital School buildings	Permanent

8.11 Mitigation Measures and Landscape Treatment Strategy

8.11.1 Introduction

This section gives a brief outline of the landscape and visual mitigation measures that will reduce, where possible, the visual impacts of the second bridge. It is also intended that these measures will assist in visually integrating the bridge into the landscape. The mitigation measures have been considered in response to the scale of the proposed bridge within the surrounding landscape character areas. Consideration has been given to the specific landscape characteristics of each area, and the relative significance of the scheme's impacts on each of

these character zones. The landscape treatment proposals are illustrated in Figures 8.7 and 8.8 and are described below.

8.11.2 Mitigation Measures and Landscape Objectives

Prior to the construction of the existing bridge, a detailed project report (*Western Parkway Liffey Valley Bridge, Ove Arup & Partners Ireland, 1985*) was published by Dublin County Council. This document examined the design, construction, landscape and economic implications of the bridge.

The report examined in detail the likely negative landscape impacts associated with the construction of such an imposing feature. An excerpt of the project design and mitigation measures associated with the bridge design is presented in Appendix B. These measures are presented in this EIS because the principles are still relevant in the context of the proposed bridge.

In support of mitigating the adverse landscape and visual impacts of the scheme, a series of landscape treatment proposals will be implemented:

- The existing grades will be restored completely with suitable topsoil following construction of the bridge abutments and pier foundations
- As far as is practicable, the River Liffey and mill race, and all surrounding walls, hedgerows and trees will be protected during the construction phase
- An extensive screen planting and aftercare programme will be implemented to both slopes of the valley, and along the river corridor. This will in time help to 'soften' the sharp engineered lines of the bridge to the northern and southern abutments. Successful establishment of these plantings will be essential to assist in integrating the bridge into its valley setting
- Screen planting will be implemented along the realigned slip roads from the southern end of the bridge onto and from the N4 Interchange
- Predominantly indigenous tree and shrub species will be selected for landscape treatments. Careful species selection will be made to ensure successful establishment in such a setting. These will provide habitats and a visual enclosure in keeping with their surrounds. Only native Irish plants will be used within the boundary of the proposed Natural Heritage Area
- Minimum levels of essential maintenance will be achieved through the selection and management of natural plant mixtures where possible
- Mature nursery stock will be planted at suitable locations to achieve positive screening effects in the short- to medium-term
- Different types of vegetation will be used where appropriate to achieve a more diverse ecological mix.

8.12 Residual Effects

The existing bridge is very much a dominant visual focus for this part of the Liffey Valley. This is because of the bridge's size and its engineered lines which contrast with the woods, open fields and the River Liffey over which it spans. The construction of the existing bridge completely altered the visual and landscape character of the Valley at this point.

As the proposed planting establishes and matures, there will be greater visual integration of the two bridges within the valley setting and the valley's ridgelines.

Because of the landscape and visual impacts associated with construction of the first bridge, the addition of a second bridge will not cause significantly higher visual and character impacts. This conclusion is reached because of the almost identical design and location of the proposed bridge, directly adjacent to the existing structure, and the consideration given to the off-set configuration of the piers.

It is also significant that in the ten or more years of operation of the existing Liffey Valley Bridge no major complaints have been voiced either in relation to the appearance of the structure, or to noise, air quality, or any other effects of the bridge.The only matter on which adverse comment has been received relates to the lack of success of the landscaping measures put in place on completion of the bridge.

9. NOISE AND VIBRATION

9.1 Introduction

This Chapter assesses the environmental noise and vibration impacts of the proposed Second Liffey Valley Bridge. The appraisal was undertaken by Forbairt. The way in which the evaluation was undertaken is described in Section 9.2. The following section provides background information relating to the evaluation of road traffic noise. The existing noise environment was measured at four potentially sensitive locations adjacent to the existing bridge. The results of this survey are presented in Section 9.4. The noise environment at these four locations under future 'do minimum' and 'do something' scenarios is then predicted. Vibration effects are examined in Section 9.6, while noise and vibration issues associated with construction of the bridge are considered in the following section. The final three sections of the Chapter describe, respectively, the significance of the predicted noise impacts, recommended mitigation measures and the residual effects of the scheme.

9.2 Method Statement

The noise and vibration evaluation considered four scenarios: base year (2001) and design year (2016) both under a 'do minimum' and 'do something' scenario. Traffic flow and speed data for the various scenarios were provided by Ove Arup & Partners Ireland (refer to Chapter 7). The noise calculations have not incorporated an allowance for the future reduction of vehicle noise as a result of stricter noise control legislation. The prediction method used was based on the *Calculation of Road Traffic Noise* (CRTN) (HMSO, 1988). Baseline measurements were made, and future noise levels predicted in accordance with CRTN at four selected locations in the area. These locations were chosen because they represent potentially the most noise-sensitive locations in respect to the proposed scheme.

9.3 Sound Levels and Road Traffic Noise

The following section describes the terminology used in measuring and evaluating the significance of road traffic noise. Noise is measured with a sound level meter in units called decibels (dB). Environmental noise levels are usually assessed in terms of A-weighted decibels, the dB(A). A-weighting is used in measuring environmental noise because it more closely represents the response of the human ear to sound energy.

The most commonly used parameter for evaluating road traffic noise levels in Ireland and the U.K. is the L_{10} dB(A) level, i.e. the noise level exceeded for 10% of a specified period of time. The specified time used in the U.K. and by local authorities in Ireland is the L_{10} (18-hour) dB(A). This value represents the mean of hourly L_{10} levels over the period 6 a.m. to 12 midnight. Social surveys in the U.K. have shown that L_{10} levels are a useful basis for correlating dissatisfaction towards road traffic noise with the perception of nuisance. U.K. legislation stipulates a limit of 68 dB(A) L_{10} (18-hour) for new highways as a threshold above which noise abatement at a sensitive location is required. A change in sound levels of 2 dB is regarded as 'just perceptible', and an increase of 10 dB is generally regarded as causing a doubling of 'loudness'. An alternative to the L_{10} (18-hour) parameter is sometimes used and this is the $L_{Aeq,\ 12\ hour}$ - the equivalent continuous noise level for the period 8 a.m. to 8 p.m.

The relationship for significant traffic noise is approximately:

$$L_{10}\ (18\text{-hour}) = L_{Aeq,\ 12\ hour} + 2\ dB(A)$$

Industrial noise is usually expressed in equivalent continuous levels, L_{Aeq}. The criterion for industrial noise outside residential premises during day time is usually an L_{Aeq} of 50 or 55 dB. Level for level, traffic noise is less objectionable (and railway noise less again) than industrial noise. Road traffic noise with an L_{10}(18-hour) of 68 dB(A) is approximately equal to an L_{Aeq} of 65 dB.

9.4 Existing Noise Environment

Traffic noise in proximity to the existing Liffey Valley Bridge was measured at four locations (A, B, C and D) during October 1997 (refer to Figure 9.1). Noise measurements were made for periods in excess of twenty four hours at three of the locations (A, B and C). The measurement location was nominally 1 m in front of the facade of the buildings. At the boundary of residence D, the shortened 3-hour measurement method as described in the CRTN was used. The noise level was sampled continuously and the following statistical data were obtained for each hour: L_{A01}; L_{A10}; L_{A90} ; L_{Aeq}. An explanation of these terms is presented in the Glossary. The data for each period were tabulated and plotted. These are presented in Appendix C. The $L_{10\ (18\text{-hour})}$ dB(A) levels pertinent to the evaluation of road noise are presented in Table 9.1.

Table 9.1
1997 Baseline Ambient Noise Levels

Receptor	Location	Facade / floor	$L_{10\ (18\text{-hour})}$ dB(A)
A	Residence near N4 Interchange	front, 1st.	68
B	School, residential	front, 1st.	60
C	School, Classroom	front, 1st.	59
D	Boundary of Residence		61

9.5 Predicted Noise Environment

Traffic noise levels were predicted at the four receptors for each of the scenarios described in Section 9.2. The predictions were made using the measured noise levels at each receptor as a baseline value. The predicted basic L_{10} level is a function of traffic flow, traffic speed, proportion of HGVs, road gradient and the type of road surface. The basic noise level is then corrected as appropriate to assimilate the effects of variables such as the distance of a receptor from the road, the nature of the ground surface, and intervening barriers to the transmission of sound from the road to a receptor.

Table 9.2 shows the predicted road traffic noise levels compared with the empirical baseline values. The predicted levels are considered under the various scenarios in question.

Table 9.2
Predicted Noise Levels: $L_{10\ (18\text{-hour})}$ dB(A)

Receptor	Location	Baseline	Do Minimum		Do Something	
			2001	2016	2001	2016
A	House near N4 junction	68	70	71	70	71
B	School, residential	60	62	63	62	63
C	School, classroom	59	60	62	60	62
D	House, north	61	62	64	63	64

Table 9.2 indicates that the existing maximum L_{10} (18-hour) sound level is 68 dB(A). This measurement was recorded at location A. The projected increase in traffic in 2016 causes an increase at Receptor A to 71 dB(A). This noise level would occur, however, even if the second bridge were not constructed. This absolute baseline value is significant in terms of being a noise disturbance threshold.

At the other three receptors, the noise implications of the proposed scheme are also negligible. This is because calculations show a difference of less than half a dB between the 'do minimum' and 'do something' scenarios. (The values in Table 9.2 are rounded up to the nearest whole number.) The projected increase in traffic between the baseline and design years does not cause a significant increase in traffic noise levels. These predicted noise levels are shown in Figure 9.2.

The main conclusion that can be drawn from the ambient noise survey is that the measured sound levels, which contain the total noise environment, are principally controlled by noise from road traffic, near and distant, at all four receptors.

9.6 Vibration

As a vehicle travels along a road, vibrations can be generated in the road and transmitted towards adjacent buildings. These vibrations are generated in one of two ways:

- By the interaction of a vehicle's wheels and the road surface. This generates energy waves in the road which are transmitted through the ground to adjacent buildings
- By direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle. These waves enter a building *via* windows, open doors, etc.

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibrations in buildings located near to well-maintained and smooth road surfaces. The problem can largely be avoided by maintenance of the road surface, and the infilling of pot holes which propagate road surface-wheel vibrations.

The ground vibration from the operation of the second Liffey bridge would be expected to be orders of magnitude less than that required to cause disturbance to occupiers of a building (about 1 mm/s) or structural damage to property (>8 mm/s).

9.7 Noise and Vibration During Construction

British Standard BS 5228: 1997 *Noise and Vibration Control on Construction and Open Sites* provides guidance on the methods available to control noise from road construction. Its application in areas sensitive to construction noise and vibration would be expected to minimise disturbance to the local residents.

Vibration arising from piling operations and other vibration-generating construction activities will also be controlled where necessary.

Ground vibration from construction work would not be expected to cause undue disturbance or structural damage as long as access roads are maintained.

9.8 Significance Evaluation

The significance of the noise impacts of the scheme, derived from the significance evaluation criteria in Table 2.1, and Section 50 of the Roads Act, 1993, may be summarised as follows:

- Significant local adverse effects during construction, achieving a **moderate** significance level,
- Significant traffic noise levels at a property adjacent to the N4 Interchange. It should be stressed, however, that this impact occurs regardless of whether or not the scheme proceeds.

9.9 Mitigation Measures

It is recommended that mitigation measures are implemented for the benefit of the residential property at the N4 Interchange. This is because under current best practice, the property is subjected to unacceptable levels of road traffic noise. The noise levels at this property will deteriorate slightly between the baseline and design year, regardless of whether the second bridge is built. Appropriate mitigation measures which could be implemented at the Interchange include:

- Installation of double glazing
- Construction of an acoustic barrier adjacent to the off-ramp and/or at the property boundary
- Provision of porous asphalt road surface on the off-ramp, which absorbs sound generated by the interaction of tyres and the road surface.

It is not anticipated that mitigation measures will be required in respect of vibration caused by road vehicles. This is because vibration will not be a significant issue, subject to access roads to the construction sites being properly maintained.

9.10 Residual Effects

The proposed scheme would not give rise to an increase in road traffic noise levels over and above any increases arising from normal traffic growth.

Construction noise would be a potential medium-term source of nuisance. Construction noise would be controlled through the application of proven procedures to minimise undue disturbance to local residents and users of adjacent land. These measures would be agreed in advance of construction and would involve consultation with the Contractor and the competent authority.

Ground vibration from the use of road haulage routes will not cause disturbance to occupants on nearby properties or structural damage. Similarly, vibration-generating construction activities would be within acceptable bounds.

References

UK Department of Transport, Welsh Office, (1988) *Calculation of Road Traffic Noise (CRTN)*

10. ARCHAEOLOGY AND CULTURAL HERITAGE

10.1 Introduction

Major new structures such as the second Liffey Bridge involve substantial earth moving operations, spoil excavation and site recontouring. Such operations have the potential to disturb or even destroy features of historical and archaeological interest. (However, construction of the first bridge did not uncover any archaeological remains.)

A specialist study by Margaret Gowen & Co. Ltd. was commissioned to examine these potential effects and to recommend mitigation measures where appropriate. This chapter therefore describes the archaeological and cultural heritage resources of the Liffey Valley. The Chapter begins with a brief review of the archaeological and cultural heritage context of this part of the valley. The evaluation methods employed are described in Section 10.4 and is followed by reference to the evaluation criteria. A description of current receiving environemnt in relation to archaeology is presented in Section 10.6, and is complemented by a list of the four nearby properties identified for *preservation consideration* in the Local Plan. An evaluation of the scheme's effects on archaeological and heritage resources is presented in Section 10.7. The final two sections of the chapter provide recommended mitigation measures during the construction programme and a summary of the residual effects.

10.2 Study Area

The corridor of land under investigation flanked the southern and northern sides of the River Liffey and included the townlands of Diswellstown, Astagob and Palmerston Lower. The width of the corridor was sufficient to encompass both land directly affected by construction activities, and more distant features whose setting could be affected by the bridge.

10.3 Archaeological and Cultural Heritage Context

The area has a long history of settlement which dates back to the Stone Age. Although no standing monuments of Neolithic age occur in the study area, a stone axe and hollow flint scraper of that date have been uncovered nearby. Further, several features of possible Neolithic date were revealed during construction of the North Eastern gas pipeline in the townland of Diswellstown. This Neolithic site (SMR 017:010) is located one field north of the toll plaza, and is separated from it by the Diswellstown Road. The location of these and other sites are indicated in Figure 10.1 and described in Appendix D.

There are several great houses in the area, none of which will be directly affected by the development. The following are mentioned as they coincide with the scheme's zone of visual influence:

- Knockmaroon
- Oatlands
- Brooklawn
- Riversdale.

10.4 Evaluation Methods

This Chapter is based on an archaeological and historical desk study together with a field inspection of the application area.

10.4.1 Desk Study

The following sources of information were reviewed in support of the archaeological desk study:

- **Sites and Monuments Record**: The primary source of information for the desk study was the Sites and Monuments Record (SMR) of the Department of Arts, Culture and the Gaeltacht (formerly the Office of Public Works, OPW). The SMR records known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. This is based on a comprehensive range of published and publicly-available documentary and cartographic sources.
- **The National Museum of Ireland (NMI), Topographical Files**: These files identify recorded *stray finds* which have been donated to the State in accordance with National Monuments legislation. Sometimes they include reports on excavations undertaken by NMI archaeologists earlier in the twentieth century
- **Documentary Sources**: Documentary and literary references were consulted as well as cartographic sources, including the 1st and 3rd edition maps of the Ordnance Survey.

10.4.2 Field Investigation

Field investigation was undertaken to assess current and previous land use, access to the site, topography and any additional environmental information relevant to the archaeological appraisal. This also sought to locate any low visibility archaeological monuments with little surface expression.

10.5 Significance Evaluation Criteria

Significance evaluation criteria have been developed to reflect issues relating to both archaeology and cultural heritage. These evaluation criteria incorporate the following:

- The Environmental Protection Agency (EPA) guidelines with the existing criteria developed for the EIS
- A Classification Table (Appendix E) prepared for the purposes of this EIS only.

Despite the comprehensive evaluative framework shown in Appendix E being prepared for this study, the conclusions drawn later in this Chapter (Section 10.7) suggest that it is most unlikely that the scheme will cause more than a **minor adverse** effect. This level of significance is not relevant in the overall decision-making process. It can, however, be relevant to the subsequent detailed design stage and to shaping the nature and scope of mitigation works.

10.6 Existing Conditions

10.6.1 Introduction

The area of landtake for the proposed bridge was inspected in January 1998. The entire area was investigated ensuring that as much 'total' foot coverage as possible was achieved.

A *surface visibility* rating was used to describe the study area. This refers to the extent to which archaeological investigation might be impeded or hindered due to obstruction on the ground surface. The main factors affecting surface visibility are vegetation cover and development features. The corridor of land to be developed was sectioned off as part of the original Compulsory Purchase Order in the 1980s. The majority of the CPO area has been previously disturbed and landscaped during construction of the first bridge. This reduces the likelihood of uncovering archaeological remains during earthworks for the second bridge.

10.6.2 Archaeology

The area under investigation was divided into two sections, north and south of the Liffey. The land to the north comprises:

- A field on the plateau above the valley, to the east of the Toll Plaza. This field is under agricultural use, and is moderately undisturbed. A back-filled trench was located in the centre of the field, but this was of recent origin and nothing of archaeological significance was found. This field is bounded to the north by Diswellstown Road, on which Diswelltown House stands and the site of Ragwell, a holy well (SMR 017:011) can be viewed. The field located north of this road commands a good view of the surrounding landscape and during construction of the gas pipeline in 1984, Neolithic remains (SMR 017:010, refer to Appendix D) were revealed. This field is, however, outside the corridor of the proposed development
- Land extending northwards from the Lower Road at Strawberry Beds up the steep valley slope to the plateau. This area was previously disturbed through construction of the first bridge, and is therefore most unlikely to yield archaeological remains.

On the south side of the Liffey, the land is divided into two separate fields with a right of way bisecting them east/west. The land slopes steeply to the River Liffey at the bottom of the valley. The area is under grass, and is quite marshy in places. A mill race running parallel to the river is culverted for a stretch and has been previously disturbed. Nothing of archaeological significance was noted and no sign of an early mill structure was apparent.

The 1993 Dublin County Council Development Plan makes reference to a List 1 (*for preservation*) archaeological monument in the townland of Palmerston Upper. This monument, a mound located in a prominent position on the crest of a rise, is within the zone of visual influence of the scheme. The site (SMR 017:072) has been subject to recent (1995) archaeological investigation, and was found not to be of significance. The area that the site occupies will not be disturbed in any way by the proposed scheme.

10.6.3 Cultural Heritage

There are four properties prescribed in the 1993 Structure Plan as List 2, *for preservation consideration*, located along the periphery of the zone of visual influence. These are:

- Oatlands (ref. No. 11): the house, out-offices and gates located in the Diswellstown townland west of the development

- Knockmaroon House (ref. No. 12): the house, stable residences, stables, lodges (2), gates and piers located in the townland of Castleknock, north-east of the development
- Brooklawn (King's Hospital) (ref. No. 20): Old Lucan Road, house located in the townland of Brooklawn, south-west of the development
- Riversdale House (ref. No. 22): Lucan Road, Palmerston, house located in the townland of Palmerston Lower.

All these houses will remain intact and will not be affected by the proposed second bridge.

10.7 Archaeological and Heritage Evaluation

10.7.1 Archaeology

There are no registered SMR sites or archaeological finds located within the curtilage of the application site. However, a prehistoric habitation site, a mound likely to contain burials of Neolithic or Bronze Age origin, and reported finds of skeletal material of an uncertain date are indicative of prehistoric occupation and activity in the area. The site of a holy well on Luttrellstown Road, may indicate an ecclesiastical presence in the area.

The predicted impact of the development is **minor** to **none**, with no adverse effects expected. However, archaeological soils, features and/or deposits are on occasion discovered during construction projects involving extensive earthmoving and sub-surface excavation. It is therefore recommended that a watching brief be maintained by a qualified archaeologist during the initial stages of construction (refer to Section 10.8).

10.7.2 Cultural Heritage

There are no known Listed Buildings (i.e. List 1 and / or List 2) and / or state-owned buildings within the curtilage of the proposed construction area. The scheme will not encroach onto the footprint of any structures, nor will the aforementioned houses have their demesnes altered. No immediate adverse effects upon sites of cultural interest are therefore envisaged. The visual aspects of the development, and in particular the intrusion of the scheme within the setting of these houses, is considered further in Chapter 8.

10.8 Mitigation Measures

10.8.1 Archaeology

Although the proposed second bridge will not encroach onto any known archaeological remains, there are recorded archaeological sites and artifacts in the immediate area. It is recommended, therefore, that the following mitigation measures be adopted within the planning conditions attached to the scheme:

- All top soil stripping in the field located on the plateau adjacent to the Toll Plaza be monitored by a licensed archaeologist
- The clearance of the thicket and scrub located on the break of the slope of the steep embankment immediately south of the field boundary should also be monitored by a licensed archaeologist

- The northern embankment was previously cleared during construction of the existing bridge. Therefore, this corridor of land has been disturbed and should only require a cursory inspection. It is also unlikely that land such as this would have been settled during prehistory. There is always the possibility, however, that stray finds from associated settlements located on the high ground could be retrieved during construction.

Any disturbance to the River Liffey and the associated mill race should therefore include an archaeological inspection, because associated features or stray finds may be revealed.

The previously disturbed, steeply sloping land south of the River Liffey should require only an initial inspection as the entire area has recently been landscaped. If the monitoring of topsoil during the construction phase reveals nothing of archaeological significance, the development should require no further archaeological involvement.

The above mitigation proposals would have to be conducted within the relevant National Monuments legislation. This statute states that in the event of the discovery of archaeological finds or remains, Dúchas, Heritage Services, Department of Arts, Heritage, Gaeltacht and the Islands and the National Museum of Ireland should be notified immediately. The developer should make provision to allow for, and to fund, whatever archaeological works may be needed on the site if any remains should be uncovered after topsoil removal.

Any further recommendations regarding the site will be subject to discussion with, and approval from, the Planning Authority and Dúchas, Heritage Services, Department of Arts, Heritage, Gaeltacht and the Islands.

10.8.2 Cultural Heritage

There are no specific mitigation measures required in regard to protection of cultural heritage features. Broader landscape treatment proposals, and their relation to screening key viewpoints within the visual envelope of the bridge, are discussed in Chapter 8.

10.9 Residual Effects

10.9.1 Archaeology

It is anticipated that there would be **no residual effects** with respect to archaeology.

10.9.2 Cultural Heritage

No building of an historical nature and / or recorded on List 1 or List 2 for preservation consideration should be directly effected by the proposed development. However, the setting of these structures could be altered and this would have a **minor adverse effect**.

11. NATURE CONSERVATION

11.1 Introduction

This Chapter describes and evaluates the results of a survey investigating the ecological character and nature conservation value of the lands adjacent to and below the proposed second Liffey Valley bridge. Section 11.2 describes the nature conservation designations that have been conferred on the valley and the implications of these in a planning context. A brief description of the ecological evaluation methods in Section 11.3 is followed by two sections describing the results of terrestrial and aquatic habitat surveys, respectively. Significance evaluation criteria are presented in Section 11.6 and this is followed by the ecological impact evaluation. The final two sections conclude the Chapter by describing the mitigation measures that will be implemented, and the residual effects of the scheme following mitigation.

11.2 Nature Conservation Designations

There are two designated areas which are intersected by the proposed bridge. These designations are:

- A proposed Natural Heritage Area
- A Special Amenity Area Order.

Each of these designations is described below in the context of the likely impacts of the scheme upon them.

The proposed Natural Heritage Area (NHA), number 0128, covers a large part of the lower valley of the River Liffey (refer to Figure 11.1). At the site of the current bridge, the proposed NHA includes the river itself, the south bank (including the mill race, and woodland and scrub to the west), and the woodland at the top of the northern slope. The NHA was proposed by the Department of Arts, Heritage, Gaeltacht and the Islands in 1994. The designation at present has no legal status, but is regarded as a listing of important areas for nature conservation. It is expected to be covered by an amendment to the Wildlife Act 1976 in due course. The protection of NHAs (formerly Areas of Scientific Interest) is normally an objective of the County Development Plan.

A Special Amenity Area Order (Statutory Instrument No. 59 of 1990) was conferred on the Liffey Valley in 1990. A precis of the Special Amenity Area Order is provided in Section 6.5 of the EIS. The Schedules attached to the Order set down the objectives for the area covered by the SAAO (refer to Appendix A). These are mainly concerned with visual issues, but from a nature conservation viewpoint, there is provision for the Councils to take measures to protect flora and fauna, if necessary.

11.3 Ecological Evaluation Methods

A habitat survey following widely-accepted guidelines was conducted on the site in December 1997. The purpose of this survey was to describe the character, extent, location and significance of any semi-natural terrestrial habitats for their flora and fauna. In addition, an aquatic survey of the River Liffey's biological resources was also undertaken. Incidental sightings of birds and mammals which were made during the habitat survey were noted and mapped.

In conjunction with the field surveys, a desk-based study was undertaken by means of consulting both statutory and non-statutory agencies, and readily-available published sources of information.

11.4 Terrestrial Ecology

11.4.1 Survey Method

The site was visited on 17 December 1997 and traversed on foot. The main terrestrial habitats were recorded using the widely-accepted Phase 1 Habitat Survey method (Nature Conservancy Council, 1990). The dominant plant species were recorded during this survey; however, December is not an ideal time for vegetation survey because most of the herbaceous plants have died back.

11.4.2 General Description of Resources

The southern slopes of the Valley comprise grassland grazed by cattle and horses. The northern slope is much steeper, with a gradient of about 30°. Much of this area was disturbed during the construction of the existing bridge. The disturbed area was planted with a grass sward and a scattering of shrubs. Subsequently, a range of native plants has colonised the area. At the top of the northern slope is an area of planted mixed woodland with broadleaf and coniferous species.

The banks of the river are generally narrow and steep (2 - 4 m high) and are covered with scrub and scattered trees. There is a small area of woodland and scrub on the southern bank. An area along the southern bank has been cleared of woody vegetation and is grass-dominated at present, with alder and willow saplings recolonising. There is little or no emergent aquatic vegetation at the river's edge because the banks are generally too steep. The mill race which runs parallel to the Liffey on the southern side is bounded by low banks (<1.5 m high) with patchy scrub. Cattle have access in places to the water and have poached the area. There is some aquatic vegetation at the edge of the channel.

The river and part of the southern bank forms part of the proposed NHA.

11.4.3 Habitat Descriptions

A detailed description of the terrestrial habitats is presented in Appendix F.

11.4.4 Evaluation of Terrestrial Habitats

The terrestrial environment of the study area contains a variety of habitat types which are all common and widespread in the valley. The woodland and scrub have the highest ecological value as they provide habitats for the greatest variety of flora and fauna. The agricultural grassland on the south slopes and disturbed land on the northern side are of low ecological value. Several large mature trees on the river bank and at the top of the northern slope will need to be felled for bridge construction. These are of some local ecological value, but are not of any wider significance. The river banks, in general, are steep and support few or no species of emergent vegetation below the proposed alignment of the new bridge.

11.5 Aquatic Ecology

11.5.1 Site Description and General Water Quality

The proposed bridge spans the River Liffey itself and a Mill race which runs parallel to and south of the river (refer to Figure 11.1). An indication of surface water quality can be ascertained by recording a combination of the abundance and diversity of aquatic invertebrate

taxa. Certain groups are sensitive to pollution whereas others tolerate, and even thrive in, nutrient-enriched waters (Bowman *et al.*, 1996).

A Quality (Q) Value (Q1-Q5), based on the EPA Rating System for water quality, is assigned to each station based on the key taxa identified. The intermediate indices Q1-2, Q2-3, Q3-4 and Q4-5 are also used to denote transitional conditions. There are general data on water quality in the River Liffey available from the EPA (Table 11.1). These data help to assess the significance of the river in terms of its suitability as a habitat for aquatic organisms.

Table 11.1
Water Quality of the River Liffey

EPA Sample Location ref.	Location	Distance from Liffey Valley Bridge	Q Value 1991	Q Value 1995	Water Quality
2250	Hermitage Golf Club	2 km upstream	2-3	2-3	Poor to Doubtful
2400	UCD Boat Club at Islandbridge	6 km downstream	3	ns	Doubtful

Table 11.1 indicates that the river's water quality about 2 km upstream of the site has been consistently *poor* to *doubtful,* with much-reduced or low biological diversity. The mill race diverges from the river approximately 1.2 km upstream of the Liffey Valley Bridge. It is therefore likely, although not proven, that the water quality of the mill race is no better than that of the main river channel.

11.5.2 Sampling Method

Field sampling was conducted in December 1997. The high Winter volume and velocity of the River Liffey made the use of midstream and sediment sampling techniques impracticable. A one minute sweep net sample was taken from the river bank, approximately 100 m upstream of the motorway bridge, at a point with dense bank-side vegetation, composed mainly of willows, nettles and brambles. There were substantial quantities of terrestrial litter trapped along the river edge. A standard *sweep net* was used to collect samples. The depth of sampling was approximately 1 to 1.5 m. The river was roughly 1 to 2 m deep and fast-flowing. Laboratory identification was carried out shortly after the samples were collected.

The mill stream is slow flowing/stagnant and silty, directly beneath and downstream of the motorway bridge. An area with emergent vegetation, approximately 60 m downstream of motorway bridge, was chosen as the sampling site. The stream was about 4 m wide and 40 cm deep. The EPA water quality evaluation scheme could not be applied because no *riffle sequence* existed (i.e. the stream did not comprise the correct substrate, depth or flow rate) and a one minute sweep sampling technique was again employed.

11.5.3 Description of Macrofauna

The results of the sampling exercise are given in Appendix G. The results indicate that the River Liffey supports a relatively high species richness. There is a good representation of predatory species, as expected in mature rivers. This millstream is dominated by Tubifidae and *Assellus*

aquaticus, both of which are indicative of poor water quality and in particular, organic enrichment.

The overall species richness is high. It was obvious that a number of species of chironomid larvae and oligochaete worms were present, however, identification of these groups was not pursued further.

The presence of *Crangonyx pseudogracilis*, an introduced North American species, is noteworthy. Having been first recorded in Ireland (Phoenix Park) in 1969, it has spread rapidly in recent years. It was first recorded in the Liffey in 1994 (Lynch, 1994).

11.5.4 Fish and Angling

There are no current fish stock estimates for this part of the River Liffey, because of the difficulty in sampling a river of this size. However, the River Liffey is known to be an important salmon river. Numbers of migratory salmon are closely monitored by the Dublin & District Salmon Anglers Association (refer to Table 11.2).

Table 11.2
Estimated Number of Migratory Salmon in the Lower River Liffey

Year	1996	1997
Salmon counted at Islandbridge	1,540	716
Salmon caught between Islandbridge and the Liffey Valley Bridge	45	30
Total estimated at Liffey Valley Bridge	1,505	686

Source: Pat O'Molloy, Dublin & District Salmon Anglers Association, pers. comm.

The figures in Table 11.2, although representing only the past two years, do emphasise the significance of the River Liffey as a salmon river. The use of the river by angling clubs is described briefly in Section 14.4.2.

11.5.5 Commentary

Both the River Liffey and the mill race were shown to support a relatively high species diversity. Nothing found in this survey can be considered, however, as being of high nature conservation value. This could be a function of the Winter flood conditions at the time of the survey. Flood conditions are unsuitable for macroinvertebrate sampling and therefore, the full species complement may not have been collected. The sampling technique used in the Liffey is also unlikely to have captured the full range of organisms present at the time of sampling. The species found at the two sites are quite similar, as would be expected. The water quality of the mill race appears to be low. Stagnation of this watercourse is likely to be an important factor, and possibly also organic enrichment.

This section of the River Liffey is not of particular importance for angling because of access problems to the river banks. The number of salmon migrating through the river is significant and there is some coarse fishing in the area. The mill race is not presently used for angling but has the potential for restoration.

11.6 Significance Evaluation Criteria

The following criteria presented in Table 11.3 were used to assess the significance of effects of the proposed development on ecological resources.

Table 11.3
Nature Conservation: Significance Evaluation Criteria

Criterion	Definition
Severe Adverse or Profound	Irreversible loss or damage to a substantial part of a habitat type, community or population of flora or fauna of international importance. Irreversible loss or significant damage (such as landtake) to a statutorily-designated site such as a National Nature Reserve or Special Protection Area. Irreversible adverse effect on National Red Data Book species or a protected species of flora or fauna.
Major Adverse	Irreversible loss or damage to a substantial part of the regional distribution, or the majority of the local distribution of a habitat type, community or population of flora or fauna. Irreversible loss or significant damage to a non-statutory designated site such as a proposed Natural Heritage Area. Significant long-term disturbance effects to animal populations of national importance.
Moderate Adverse	Loss or damage to any part of a habitat type, community or population of flora or fauna of regional importance which can be mitigated by means of habitat reconstruction or relocation. Adverse effects on protected species of flora or fauna where mitigation measures can be successfully applied.
Minor Adverse	Reduction in nature conservation value of a habitat type, community or population of flora or fauna of local importance such as may occur through the severance of linear habitats which may form links between sites. Encroachment into the territorial range of a protected animal species, but with no direct adverse effect.
Not Significant	Loss of recently-created artificial habitats (e.g. landfill sites, amenity grassland). Loss of non-native species of flora and fauna.
Minor Beneficial	A direct or indirect improvement to the nature conservation value of any habitat or any area which supports species of nature conservation value.
Moderate beneficial	A direct or indirect improvement to the nature conservation value of any designated site such as a proposed Natural Heritage Area or a Special Protection Area.

11.7 Ecological Impact Evaluation

11.7.1 Short-Term Impacts

The construction phase, expected to last some two years, will result in the temporary disturbance of habitats within the working area beneath the bridge. The respective areas of different habitats affected are given in Table 11.4. Most of the area impacted is neutral grassland and disturbed land/scrub, which are both of low ecological value.

The construction of the temporary bridge across the River Liffey will result in a short-term impact on the proposed NHA. This is because positioning the temporary bridge will require the removal of some native trees and scrub along the river banks. The length of bank impacted is about 15 m on each side. Given the ecological significance of the proposed NHA, this constitutes a **moderate adverse impact** in the short term. Mitigation measures outlined below will restore the habitat after construction is completed.

Indirect effects include surface run-off from the construction area entering the mill race or the River Liffey. Mitigation measures will be implemented to reduce these effects to the level of no significance for flora and fauna. (Refer to Section 11.8.2 and Chapter 13).

Table 11.4
Predicted Areas of Affected Habitat

Habitat Type	Area Affected by Short-term Construction Impacts	Permanent Impacts
Broadleaved Woodland/scrub	0.20 ha	-
Neutral grassland	4.35 ha	0.05 ha
Mixed plantation woodland	0.52 ha	-
Disturbed land/scrub	0.95 ha	-
Total	6.02 ha	0.05 ha

11.7.2 Permanent Impacts

Permanent impacts outside the proposed NHA will comprise the loss of 0.05 ha. of neutral grassland and disturbed land beneath piers 1, 2 and 4. The effect of this permanent change is not significant for flora and fauna.

Permanent impacts on the proposed NHA will be limited to the loss of neutral grassland beneath the base of pier 3. This covers an area of approximately 0.02 ha.. Although this constitutes a small loss of a grassland habitat which is of low ecological value, nevertheless, it is within a proposed NHA and therefore constitutes a **moderate adverse impact**.

11.8 Mitigation Measures

Short-term impacts during construction will be mitigated by adopting the principles of avoidance, reduction or remedy. Each of these components of ecological mitigation are discussed below:

11.8.1 Mitigation by Avoidance

The design of the proposed bridge is such to ensure that there will be no direct interference with the channel of the River Liffey, which is the key wildlife habitat within the proposed NHA.

The temporary bridge erected during construction will comprise temporary piles that will impede the flow of the river channel to an insignificant degree, which will not require any mitigation measures.

11.8.2 Mitigation by Reduction

Run-off from the construction site could, on occasion, contain suspended material and possibly small amounts of oil or fuel from accidental spillages. All run-off would be channelled through oil interceptors into settling tanks, to be located in the vicinity of the temporary bridge, before being discharged into the River Liffey. This pollutant capture system would reduce the likelihood of contaminating materials entering directly into the river. The Liffey is an important salmonid river which must be protected from such discharges. The interceptors and tanks would be checked and emptied at regular intervals to ensure they are operating correctly.

When the construction of the bridge is nearing completion, three stormwater interceptors will be installed to screen all run-off from the decks of both existing and proposed bridges. These interceptors would ensure that the discharge into the river and the Mill race would contain insignificant levels of pollution. These interceptors are dicussed in more detail in Chapter 13.

11.8.3 Mitigation by Remedy

Following completion of bridge construction, those habitats which have been adversely affected will be restored as follows:

Grassland will be sown in the working area using a mixture of native species to include at least four of the following:

Alopecurus pratensis	Meadow foxtail
Cynosurus cristatus	Crested dogs-tail
Poa pratensis	Smooth meadow-grass
Festuca rubra	Red fescue
Anthoxanthum odoratum	Sweet vernal-grass
Plantago lanceolata	Ribwort plantain
Trifolium repens	White clover
Trifolium pratense	Red clover
Achillea millefolium	Yarrow

River Liffey Banks

The river banks which are impacted will be planted with native trees at the base of the banks as follows:

Alnus glutinosa	Alder
Salix spp.	Willows

and on the upper banks with:

Fraxinus excelsior	Ash
Quercus petraea	Oak
Corylus avelana	Hazel
Ilex aquifolium	Holly

All plant material will be derived from native Irish stock. This will facilitate the restoration of the natural woodland cover on the banks of the river, and also enhance the value of the linear corridor for wildlife species in time.

Disturbed Land/Scrub

Following construction, the steep slope on the north side of the river will be stabilised with a grass sward as above and in addition native species of shrub will be planted to include some of the following:

Ulex europaeus	Gorse
Corylus avellana	Hazel
Betula pubescens	Birch
Sorbus aucuparia	Rowan

Exotic species (for example, garden shrubs) would not to be used and plants would be derived from native Irish stock.

Plantation Woodland

Any trees removed from the plantation woodland at the top of the northern slope would be replaced with trees species to include oak, ash, birch or scots pine (*Pinus sylvestris*).

11.9 Residual Impacts

The scheme's only permanent adverse impact will be at the bases of the piers. These will be compensated for by the creation, in time, of additional woodland cover which will be of beneficial effect to the scheme.

References

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12. AIR QUALITY

12.1 Introduction

The following Chapter examines the effects of the proposed scheme upon air quality. The Chapter begins with a summary of relevant air quality standards and guidelines, against which the air quality predictions have been assessed. A specially adapted air dispersion model for evaluation of air quality impacts near transportation facilities was used to predict the ground level concentrations of vehicle related pollutants at a number of receptor locations generated from traffic, with and without the construction of the second Liffey Valley Bridge. The approach to the modelling is described in Section 12.3. Section 12.4 presents the results of the modelling exercies. Section 12.5 examines the way in which potential dust impact during the construction phase will be mitigated through preventative measures. The significance of the modelling results are appraised in Section 12.6. The Chapter concludes with statements concerning mitigation and the residual effects of the scheme.

12.2 Ambient Air Quality Standards

The current legally enforceable national air quality standards for sulphur dioxide (SO_2), suspended particulates, lead and nitrogen dioxide (NO_2) as specified in Regulations under the Air Pollution Act 1987 (Statutory Instrument No. 244 of 1987) are summarised in Table 12.1.

Table 12.1
Air Quality Standards as Specified in Regulations under the Air Pollution Act 1987

Pollutant	Air Quality Standard ($\mu g/m^3$)
Sulphur Dioxide	350 (98^{th} %ile of daily means)
Suspended Particulates	250 (98^{th} %ile of daily mean)
Lead	2 (annual median of daily values)
Nitrogen Dioxide	200 (98% ile of hourly values in year)

Under the new EU Framework Directive on *Air Quality Management and Assessment*, which was published in 1996, new draft Air Quality Standards (refer to Table 12.2) have been published. These standards cover sulphur dioxide, nitrogen dioxide, lead and fine particulates (PM_{10}). Once this Directive is incorporated into Irish legislation, these new standards will have to be complied with before 2005 for SO_2 and lead, and before 2010 for NO_2 and fine particulates. Therefore, the relevant predicted values for the design year 2016 will be compared to these new standards.

Table 12.2
New Draft Air Quality Standards for Fine Particulates (PM_{10}), NO_2, SO_2 and Lead

Pollutant	New Air Quality Standard ($\mu g/m^3$)
Fine Particulates (PM_{10})	50 - 24-hr limit value 20 - annual mean *N/B. There is also a proposal to move away from the PM_{10} measurement to $PM_{2.5}$ measurements*
Nitrogen Dioxide	200 - hourly average limit value 30 - annual average to protect ecosystems
Sulphur Dioxide	350 - hourly limit value 125 - daily limit value 20 - annual mean value 10-15 in zones where monuments are sensitive to SO_2 damage
Lead	0.5 - annual mean value

There is no national standard for carbon monoxide (CO). Therefore, the predicted CO concentrations have been compared to the relevant air quality guidelines (Table 12.3) recommended by the World Health Organisation (WHO). Further, there is no known air quality standard for volatile organic compounds (VOCs). The predicted VOC concentration (expressed as toluene) has been compared to the new WHO-recommended weekly value for toluene.

Table 12.3
WHO Air Quality Guidelines

Pollutant	Concentration ($\mu g/m^3$)
Carbon Monoxide (1-hr)	30,000
Toluene (Weekly)	260

The WHO guidelines have been designed to provide a basis for protecting public health from the adverse effects of air pollution. Also, they provide a basis for eliminating, or reducing to a minimum, air contaminants that are known or likely to be hazardous to human health and well-being. They have been designed to protect the most sensitive part of the population providing a margin of protection for asthmatics and people with respiratory and heart problems. Therefore, the exposure of healthy adults and children to these levels should not be connected with detrimental health effects.

12.3 Approach to Modelling

12.3.1 Air Dispersion Model

Caline 4 is a specially adapted air pollution dispersion model for evaluating air quality impacts near transportation facilities. It is a recognised US Environmental Protection Agency model. Given the magnitude of emissions at source (in this case the M50 motorway), meteorology and site geometry, Caline 4 can predict pollutant concentrations for ground level and elevated receptors located within 500 m of a roadway. In addition to predicting concentrations of relatively inert pollutants such as carbon monoxide, the model can predict downwind concentrations of nitrogen dioxide which is reactive in the environment. The model also has special options for modelling air quality near intersections, cuttings, bridges and parking facilities.

12.3.2 Source of Exhaust Gas Emission Factors

Current and future predictions of the four main polluting emissions (carbon monoxide (CO), NO_X, volatile organic compounds and particulates) produced from motor vehicles were undertaken. Despite the introduction of legislation reducing the sulphur content of diesel oil, predictions of sulphur dioxide concentrations at the designated receptors were also carried out. The emission factors used to predict future concentrations of CO, NO_2, volatile organic compounds, fine particulates (HGVs only) and SO_2 were the latest figures produced by the Corinair working group for the EC Commission (COPERT II). These exhaust gas emission data incorporate various proposed changes in pollution control devices and fuel. For example, the calculated emission factors for the design year 2016 assumed that all cars will be fitted with catalytic converters. Conversely, the emission factors calculated for the base year (1997) assumed that only 30 % of Irish cars are fitted with catalytic converters. The remaining 70 % of the cars were assumed to comply with EU directive 83/351/EEC (ECE 15/04).

The emission factors used for passenger car fine particulates were figures prepared in the UK by the London Research Centre and the Transport Research Laboratory. Because emission rates are only available for catalyst cars, predictions of ground level concentrations of fine particulate were only carried out for the 'do minimum' and 'do something' scenarios in the design year, 2016. Modelling of airborne lead levels was not conducted because this is a vehicle exhaust pollutant of ever-decreasing importance. For example, the Department of Environment Sustainability Strategy stipulates that leaded petrol will be phased out in Ireland after the year 2000. Also, it is important to note that cars that have catalytic converters fitted, cannot burn leaded fuel.

12.3.3 Location of Receptors

There are residential properties in close proximity to the N4 Interchange, on the Old Lucan Road. There are also houses on Lower Road, Strawberry Beds and Kings Hospital School located north-west of the N4 Interchange. Since these properties are closest to the proposed scheme, a representative selection of receptors at these locations were chosen for the air pollution predictions. Figure 12.1 indicates the position of these receptors, A to F.

12.3.4 Modelling Scenarios and Traffic Input Data

Predictions were performed for the base year (1997) and the design year under 'do minimum' and 'do something' scenarios. The 'do minimum' scenario assumed that the proposed scheme does not proceed, and that none of the N4 Interchange improvements will be carried out.

The model was run using peak hour AM traffic flows and worst-case meteorological conditions (i.e. a highly stable atmosphere and a low wind speed of 1 m/s). HGVs generally comprised 3 to 10 % of the peak hourly traffic flow, depending on the road type under consideration.

Predicted vehicle speed, as shown on figures 7.3 and 7.4, was incorporated into all the emission factor calculations for the various vehicle classes. Vehicle speed for passenger car PM_{10} calculations was determined by adopting emission factors for two main road types: *motorway*, and *urban single and dual carriageways*. For *motorway* driving an average speed of 60 mph was assumed, and for *urban* driving an average speed of 12 mph was used in the calculation.

12.4 Modelling Results

The maximum predicted 1-hr concentration of CO, NO_2, VOC, fine particulates (PM_{10}) and SO_2 at each receptor point are presented in Appendix H and Figure 12.1, and are described below.

12.4.1 Nitrogen Dioxide and Sulphur Dioxide

The predicted 1-hr maximum concentrations of nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) (Appendix H, Tables H.2 and H.5) in relation to both design year scenarios are significantly less than the current and new proposed 1-hr Air Quality Standards recommended by the EU for these pollutants.

12.4.2 Carbon Monoxide

The predicted worst case 1-hr maximum concentration of carbon monoxide (6,559 $\mu g/m^3$ at receptor E) is significantly less than the new WHO guideline value of 30,000 $\mu g/m^3$ specified for carbon monoxide.

12.4.3 VOC

Because of time-averaging differences between the model outputs and the guidelines, the predicted 1-hr VOC and fine particulate concentrations cannot be compared directly to the weekly value for toluene and the 24-hr PM_{10} value, respectively. Compliance with these standards can be assumed, however, if the predicted short-term concentrations are similar to the long term standards. This is because the 1-hr values are always many time greater than a 24-hr, weekly or annual mean concentration. The maximum predicted 1-hr concentrations of VOC produced under both model scenarios are low, and are within typical background levels expected for total hydrocarbons in the atmosphere (0 - 500 $\mu g/m^3$). Although there are no standards for volatile organic compounds, the maximum predicted 1-hour concentrations for the design year (2016) are less than the weekly average concentration of 260 $\mu g/m^3$ recommended for toluene by the WHO.

12.4.4 Fine Particulates

The predicted maximum 1-hour fine particulate concentrations are low and they are similar to the 24-hr average concentration of 50 $\mu g/m^3$ specified for fine particulates by the EU. Currently, this limit value is under review. It is now projected that a limit value will be set for the 2.5 μm fraction instead of the PM_{10} fraction.

In general, with the exception of Site E, the maximum predicted concentrations of the various pollutants at the other site locations are similar under both the 'do minimum' and 'do something' scenarios. Although pollutant concentrations are predicted to increase at Site E, all values are less than any of the relevant EU Air Quality Standards specified in the current *Air Pollution Act, 1987 (Air Quality Standards) Regulations* (SI No 244 of 1987) and the new proposed EU Air

Quality Standards. The maximum predicted increase in carbon monoxide is also significantly less than the new WHO guideline recommended for CO.

12.5 Control of Construction Dust

Construction activities on a site of the scale and nature of the proposed bridge have the potential to release fugitive dust emissions. If uncontrolled, fugitive dust can cause nuisance at nearby properties. Good site management is the key to effective fugitive dust control. It is important therefore that the Contractor demonstrates a clear understanding of the issues involved, coupled with a sense of responsibility and commitment to avoid problems. To this end, demonstration of a proven track record at other sites is essential.

It is far more effective to prevent dust from becoming airborne and fugitive, rather than to attempt to remove such dust from the air. The priority of the dust control measures implemented by the Contractor shall therefore be to this end. A code of practice aimed at surface mineral workings is given in the UK Department of the Environment publication: *The Environmental Effects of Dust from Surface Mineral Workings*. Although relating specifically to fugitive dust emissions from surface minerals workings, the document provides performance data and guidelines which are, nevertheless, relevant to large construction sites. A code of practice has been drafted by Ove Arup & Partners Ireland and is aimed at ensuring the satisfactory performance of the construction site in dust control terms. This is presented in Appendix I.

12.6 Significance Evaluation

The predicted concentrations of exhaust gases represent contributions from road traffic only. The contributions from other potential sources are not included in these calculations. Despite the predicted increase in traffic flows for the design year, the predicted concentrations of nitrogen dioxide, carbon monoxide and volatile organic compounds are shown not to increase accordingly. This is because an ever increasing proportion of the older vehicle fleet will be replaced by new cars fitted with catalytic converters between the base year and design year.

The predicted pollutant concentrations for the design year 2016 summarised in Appendix H may be regarded as conservative estimates. This is because the model input data incorporated the more stringent exhaust emission controls brought about by one Directive (91/441/EEC) only. There are steps being taken by the EU to impose further reductions in vehicle exhaust emissions. Should these measures be adopted, then the predicted air quality effects of the scheme would be further reduced. Therefore, it is anticipated that the maximum concentrations for the year 2016 will be less than those shown in Appendix H, and in Figure 12.1 provided the long term plans proposed by the EU are implemented.

The CALINE4 model was used to predict only the maximum worst-case 1-hour pollutant concentrations at each receptor. The 'worst case' meteorological conditions employed in the model normally occur for no more than 10 % of the time during a year, based on Dublin Airport meteorological data. Therefore for 90 % of the time, the actual ground level concentrations produced as a result of the peak hour traffic flows will be much lower than the predicted maxima shown in Appendix H and Figure 12.1.

12.7 Mitigation Measures

As the proposed scheme would not compromise any statutory or guideline air quality criteria, it is not necessary to predict any mitigation measures.

12.8 Residual Effects

Since the maximum predicted concentrations of the various pollutants considered are less than the relevant air quality standards and guidelines, it is anticipated that provision of the second Liffey Valley Bridge will not have a significant adverse impact on local ambient air quality.

References

European Environment Agency, *COPERT II Computer Programme to Calculate Emissions from Road Transport - Methodology and Emission Factors*. European Topic Centre on Air Emission

13. HYDROLOGY AND DRAINAGE

13.1 Introduction

This Chapter presents a description of the hydrology and drainage issues associated with both the construction and operation of the proposed bridge. The purpose of this Chapter is to highlight the potential sources of pollution which could enter the River Liffey or the mill race, and the drainage design and pollution control measures which will serve to reduce or eliminate this potential. Sections 13.2 and 13.3 describe the potential sources of water pollution arising during the construction and operation phases, respectively. These sections also make reference to the various mitigation measures which will be implemented to protect the aquatic environment. The Chapter concludes with an evaluation of the significance of hydrogeological impacts, and a summary of the scheme's residual effects on water resources.

13.2 Construction Phase

As described in Chapter 5, the construction project will entail the spanning of the River Liffey and the mill race with a new bridge, and the spanning of both watercourses with a temporary bridge to allow construction vehicle access to the valley floor. The biological status of these watercourses is described in Section 11.5. The potential sources of water pollution during the construction phase would be associated with:

- Construction of the temporary low level access bridge across the River Liffey
- Earth moving works
- Temporary storage of oil for plant and equipment
- Disposal of foul drainage.

Each of these sources is considered separately in the following four sections.

13.2.1 Temporary Bridge

A temporary bridge will be constructed across the Liffey at low level to allow free movement of plant and materials between work areas. The construction of this bridge will involve the pile driving of two steel support pillars into the river bed. The piling operation is likely to disturb sediments within the river bed, thereby increasing suspended solids levels for a short distance downstream. Upon completion of the works the bridge will be dismantled and the support pillars removed. These dismantling works could also cause a short-term, reversible increase in suspended solids levels downstream. These temporary works have little potential to adversely affect water quality significantly. No mitigation measures are proposed, therefore, to control sediment disturbance in the river bed.

13.2.2 Earthworks

Earthworks will be required for the placement of the four piers that will support the bridge, and for regrading soil levels at the north and south bridge abutments. While the total bridge construction period will extend over a period of about two years, only about six months will involve periods of regrading at the abutments, and placement of the pier foundations. It is during this period that the potential for water pollution through excessive soil runoff and siltation of the watercourses could arise. In the absence of controls it is the mill race with its low flow rate that would be most vulnerable to such an impact.

The majority of the earthworks is associated with regrading and widening the embankment at the southern abutment. For this regrading, and for construction of the pier foundations south of the mill race, a temporary earth lagoon will be constructed to intercept surface runoff from these areas. The lagoon will provide for settlement and retention of suspended solids. The retention of solids will be further enhanced by filtration, for example, through straw bales placed on the outlet which will drain to the mill race. Such an approach has been demonstrated to be effective at other construction sites.

In the case of works conducted north of the mill race the construction of a settlement lagoon will not be a practicable option. This is due to the very steep nature of the northern embankment and the confined nature of the work area. Works at this location will consist of:

- Regrading the embankment which, due to the natural topography at this location, will be limited in extent.
- The construction of the foundations for two piers, one located on the embankment and the other between the Liffey and the mill race.

Runoff from the embankment area will be to the existing drain on the Strawberry Beds road and thence to the Liffey. Runoff from the pier construction area between the Liffey and mill race will be to the Liffey. Runoff of suspended solids to the Liffey would have significantly less potential to cause an adverse impact, than runoff to the mill race. This is because of the much larger flow rates in the Liffey compared with the mill race. Nonetheless, care should be exercised at this location during periods of heavy rainfall, when the erosion of exposed subsoils within construction areas is more likely.

13.2.3 Oil and Fuel Storage

Temporary storage of oil and diesel for plant and machinery will be required for the duration of the construction period. Storage will generally be on the south bank area, downstream of the working zone. It will be a condition of contract that all oil storage, both of fuel and hydraulic oils, will be in a secure bunded facility. The filling and take off points will be located within the bunded areas. The bunds will protect against accidental tank rupture and will ensure that any spilled oil can be retained for subsequent disposal to an appropriate outlet such as a waste oil recycler.

13.2.4 Foul Drainage

The construction crew will be provided with temporary, contained chemical toilet facilities such as *Portaloos*. The chemical toilets will be taken off site for emptying at a suitably licenced disposal location. Consequently, there will be no discharge of sewage to surface waters.

13.2.5 Construction site run-off

All run-off from the construction site will be channelled through sediment retention tanks prior to discharge into the River Liffey. The tanks will be placed at the lowest points on the site (north and south of the river), in the vicinity of the temporary bridge over the river. This retention system will reduce the possibility of contaminated material from the site entering the river and effectively remove them from the run-off. All site run-off will be piped across the Mill race, leaving it free from incidental inputs during the construction phase. Discharge licenses to control the outputs from these sediment retention tanks, if required by legislation current at that time, will be obtained by the contractor from the Competent Authority prior to the commencement of construction activities on site.

13.3 Operational Phase

During the operational phase of the scheme, drainage management issues will be confined to stormwater runoff from the highway pavement, and foul drainage from the staff quarters at the Toll Plaza. Both of these sources are described in the following two sections.

13.3.1 Stormwater Runoff

Runoff of pollutants from the highway pavement will arise from rainfall scouring of unburnt exhaust condensate (hydrocarbons), road grit and from spillages arising from road accidents involving bulk liquid transporters. In this regard, the bridge is no different than any other major road as all such runoff, other than in exceptional circumstances, ultimately drains into watercourses whether local or remote. Stormwater runoff from the existing bridge and Toll Plaza drains to the Liffey *via* a number of comparatively small interceptors. It is proposed to redirect the outflow from these to three additional interceptors which will be installed for the new bridge and extended Toll Plaza. The interceptors have been sized to accommodate runoff from both bridges on the basis of a storm intensity of 50 mm/hr. Runoff from the combined bridge drainage is divided into three catchments with each interceptor sized for the respective catchment area. The interceptors have a capacity of 12 m^3, 15 m^3 and 40 m^3. The proposed drainage system that will serve both bridges is illustrated in Figure 13.1.

The interceptors will be commercially-available prefabricated units. These units are designed to retain the grit, suspended solids and hydrocarbon runoff from road surfaces, and to allow it to be discharged to surface water courses without an adverse impact on water quality. The interceptors will be desludged and degritted at regular intervals as part of a routine bridge maintenance programme. In the event of an accidental spillage onto the road surface which enters the drainage system, the interceptors would be isolated by an outlet valve. Such action would form part of the Operator's accident response programme. Subject to such maintenance and accident contingency, the potential for runoff from the bridge and Toll Plaza to cause pollution of either watercourse is minimal. Discharge licenses to control the outputs from these interceptors, if required by legislation current at that time, will be obtained prior to the opening of the bridge

13.3.2 Foul Drainage

Domestic sewage flow rates will marginally increase over existing levels with increased staffing. The domestic sewage can be adequately catered for by septic tank and soakaway as at present.

13.4 Hydrological Evaluation

The scope for adverse pollution impacts on the River Liffey and the mill race is limited. This is because of the nature and limited extent of the potential impacts, and the proven techniques that are available to mitigate against them. Appropriate mitigation measures will be implemented during both the construction and operation phases of the scheme. These will form binding commitments which the Contractor and Operator must adhere to. It is anticipated that hydrogeological impacts will not extend beyond a short-term, localised and **minor adverse** effect.

13.5 Residual Effects

Following the implementation of all mitigation measures at the relevant stages of the scheme, residual effects will be confined to insignificant/minor issues.

14. RECREATION AND AMENITY

14.1 Introduction

The Liffey Valley is a highly significant natural amenity resource, and supports a range of recreational activities. The valley is unique in its location between two major developing new towns, each with a planned population of 100,000 people. As discussed in Chapter 6, the valley's importance and potential have been recognised through its designation as the country's first Special Amenity Area. However, historical difficulties in securing public access to various parts of the valley mean that it is a relatively under-used resource. Steps are being taken by both South Dublin and Fingal County Councils to secure better access within the valley, and to provide more facilities such as car parks and footpaths. It is intended that by enhancing the recreational and amenity status of the valley, it can meet its full potential. An objective of the County Council is to establish a linear park within the valley.

The following Chapter describes existing recreational use of the valley, and summarises some of the steps being taken by the planning authorities to affirm its significant status.

Section 14.2 describes the evaluation method employed, while 14.3 summarises the 1993 Liffey Valley Management Plan prepared by the then Dublin County Council. Sections 14.4 and 14.5 describe recreational usage of the valley, and amenity issues, respectively. The final section of the Chapter concludes with a statement of the nature and significance of the proposed scheme's interactions with recreational and amenity resources, and its residual effects.

The aim of the Chapter is to highlight those amenity issues and resources not already covered in other parts of the EIS. Therefore amenity issues that have already been addressed, for example landscape and visual impact, have not been considered in this Chapter.

14.2 Evaluation Method

Information on the recreation and amenity status of the Liffey Valley was obtained through consultations with the planning departments of both county councils, and from a review of two documents relating to the amenity interest of the valley:

- An application made jointly by Fingal and South Dublin to the European Commission for funding to enhance resources within the valley under the European Regional Development Fund regulations. (Although this submission for funding was unsuccessful, the document serves to provide a useful résumé of the current recreational use and amenity value of the valley, and identifies the challenges facing its development as a tourism resource.)
- The former Dublin County Council's Liffey Valley Special Amenity Area Order Management Plan prepared in 1993 (refer to Appendix A).

14.3 Liffey Valley SAAO 1993 Management Plan

The Management Plan prepared by the former Dublin County Council comprises a series of management proposals to maintain and enhance the amenity and recreational qualities of the Special Amenity Area. The proposals relate to three broad management areas:

- Parklands and ancillary facilities
- Recreational facilities
- Amenity.

The parklands and ancillary facilities component of the Management Plan relates to items such as parklands, the provision of car parks and picnic areas, and catering for visitors. The proposed scheme would not interact with or compromise any of the action items listed in this management category. The impact of the scheme upon recreational use of the valley is examined in Section 14.4 below. The amenity objectives of the management plan are summarised in Section 14.5, however, the landscape appraisal (Chapter 8) considers amenity and visual impact issues in more detail.

14.4 Recreation

The following section summarises the three main recreational activities on the Liffey: canoeing, angling and walking.

14.4.1 Canoeing

The Liffey is a nationally important river for canoeing. The Irish Canoe Union has been consulted in regard to the use of the Liffey in the vicinity of Strawberry Beds, to determine how the proposed second bridge could affect canoe interests. Canoeing activities can be broadly divided into categories, recreational and competitive.

There are two well-established sections of the river that are used for recreational canoeing: Leixlip to Lucan, and Lucan to Palmerston. From Lucan through Strawberry Beds to Palmerston, the main problems encountered by recreational canoeists are inadequate car parking and a lack of canoe landing platforms / areas. There are no reports of the existing bridge directly impinging on the activities of recreational canoeists. A recreational canoeing training centre exists at Strawberry Beds, approximately 300 m downstream of the existing bridge. This training and activity centre represents the first step in the Canoe Union's long term objective of re-locating its administrative office to the Liffey Valley.

The flow of the River Liffey is dam controlled; it is highly suitable for competitive events because high flow rates can be released during a competition. Upstream of the existing bridge, the Leixlip Dam in particular is of considerable importance to competitive canoeing. An important element of the Canoe Union's development plans is to construct a semi-artificial slalom course. Three sites on the Liffey have been identified as being potentially suitable for an international standard slalom course. The nearest of these potential competition sites to the proposed bridge is Sluice Weir at Lucan. This weir would not be affected either directly or indirectly, for example through visual intrusion, by the proposed scheme.

Competitive long distance canoeing is also popular on the River Liffey. The *Liffey Descent* is one of the country's most important long distance canoe races, starting in County Kildare and finishing at Chapelizod. The event attracts 1,200 competitors from Ireland and abroad.

Although naturally a visually-intrusive element for canoeists within the Liffey Valley, the existing bridge does not constrain or impinge on recreational canoeing activities *per se*. The proposed bridge would not affect any of the weirs along the river, nor compromise any existing canoe landing platform / area. The main potential impact would arise during the construction phase. Specifically, this would relate to the construction of the temporary access bridge over the River Liffey from Lower Road to the construction area. It is intended, that any temporary bridge will be designed to ensure that there is sufficient space to allow canoeists to pass safely beneath it.

14.4.2 Angling

Two game angling clubs (Chapelizod Anglers Club and Glenside Anglers Club) fish the reach of river downstream of the existing bridge. The section of river close to the bridge is little used at present, however, due to the difficulty of access to the river banks. The main coarse fish caught in the Liffey are pike and perch (source: River Liffey Water Quality Management Plan). There are no coarse angling clubs active in the study area, but some individual anglers do fish along this stretch.

The mill race is presently not suitable for angling. This is because of low flow rates caused by several breaches in the channel upstream of the current bridge. However, it has the potential for restoration as a coarse fishery, possibly in connection with the development of riverside walks.

14.4.3 Pedestrian and Cyclist Access

Access along the River Liffey between Lucan and Palmerston is constrained by the traditional private land tenure situation.

14.5 Amenity

The amenity section of the Management Plan identifies those resources whose quality or presence can influence the aesthetic value of the valley, either adversely or positively. These resources include water features (such as the mill race, pumphouses and weirs), hedgerows and stone walls, wildlife, road traffic, ESB power lines, and illegal fly tips. The effects of the proposed second bridge in relation to some of these amenity resources are considered in specific Chapters of the EIS. For example, hedgerow, and wildlife are examined separately in Chapters 8 and 11 respectively. Other variables, such as issues relating to the overhead power lines, fly tipping, and the screening of local eyesores extend beyond the direct impacts of the bridge.

The 1998 Draft South Dublin Development Plan stipulates specific local objectives relating to the preservation and enhancement of the Liffey Valley's amenity value. These are listed in Table 14.1 to highlight the environmental resources considered worthy of protection, or existing areas in which there are plans to implement amenity improvements.

Table 14.1
Liffey Valley Amenity Issues

Amenity Issue	Specific Local Objective	Potential Interactions with Proposed Scheme
Land tenure and public access	Consider in detail the need to secure control over some of the lands in the area covered by the SAAO, with a view to enhancing public access to the banks of the river.	None - the proposed bridge will not affect any current land tenure or public access matters. The second bridge will not, through physical obstruction, compromise any future access along the banks of the Liffey. **No effect**

Amenity Issue	Specific Local Objective	Potential Interactions with Proposed Scheme
Intrusion of overhead powerlines	To maintain ongoing consultations with the ESB to seek opportunities for re-aligning or removing the overhead power lines which traverse the Valley.	This issue is unrelated to the scheme under consideration. **No effect**
Car parking provision	Consider the need for additional car parks in the area, and to seek the improvement of existing car parks through negotiation with the owners.	The proposed bridge will not interact with any current or proposed car parking provision in the vicinity of Strawberry Beds. **No effect**
Facilities for anglers and canoeists	Encourage the development of facilities for anglers and canoeists, but at the same ensuring that the possible conflicts arising between these two river users are dealt with sympathetically.	Neither the construction or operation phase of the scheme will affect existing facilities. The temporary construction access bridge over the River Liffey will be constructed to ensure satisfactory clearance for canoeists under high flow conditions. **No effect**
Pedestrian access	Consider in detail the provision of public rights of way and public footpaths in the river valley.	There are presently no public rights of way which pass beneath the bridge. Construction of the proposed bridge will not sever any public footpaths, or interfere with the alignment proposed paths. **No effect**
Nature conservation	Take appropriate steps to protect the flora and fauna of the valley.	The effects of the scheme upon wildilfe have been described in Chapter 11.
Landscape and visual intrusion	To maintain and enhance landscape quality and key viewpoints.	The effects of the scheme in a landscape context are described in Chapter 8.

Source: Based on South Dublin County Council 1998 Draft Development Plan

14.6 Significance Evaluation and Residual Effects

With the exception of nature conservation and landscape issues, it is anticipated that the bridge will not adversely affect the recreational or amenity value of the Liffey Valley. To avoid duplicating the description of the scheme's effects upon landscape and ecological resources, these are considered separately in Chapters 8 and 11 respectively. In conclusion, therefore, the second bridge would not give rise to any significant effects on existing or proposed recreational resources within the valley. The amenity value would, however, be adversely affected at certain locations. The mitigation measures proposed to redress these adverse effects are described in the aforementioned Chapters.

15. INTERACTION OF EFFECTS AND CUMULATIVE IMPACTS

15.1 Introduction

It is regarded as good practice to examine within the EIS the interaction of environmental effects caused by a scheme. This approach ensures that full consideration is given to a location where two or more different types of impact may occur. In turn, this ensures that the impacts of a scheme are considered cumulatively, rather than in isolation. This Chapter therefore commences with a summary of the key residual effects relating to each individual topic in the EIS. The potential interactions of these effects are then considered in Section 15.3. The cumulative environmental effects of the scheme are then addressed, from which the main environmental issues associated with the second bridge are identified in Section 15.5.

15.2 Residual Effects

15.2.1 Land Use, Ownership and Development

There will be no residual effects on land uses or property ownership on land adjacent to the application site. The second bridge will not sever or sterilise land zoned for, or subject to, committed development.

15.2.2 Policy

The proposed scheme either conforms to (or in cases where the scheme is not mentioned specifically, does not contradict) a broad range of national and local transportation and planning policies and stated objectives. For example, the second bridge conforms with national and county policies to relieve road congestion on strategically important routes, and with county policies which seek to secure landscape treatment and environmental protection measures in relation to development projects. Moreover, Fingal County Council has conveyed its approval in principle and without prejudice for the proposed scheme.

15.2.3 Traffic

The removal of the M50 capacity constraint created by the existing bridge will increase safety for road users, decrease transit times and reduce traffic congestion on the approach to the bridge. Irrespective of whether the scheme proceeds, there will be longer queues at the N4 Interchange than at present. This would be because of traffic growth that will occur independently of the second bridge. The level of traffic using the proposed bridge during the morning peak in 2016 will be approximately 81 % greater than the 1997 traffic flows, compared with an increase of 67 % should the scheme not proceed. This growth in traffic can be attributed both to proposed DTI schemes, such as the Dublin Port Tunnel, and normal traffic growth.

The proposed scheme would entail the removal of the existing priority junction on the northbound slip road merging with the M50, and its replacement with a merge lane. This slip road re-alignment would enhance road safety at the junction, and eliminate the projected queues and delays that would arise should the existing junction layout remain in place.

15.2.4 Landscape and Visual

The proposed bridge introduces a second structure which would, from certain viewpoints, significantly change the character of the valley. Short-distance views of the bridge, especially from some parts of the floor of the valley, would be more intrusive than those of the existing bridge alone. However, the careful alignment of the second bridge's piers would ensure that more distant views will be of a single visual entity, rather than two separate structures. As the proposed planting establishes and matures, it will help to integrate the two bridges into their Valley setting.

Because of the existence of the first bridge, the addition of a sensitively-designed second bridge will not cause significantly higher visual and character impacts, except from some discrete locations on Lower Road.

15.2.5 Noise and Vibration

The proposed scheme would not give rise to an increase in road traffic noise levels over and above any increases arising from normal traffic growth. Ground vibration from the use of the road will not cause disturbance and vibration from construction work would not be expected to cause undue disturbance or structural damage. Non-mandatory road traffic noise criteria are currently exceeded at one property on the Old Lucan Road. This situation will deteriorate slightly between the baseline and design year, regardless of whether the scheme proceeds.

15.2.6 Archaeology and Cultural Heritage

The second bridge would not affect any known archaeological features. No building of an historical nature and / or recorded on List 1 or List 2 for preservation consideration should be directly effected by the proposed development. However, the setting of some buildings proposed for preservation (Section 8.4 of the main document, also Appendix A – Special Amenity Area Order, Objective 1.4) will fall within the zone of visual influence.

15.2.7 Nature Conservation

The scheme's construction phase would result in the temporary disturbance of habitats within the working area beneath the bridge. Most of the area impacted is neutral grassland and disturbed land/scrub, which are both of low ecological value.

The construction of the temporary bridge across the River Liffey will result in the disturbance of some riverbank vegetation and trees along a short (15 m) section of the river within the proposed Natural Heritage Area. Indirect effects include surface run-off from the construction area entering the mill race or the River Liffey, although following mitigation, these will be of no significance for flora and fauna.

Permanent impacts outside the proposed NHA will comprise the loss of 0.05 ha. of neutral grassland and disturbed land beneath piers 1, 2 and 4. The effect of this permanent change is not significant for flora and fauna. Permanent impacts on the proposed NHA will be limited to the loss of neutral grassland beneath the base of pier 3. This covers an area of approximately 0.02 ha.

15.2.8 Air Quality

Since the maximum predicted concentrations of the various pollutants considered are less than the relevant air quality standards and guidelines, it is anticipated that construction of the second Liffey Valley Bridge will not have a significant adverse impact on local ambient air quality.

15.2.9 Hydrology and Drainage

No significant effects are anticipated.

15.2.10 Recreation and Amenity

With the exception of nature conservation and (more significantly) landscape issues (considered respectively in Sections 15.2.7 and 15.2.4 above), it is anticipated that the bridge will not adversely affect the recreational or amenity value of the Liffey Valley.

15.3 Interaction of Effects

The second Liffey Valley Bridge would represent a material asset of major importance in a regional context. Its location, however, within an environmentally sensitive setting, adjacent to both residential areas, a school and a highly-valued landscape, will inevitably give rise to environmental effects interacting with each other. These effects will be both beneficial and negative, for example:

Implementation of the scheme will provide a much-needed element of transport infrastructure for the Greater Dublin area. It will serve to alleviate congestion, reduce fuel consumption and costs to industry, enhance road safety along this section of the motorway, and assist in maintaining the M50 corridor as a strategic location for inward investment. The interaction of beneficial social and economic effects is therefore considerable.

Conversely, the construction phase will cause adverse interactions in terms of temporary road haulage access adjacent to residential property, visual impacts on the Liffey Valley, and loss of amenity value along this part of the designated Special Amenity Area.

The significance of these interactions, during both the construction and operation phases of the scheme will, however, be maintained within acceptable bounds. This will be achieved through implementation of the mitigation measures described for each topic, in tandem with the environmental management and monitoring proposals presented in Chapter 16.

15.4 Cumulative Effects

Cumulative effects are those which arise from multiple environmental effects on the same location or resource. The cumulative environmental effects of the proposed scheme are presented in Table 15.1. The overall impact for each area, based on the interaction of environmental issues, is shown in the last column. The key conclusions that can be drawn from Table 15.1 may be summarised as follows:

- As part of a strategically important highway corridor the proposed scheme, which was always considered to be an integral but future component of the existing bridge, represents a **major beneficial effect** in transportation terms. The proposed bridge will serve to alleviate the inevitable traffic congestion and delay problems which would otherwise occur were the scheme not to proceed. It will serve to meet the projected traffic growth within the greater Dublin area, and will asssist in ensuring the optimum performance of DTI schemes across the city. In summary, the proposed scheme represents a highly significant addition to the material assets of the area.

- The Liffey Valley Special Amenity Area poses a range of considerable environmental constraints to the scheme. The conclusion that may be drawn from the cumulative environmental effects table is that this resource will be subject to an additional **moderate adverse effect**, when taken in the context of the existing bridge and its siting. At certain points within the valley, mitigation measures will only partly redress the adverse impacts. Conversely, at other locations, bold landscape treatment proposals will serve to reduce visual and amenity impacts markedly..

Table 15.1

Cumulative Environmental Effects

Location	Policy & Development	Traffic	Landscape and Visual	Noise & Vibration	Archaeology & Cultural Heritage	Nature Conservation	Air Quality	Hydrology & Drainage	Recreation & Amenity	Cumulative Effects
Houses on Strawberry Beds, Lower Road	Not applicable	HGV and plant access to construction areas. **Minor adverse effect**	Severe visual intrusion and disturbance during construction at two properties east of the bridge. **Major adverse effect** Will reduce to a permanent **moderate impact** on completion of construction. For other properties, visual impacts will vary between low and high depending on distance. **Minor to moderate adverse effect**	Imperceptible (<1dB (A) L_{10} (18 hour)) difference between 'do minimum' and 'do something' scenarios. Overall increase of <3dB (A) L10 (18 hour), irrespective of whether proposed scheme proceeds. **Minor adverse effect**	Not applicable	Not applicable	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines.	Not applicable	No effects on recreation. Refer to landscape and visual for effects on amenity.	Certain homes in proximity to the second bridge will be subject to a **major adverse effect** during the construction phase. This will alleviate to a **moderate adverse effect** on completion of the scheme. Other properties on Lower Road will be subject to a varying impact according to location.
Houses on Old Lucan Road, Palmerston	Not applicable	HGV and plant access from N4 to rear of properties on south side of road. **Minor adverse effects**	**Moderate** permanent visual impact.	3 dB (A) L_{10} (18 hour) increase from 68 dB (A) to 71 dB (A) at one property between 1997 and 2016, irrespective of whether the scheme proceeds. **Moderate adverse effect** Other properties within acceptable noise level increases. **Neutral effect**	Not applicable	Not applicable	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines.	Not applicable	No effects on recreation. Refer to landscape and visual for effects on amenity.	Permanent **moderate adverse effects**, relating primarily to visual intrusion. Enhanced disturbance during construction phase, but remaining within a **moderate** level of significance.
King's Hospital School, residential	Not applicable	Not applicable	Permanent but **minor visual impact**.	3 dB (A) L_{10} (18 hour) increase from 60 dB (A) to 63 dB (A) between 1997 and 2016 under both scenarios. **Neutral effect**	Not applicable	Not applicable	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines.	Not applicable	No effects on landscape or amenity.	**Neutral effect**
King's Hospital School, classroom	Not applicable	Not applicable	Not applicable	3 dB (A) increase from a 1997 baseline of 59 dB (A) L_{10} (18 hour) to design year sound level, irrespective of whether scheme proceeds. **Neutral effect**	Not applicable	Not applicable	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines.	Not applicable	No effects on landscape or amenity.	**Neutral effect**

Location	Policy & Development	Traffic	Landscape and Visual	Noise & Vibration	Archaeology & Cultural Heritage	Nature Conservation	Air Quality	Hydrology & Drainage	Recreation & Amenity	Cumulative Effects
Liffey Valley Special Amenity Area	Departure from landscape and amenity protection / enhancement objectives for the statutorily-protected SAAO. **Major adverse effect**	HGV and plant access to construction areas. **Minor adverse effect**	**Adverse minor impact** on river during use of temporary access bridge. Public open space east of the bridge ~ **minor to moderate visual impact** according to distance.	Imperceptible (<3 dB (A) L_{10} (18 hour) increase in sound levels between baseline and design year, irrespective of whether scheme proceeds. **Neutral effect**	**No effects** with regard to archaeology. **Minor adverse effect** on the setting of buildings / structures listed for preservation.	Short-term construction impact within a proposed NHA. **Moderate adverse effect** Permanent loss of 500 m2 of neutral grassland and disturbed land beneath piers 1, 2 and 4. **Not significant** Permanent loss of 200 m2 of neutral grassland within proposed NHA. **Moderate adverse effect**	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines.	Short-term increase in suspended sediment loading of River Liffey and mill race. **Minor adverse effect** Permanent increase in peak surface water run-off rates, but within bounds acceptable to competent authority. **Minor adverse**	No adverse effects on recreational usage of the valley or the River Liffey. Significant adverse effects on the amenity value of the river valley (refer to 'landscape and visual impact' column).	**Major adverse effect**, centred primarily on theLiffey Valley's status as nationally-important SAAO designated area.
Luttrellstown Road	Not applicable	HGV and plant access to construction area at Toll Plaza **Minor adverse effect**	**Minor adverse visual impact** for adjacent properties during construction phase.	Imperceptible (<3 dB (A) L_{10} (18 hour) increase in sound levels between baseline and design year, irrespective of whether scheme proceeds. **Neutral effect**	Not applicable	Not applicable	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines.	Not applicable	No effects on recreation resources; refer to landscape column in relation to amenity effects.	Short-term **minor adverse effects** related to the scheme's construction phase.
M50 Motorway Corridor	Promotes enhanced road capacity and safety on a strategic highway link, and alleviates a significant bottleneck. In conformance with national, DTI and local objectives. **Major beneficial effect**	HGV and plant access to construction area from southbound off ramp. **Minor adverse effect**	Not applicable	Not applicable to road users.	Not applicable	Not applicable	Predicted concentrations of road traffic-related pollutants below relevant EU standards and WHO guidelines. (Relevant to Toll Plaza employees)	Not applicable	Not applicable	**Major beneficial effect** in relation to alleviating a substantial future constraint on the M50 motorway corridor.
N4 Interchange	Not applicable	HGV and plant access to southern construction areas via Interchange **Minor adverse effect**	Not applicable	Not applicable to road users.	Not applicable	Not applicable	Not applicable ~ no occupiers or users of this location.	Not applicable	Not applicable	**Minor adverse effect**, short term, relating to construction vehicle movements.

Topic	Mitigation / Monitoring Requirement	Stage of Scheme			Duration
		PI	C	O	
Noise	The scheme promoter will give consideration, in advance of the Public Inquiry, to measures that will reduce road traffic noise levels at the affected property on Old Lucan Road below the 68 dB (A) L_{10} (18 hour) guideline value. This will entail a detailed acoustic appraisal, the aim of which shall be to design the most appropriate and cost-effective noise control solution.	✔	✔		Short-term
Archaeology	All works to be undertaken with due regard to National Monuments legislation. This is likely to entail: monitoring of top soil stripping and scrub clearance by a licensed archaeologist; and inspections of those parts of the River Liffey and mill race affected by temporary construction access.		✔		Intermittent involvement over the short-term.
Nature Conservation	At the end of the construction phase, all grassland, river bank, disturbed land and plantation woodland habitats which have been disturbed will be restored and stabilised. Species selected for planting to comprise native Irish stock only.		✔	✔	Short-term
Hydrology and Drainage	Regrading and widening the embankment at the southern abutment; construction of pier foundations south of mill race – construct a temporary earth lagoon to intercept suspended solids-contaminated surface run-off. Promote filtration of sediments using natural filters at outlet.		✔		Short-term
	Works to the north of the mill race will not require a settlement lagoon, however, the Contractor should submit procedures for limiting sub-soil erosion during periods of heavy rainfall.		✔		Short-term
	All oil, fuel and bulk storage tanks, including solids and liquids, will be located within a secure bunded facility. The filling and emptying points will be located within the bund itself.		✔		Short-term
	Desludge and degrit stormwater run-off interceptors at regular intervals; ensure that outlet isolation valves are functional at regular intervals.			✔	Medium- to long-term

N.B. PI - pre-public inquiry; C - construction phase; O - operation phase
Duration - refer to Section 2.4 for definition of terms.

FIGURES

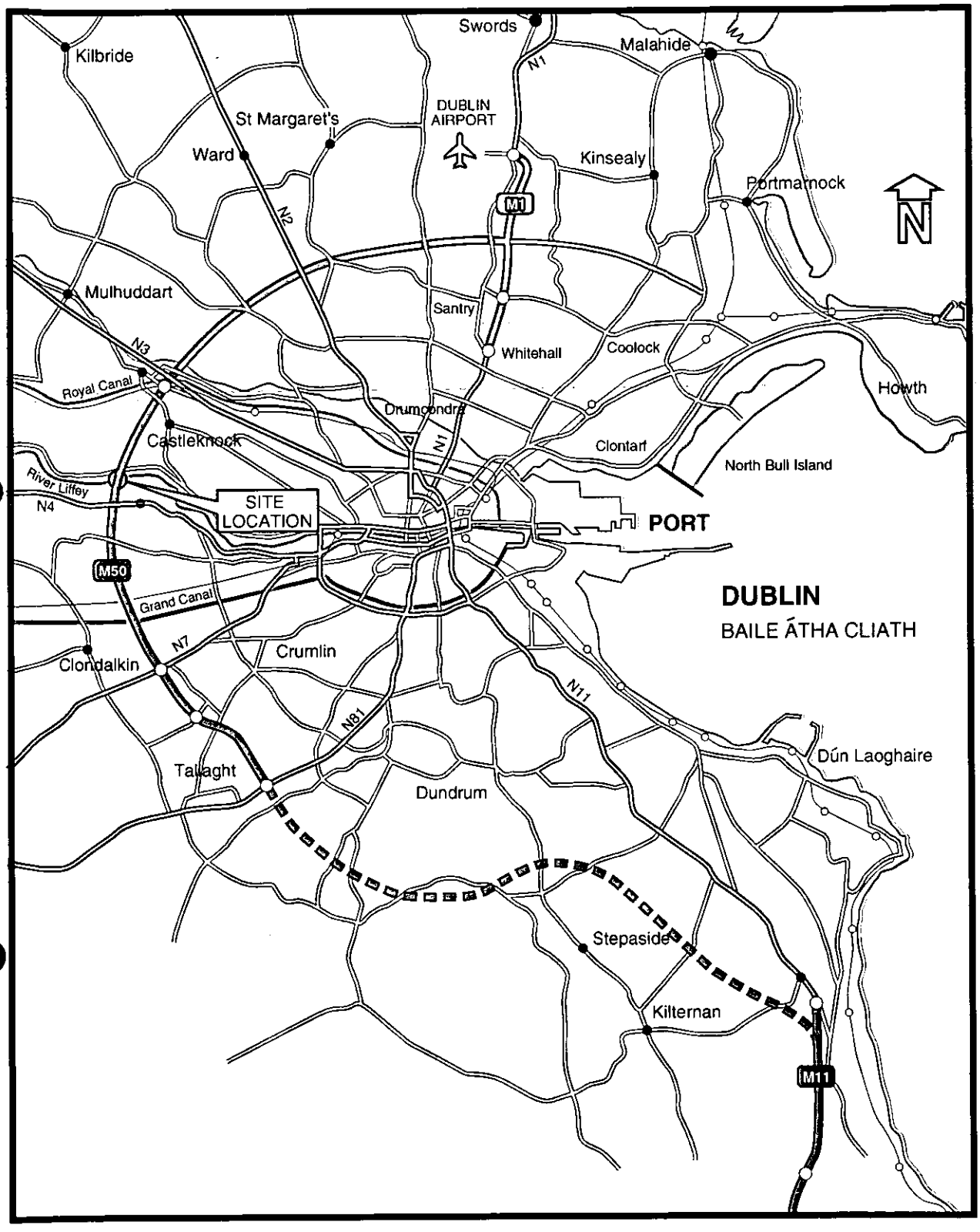


FIGURE 1.1: SITE LOCATION

ARUP

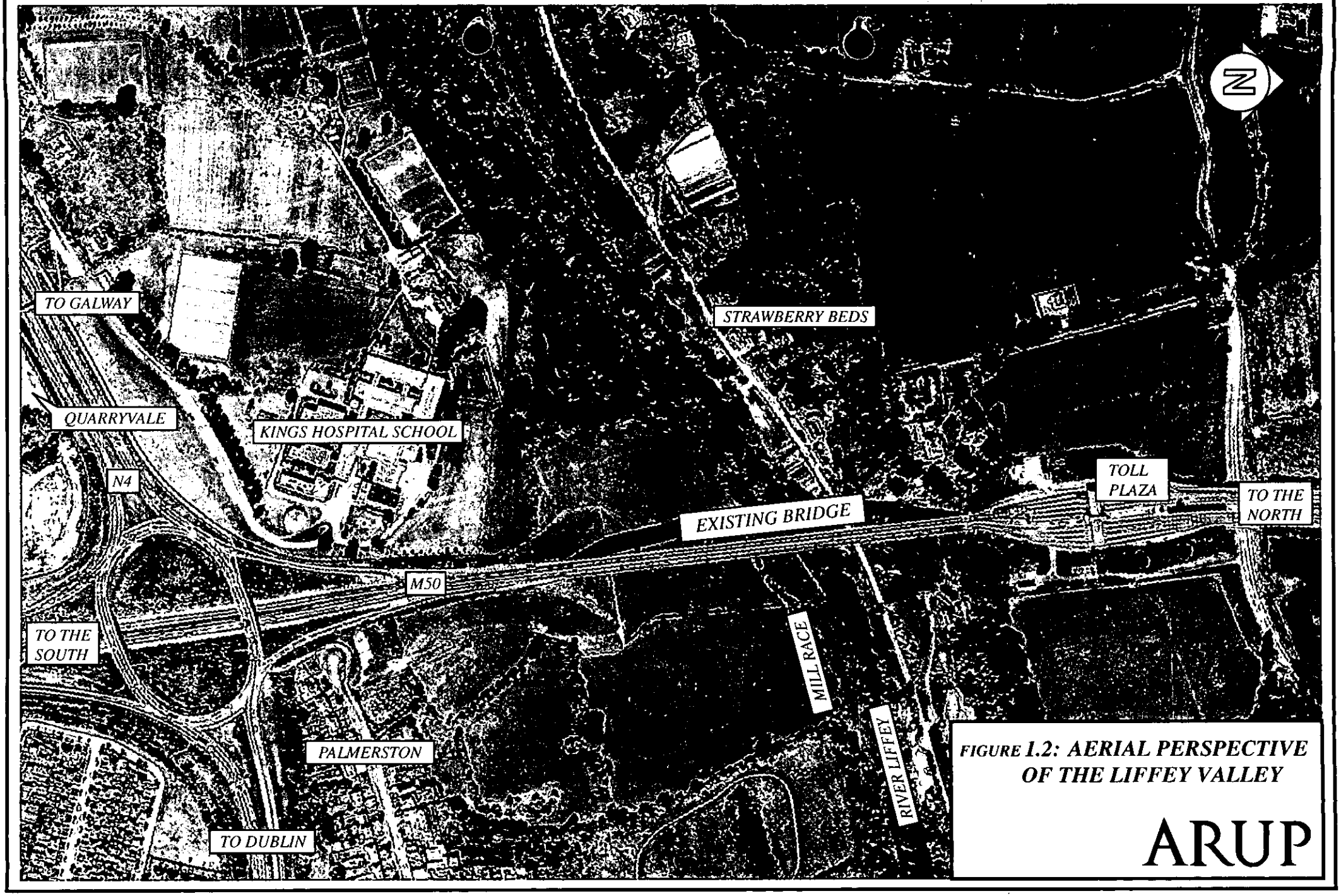


FIGURE 1.2: AERIAL PERSPECTIVE OF THE LIFFEY VALLEY

ARUP

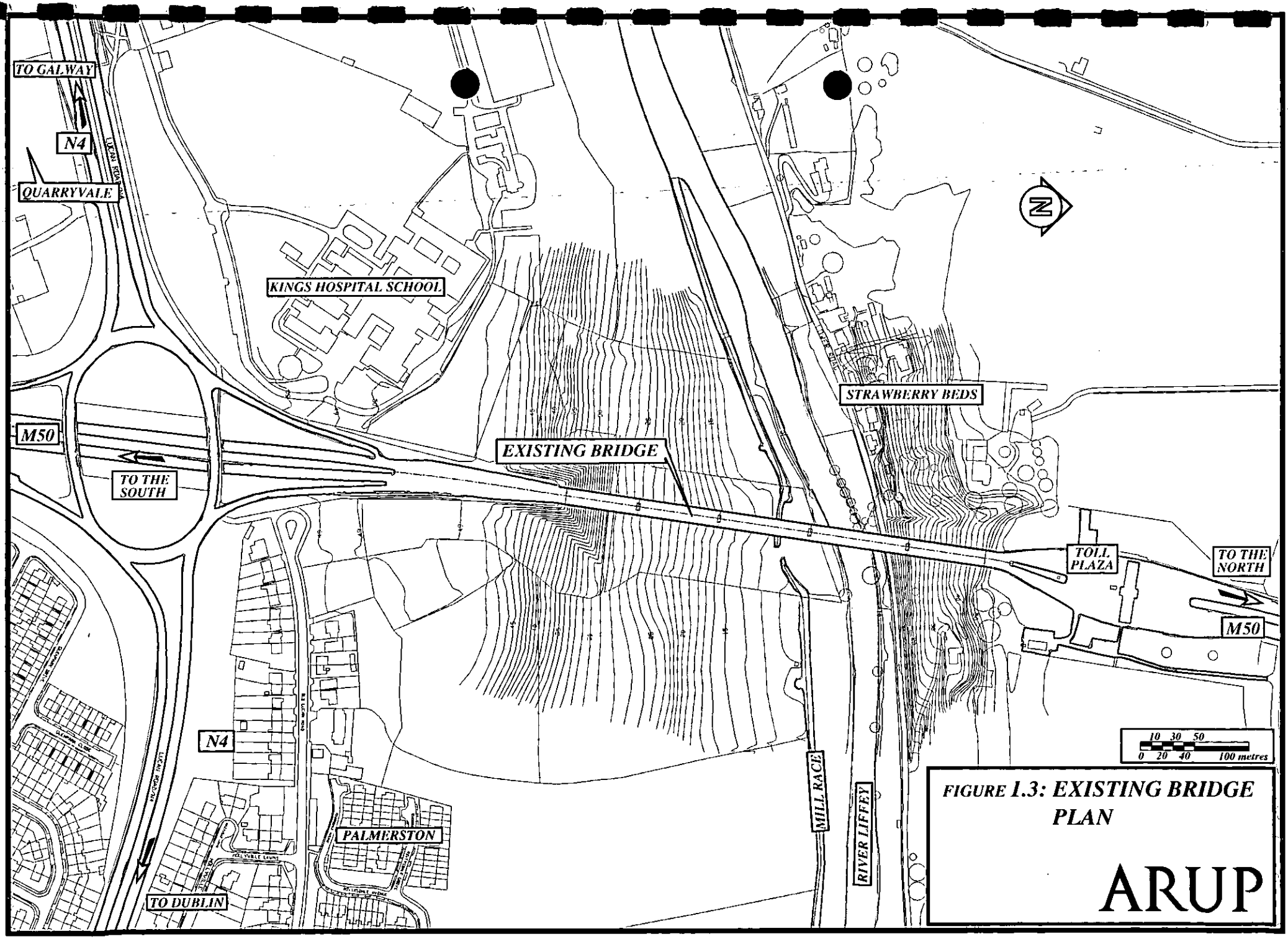


FIGURE 1.3: EXISTING BRIDGE PLAN

ARUP

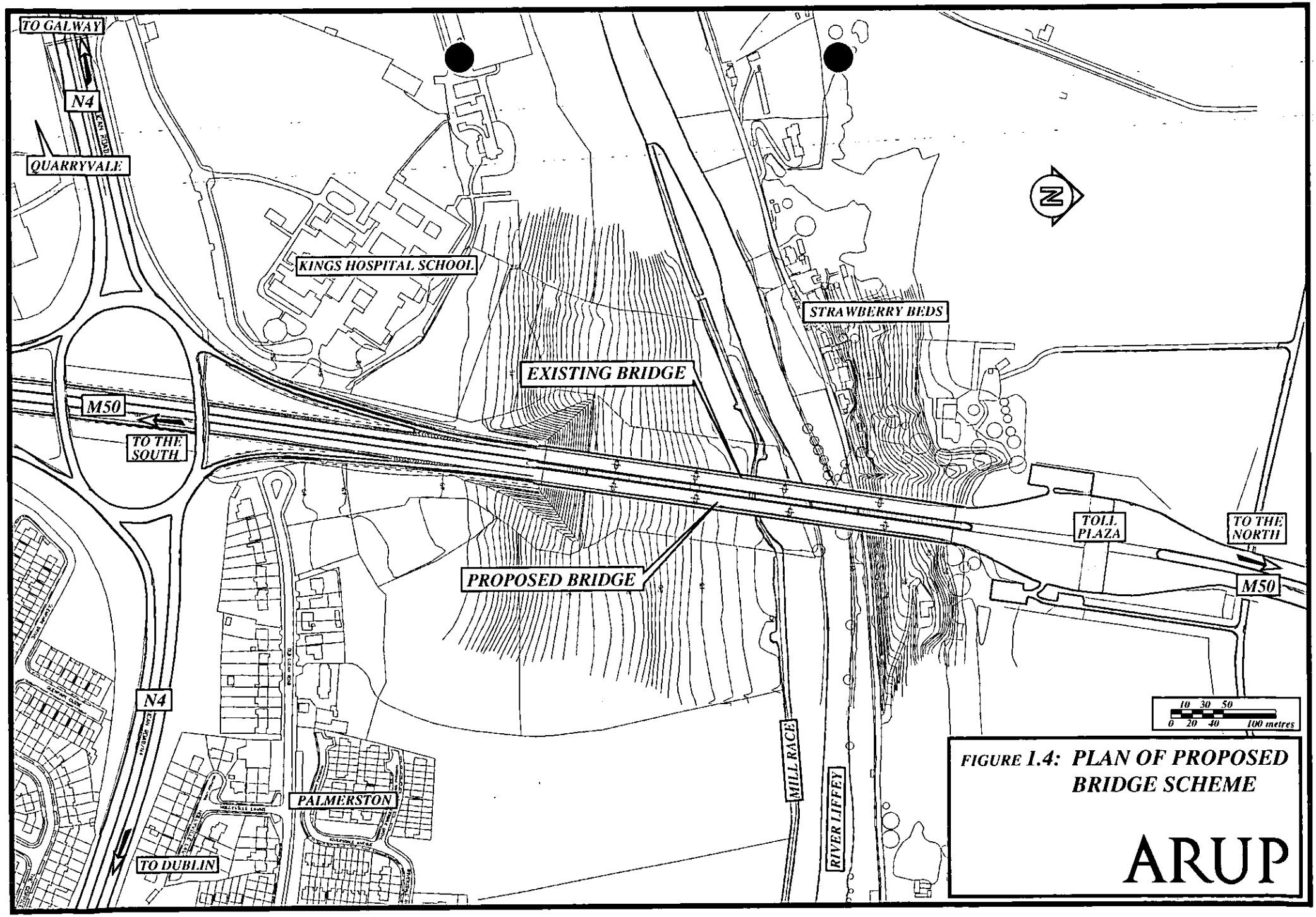


FIGURE 1.4: PLAN OF PROPOSED BRIDGE SCHEME

ARUP

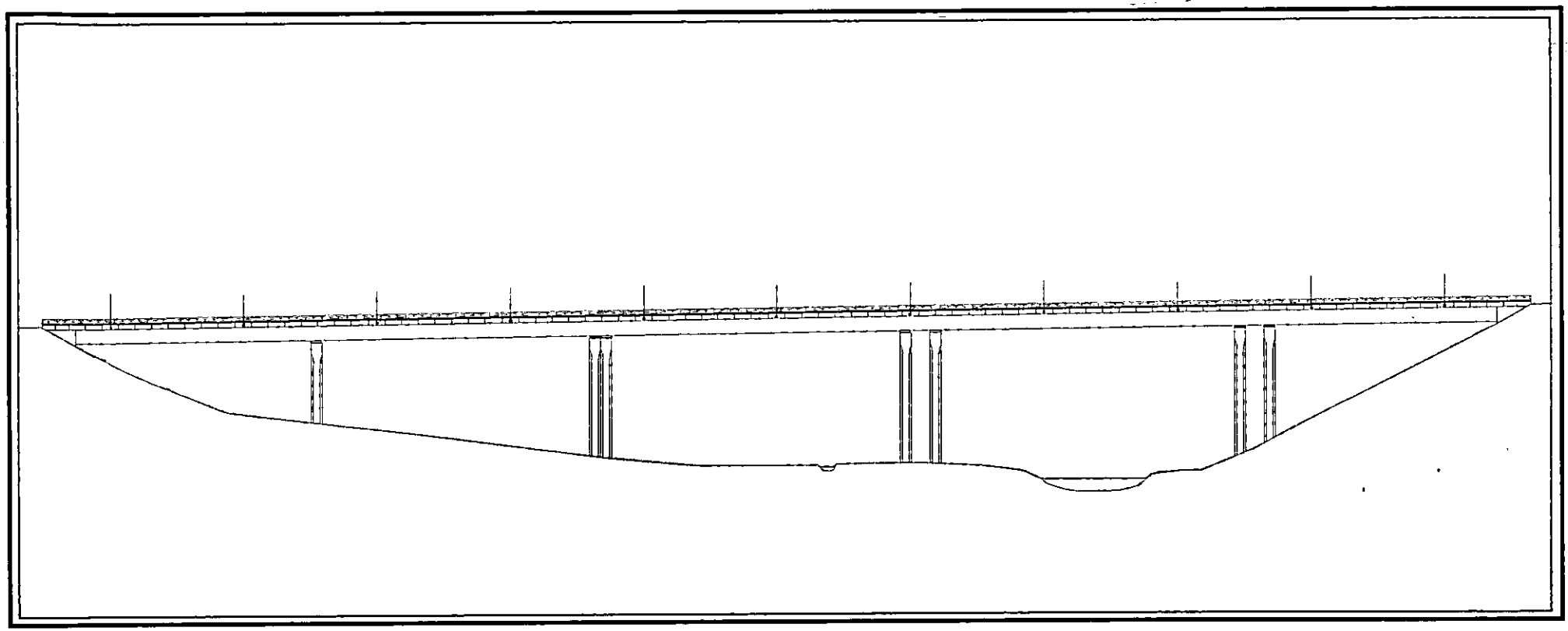


FIGURE 1.5: PROPOSED SCHEME ELEVATION

ARUP

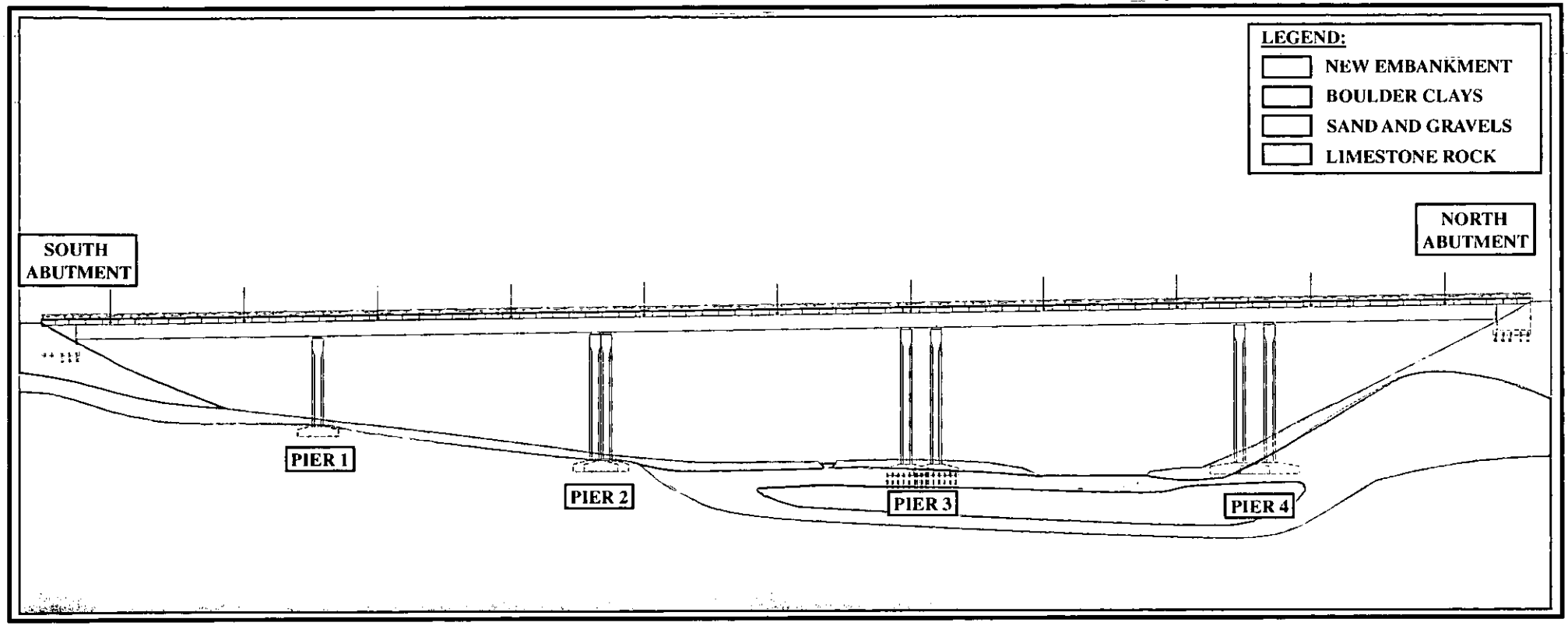


FIGURE 3.1: GEOLOGICAL CROSS-SECTION

ARUP

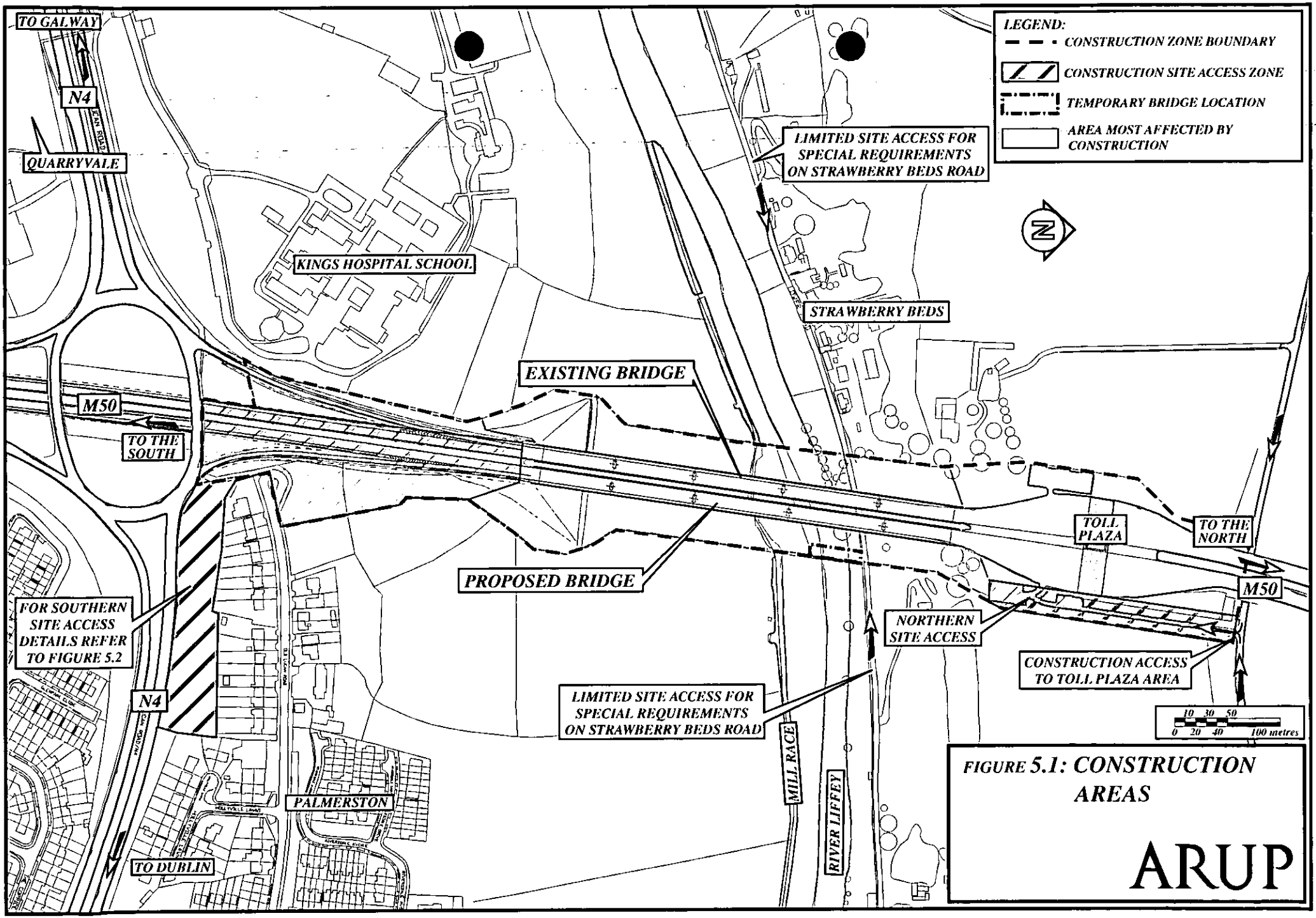


FIGURE 5.1: CONSTRUCTION AREAS

ARUP

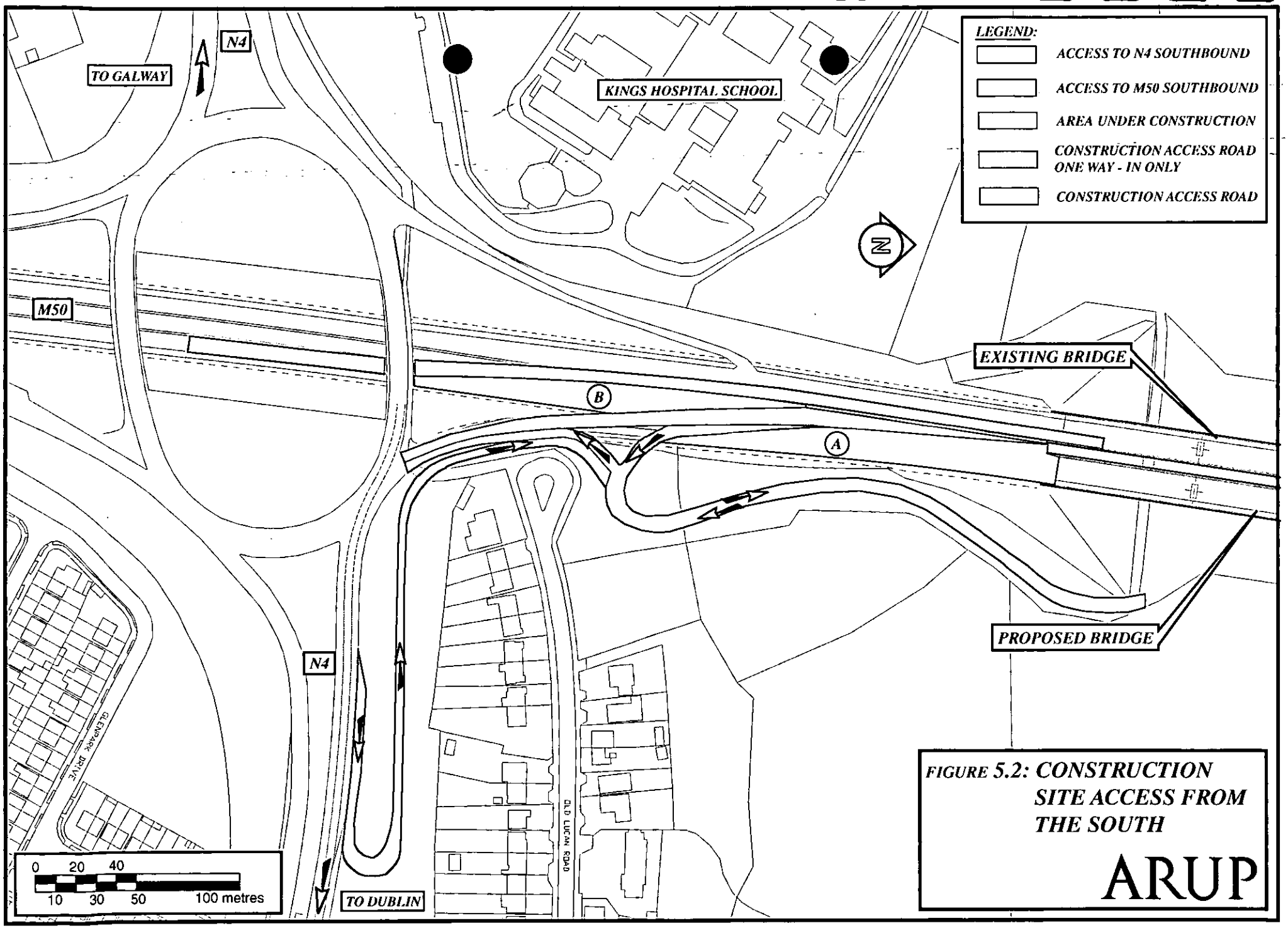


FIGURE 5.2: CONSTRUCTION SITE ACCESS FROM THE SOUTH

ARUP

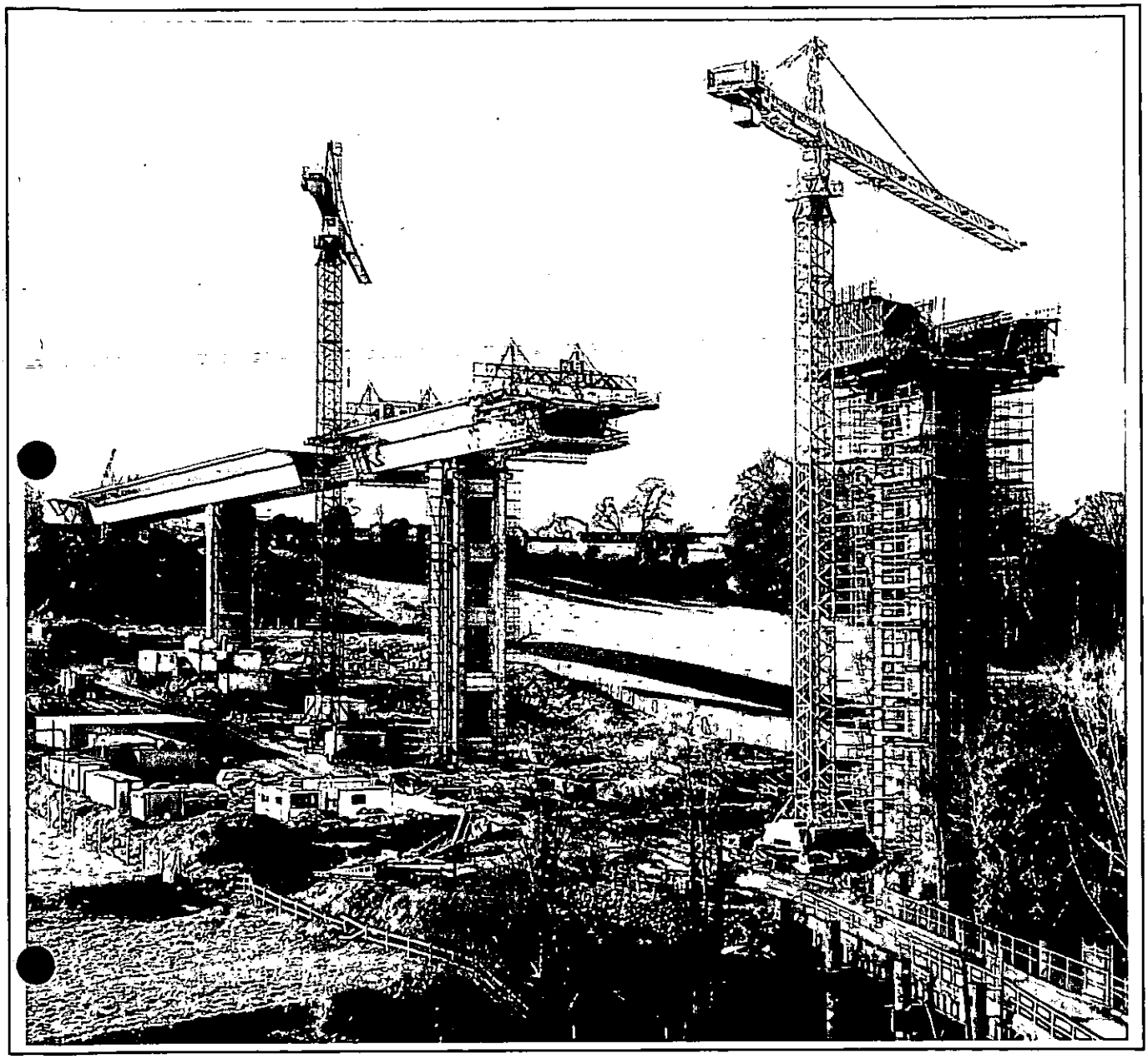


FIGURE 5.3: EXISTING BRIDGE UNDER CONSTRUCTION

ARUP

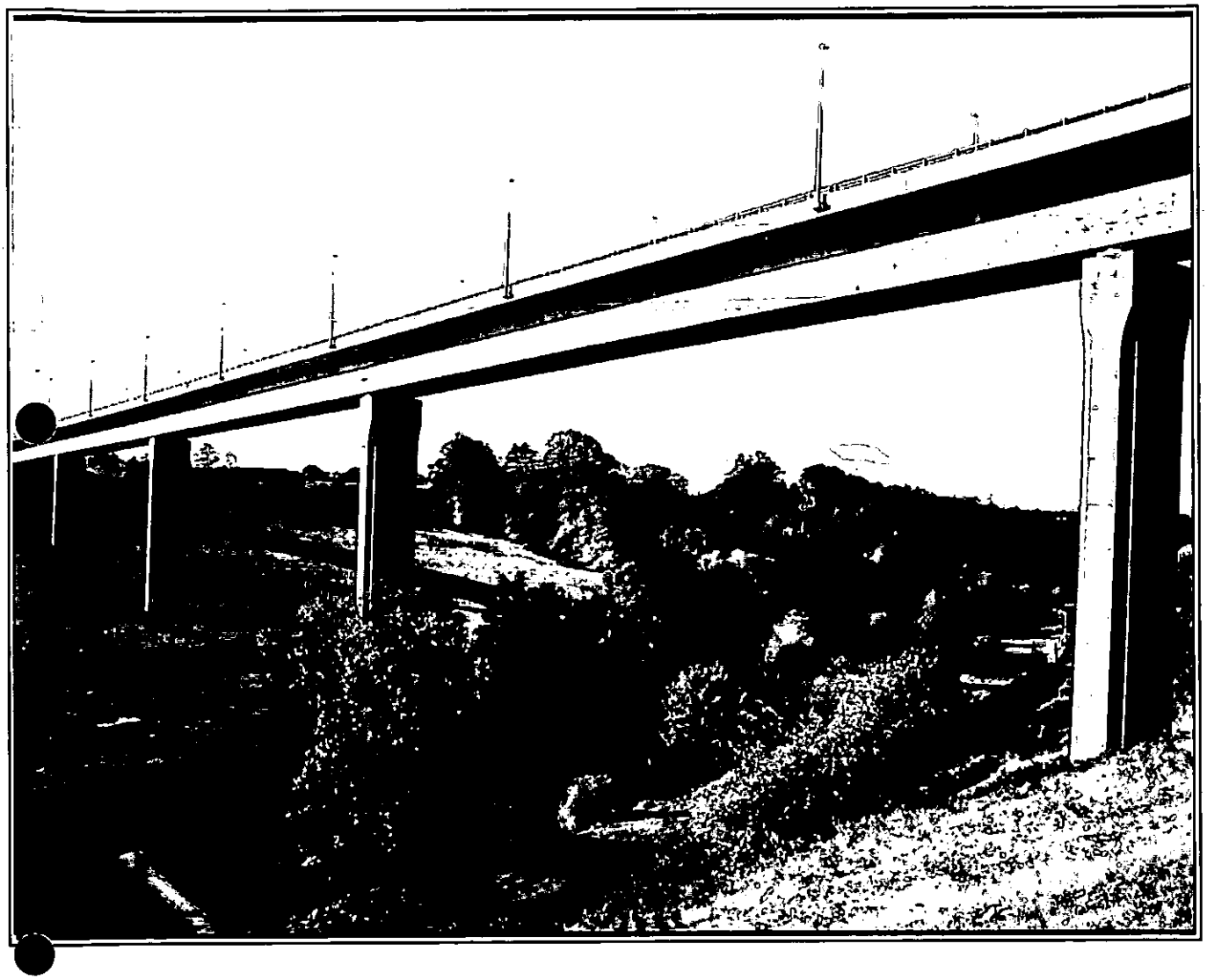


FIGURE 5.4: EXISTING BRIDGE CONSTRUCTED

ARUP

ID	TASK NAME
1	MOBILISE / ERECT OFFICES
2	SITE CLEARANCE
3	ERECT TEMPORARY BRIDGE
4	PROVIDE ACCESS TO THE VALLEY AREA
5	EXCAVATE FOR PIER 1
6	DRIVE PILES SOUTH ABUTMENT
7	EXCAVATE FOR PIER 2
8	CONSTRUCT SOUTH ABUTMENT BASE
9	CONSTRUCT SOUTH ABUTMENT WALLS AND PLINTH
10	CONSTRUCT PIER 1 BASE
11	CONSTRUCT PIER 1 COLUMN
12	CONSTRUCT PIER 2 BASE
13	CONSTRUCT PIER 2 COLUMN
14	TEMPORARY PIERS
15	COLUMN HEAD SEGMENT PIER 1
16	CANTILEVERS SPAN 1 & 2
17	STITCH SPAN 1
18	END SPAN 1
19	COLUMN HEAD SEGMENT PIER 2
20	CANTILEVERS SPAN 2 & 3
21	STITCH SPAN 2
22	BASE PILING PIER 3
23	CONSTRUCT PIER 3 BASE
24	CONSTRUCT PIER 3 COLUMN
25	COLUMN HEAD SEGMENT PIER 3
26	NORTH ABUTMENT BASE PILING
27	CONCRETE PIER 4 BASE
28	CONSTRUCT NORTH ABUTMENT BASE
29	CONSTRUCT PIER 4 COLUMN
30	CONSTRUCT NORTH ABUTMENT WALLS AND PLINTH
31	COLUMN HEAD SEGMENT PIER 4
32	CANTILEVERS SPAN 4 & 5
33	END SEGMENT SPAN 5
34	STITCH SPAN 5
35	CANTILEVERS SPAN 3 & 4
36	STITCH SPAN 3
37	STITCH SPAN 4
38	PARAPETS
39	DRAINAGE
40	FOOTPATHS
41	FINISHES
42	ROAD MARKINGS
43	LIGHTING
44	WIND BARRIER

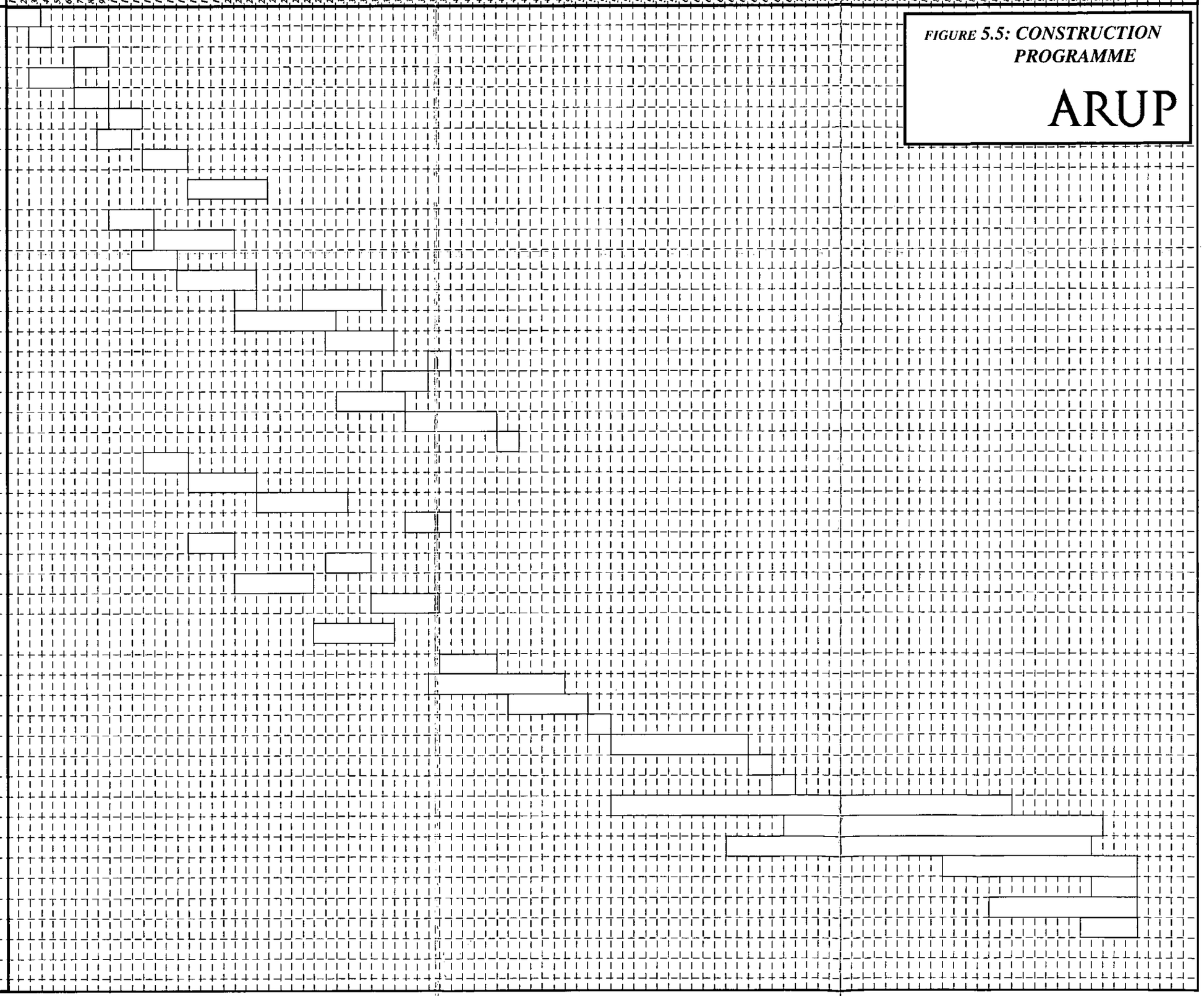


FIGURE 5.5: CONSTRUCTION PROGRAMME

ARUP

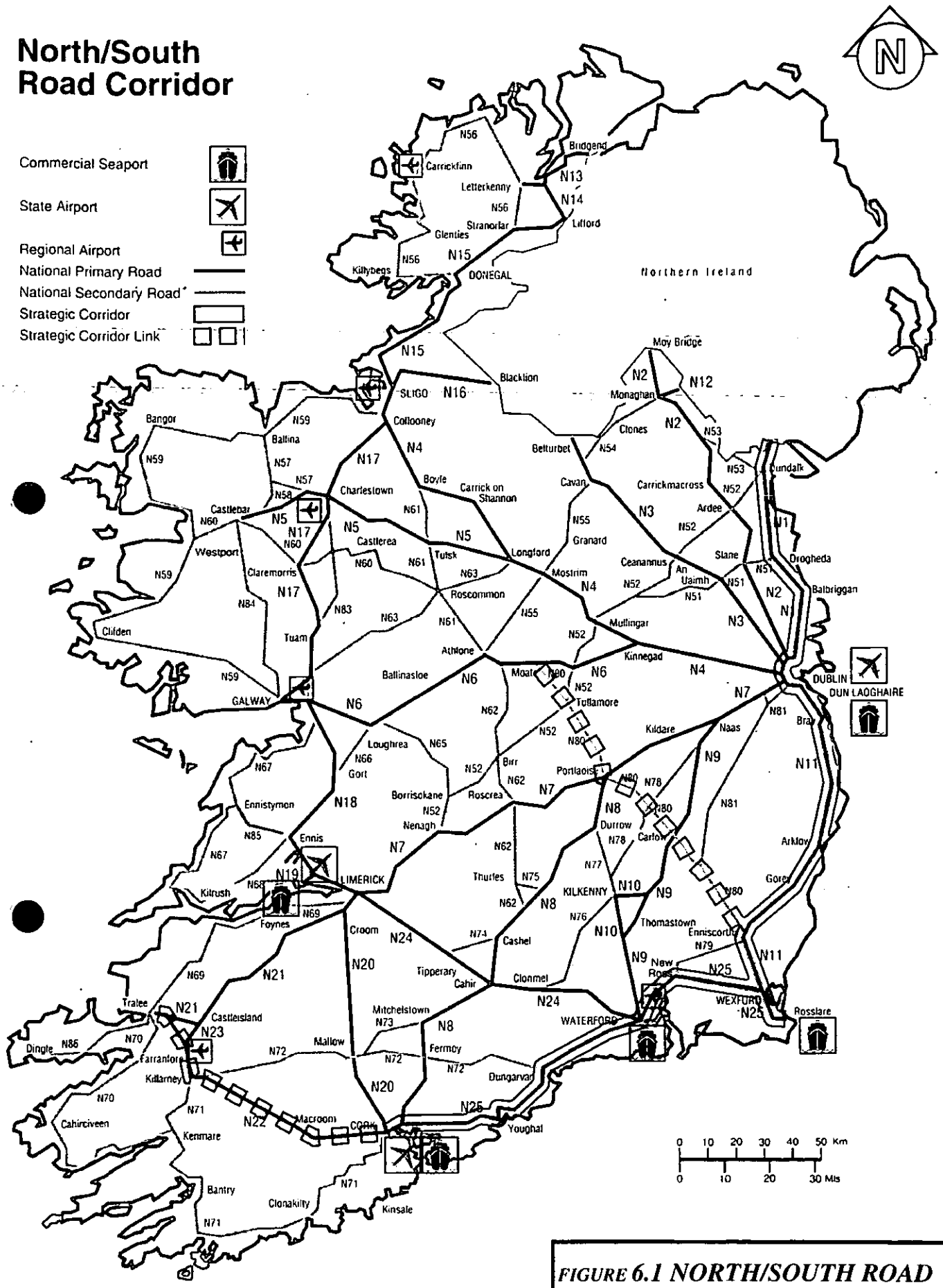


FIGURE 6.1 NORTH/SOUTH ROAD CORRIDOR

ARUP

MAP TAKEN FROM IRELAND NATIONAL DEVELOPMENT PLAN 1994-1999

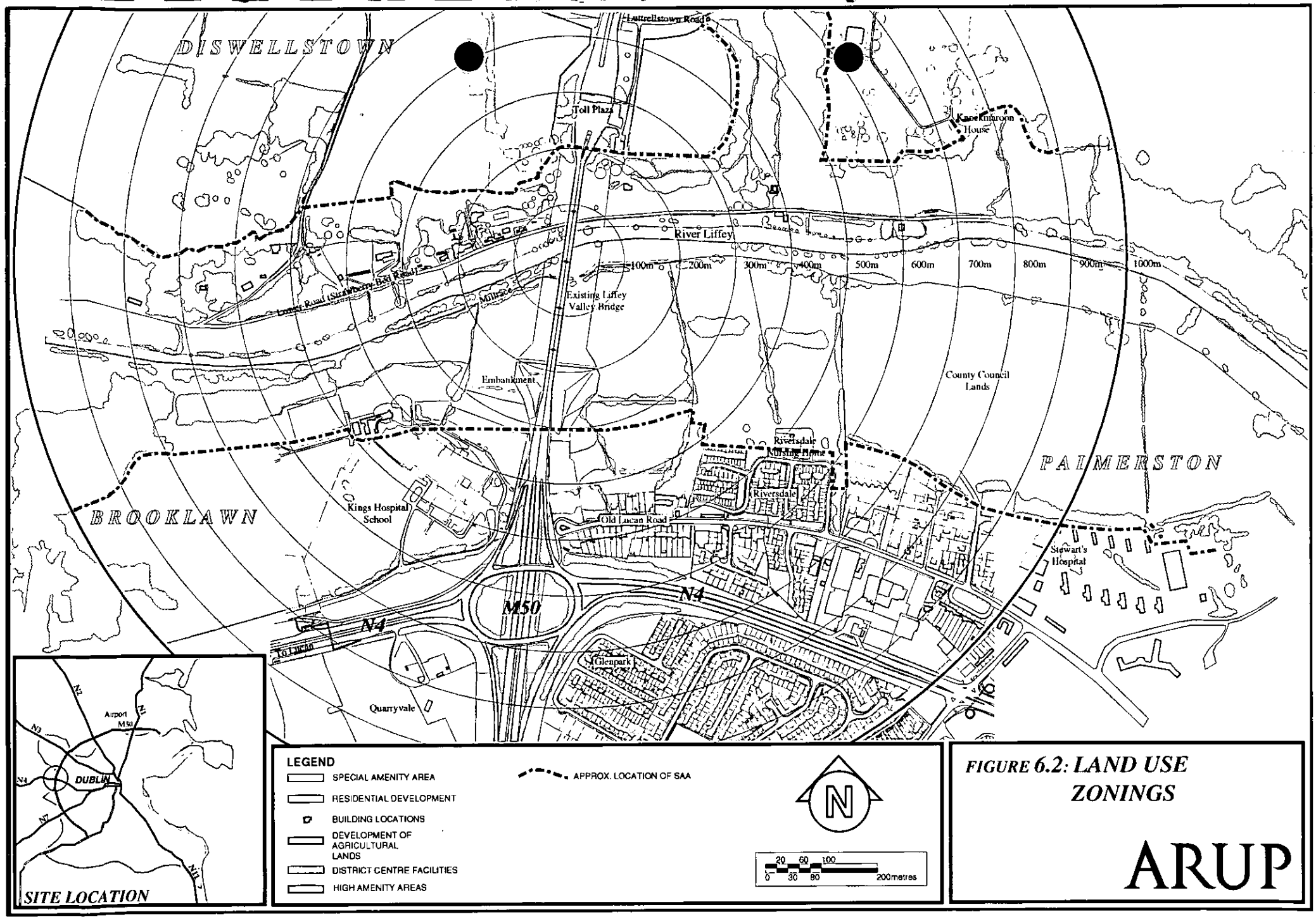


FIGURE 6.2: LAND USE ZONINGS

ARUP

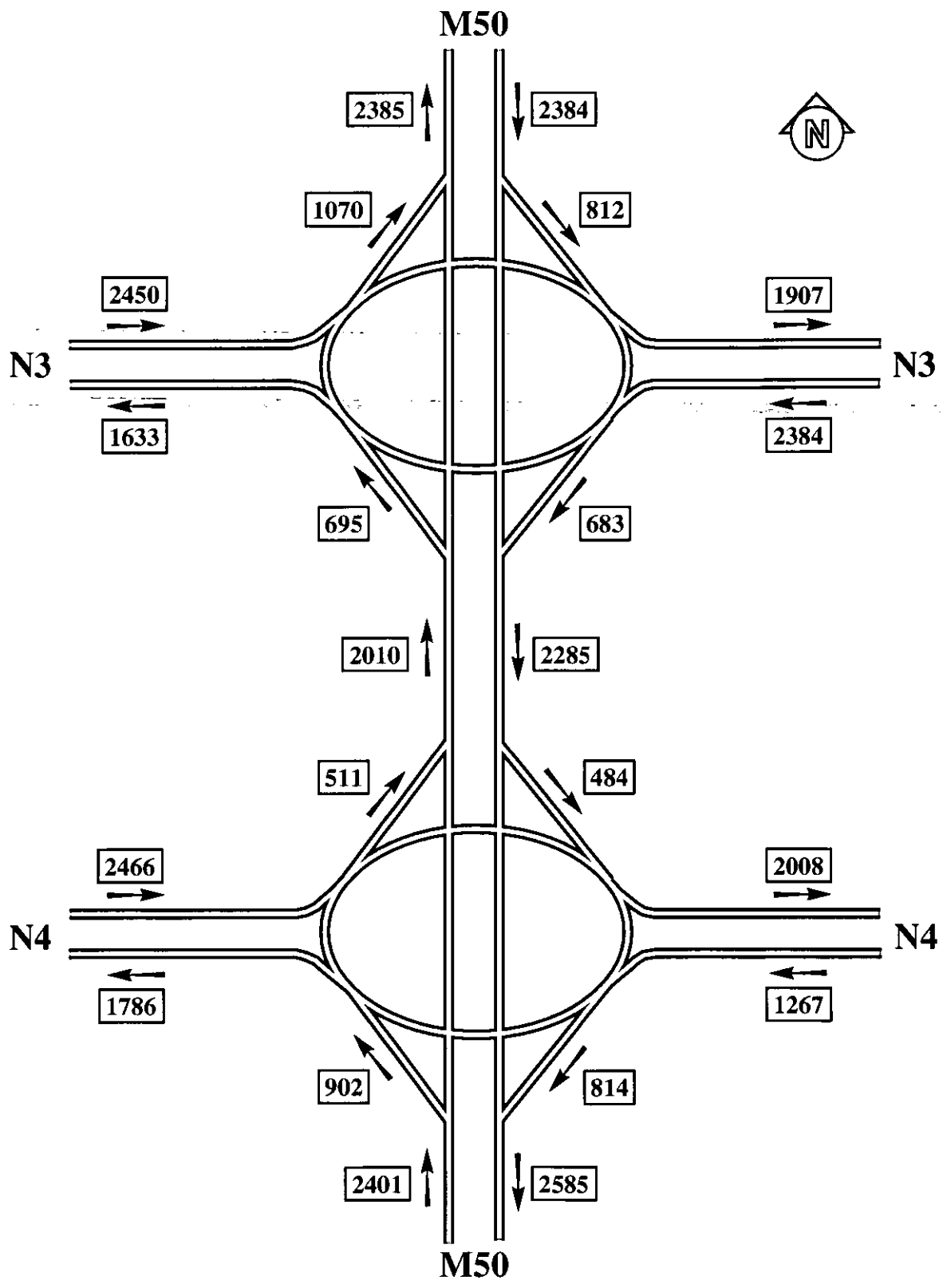


FIGURE 7.1: 1997 AM PEAK HOUR FLOWS

ARUP

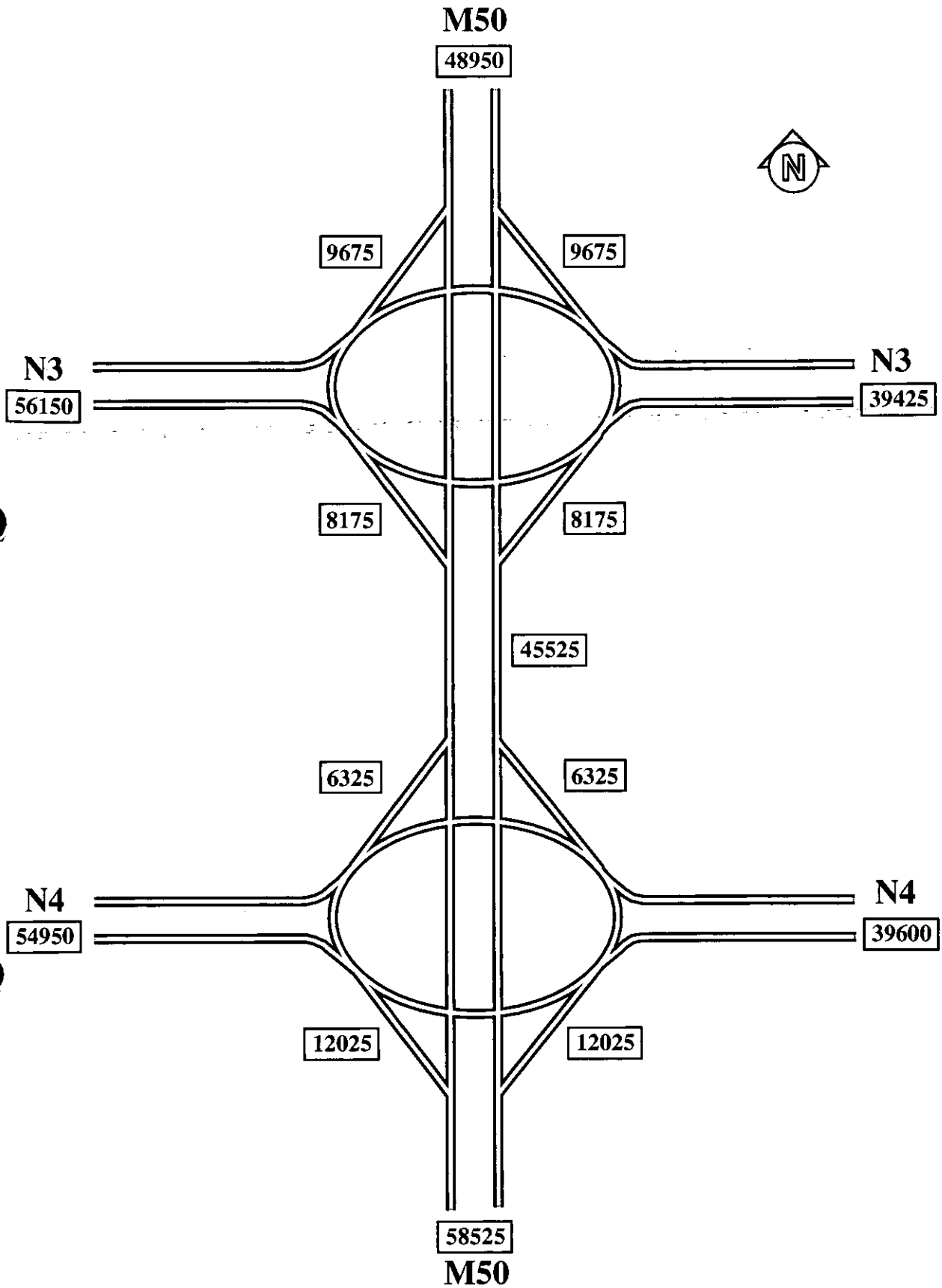
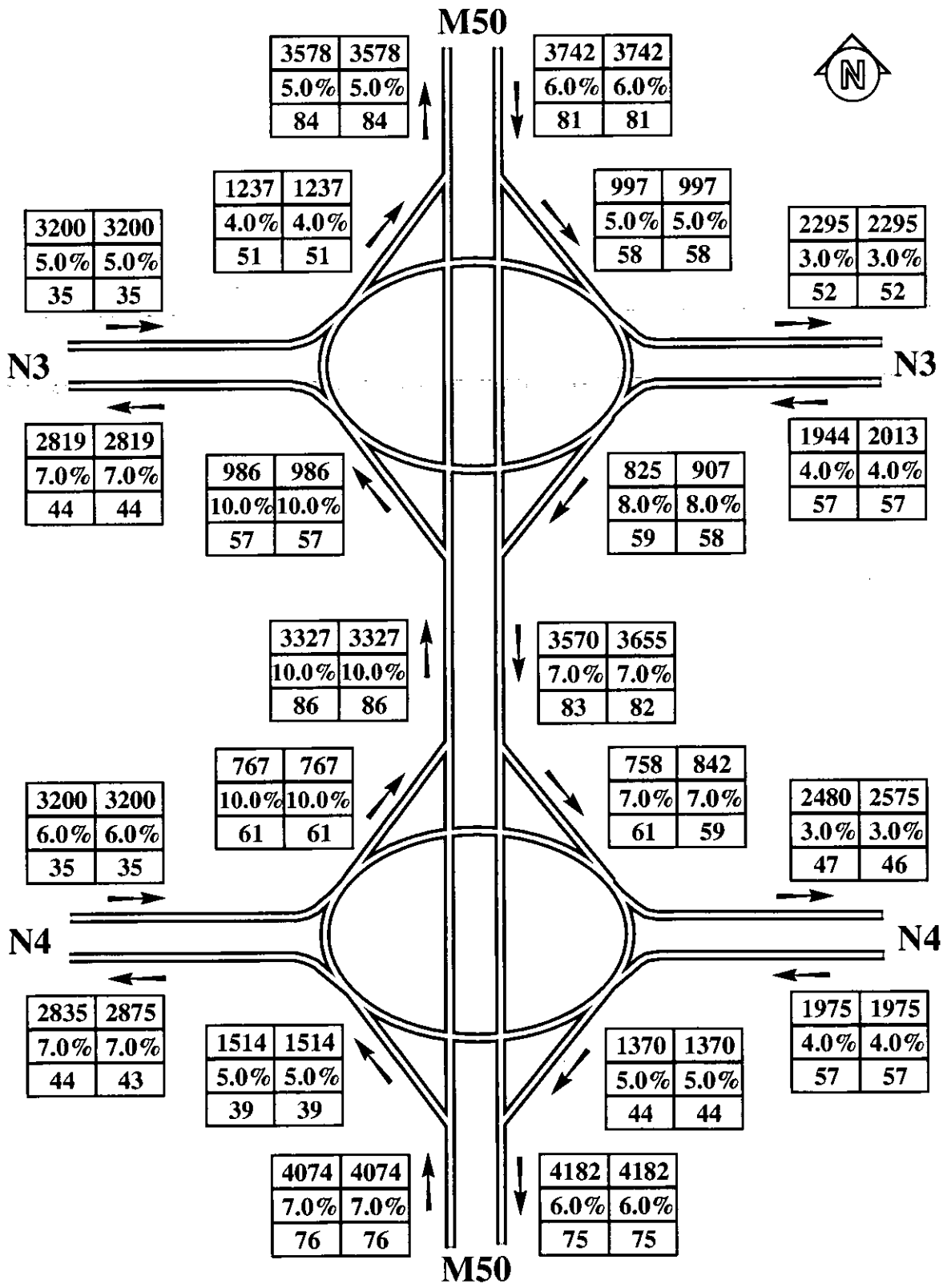


FIGURE 7.2:1997 ANNUAL AVERAGE DAILY TRAFFIC (AADT) FLOWS

ARUP

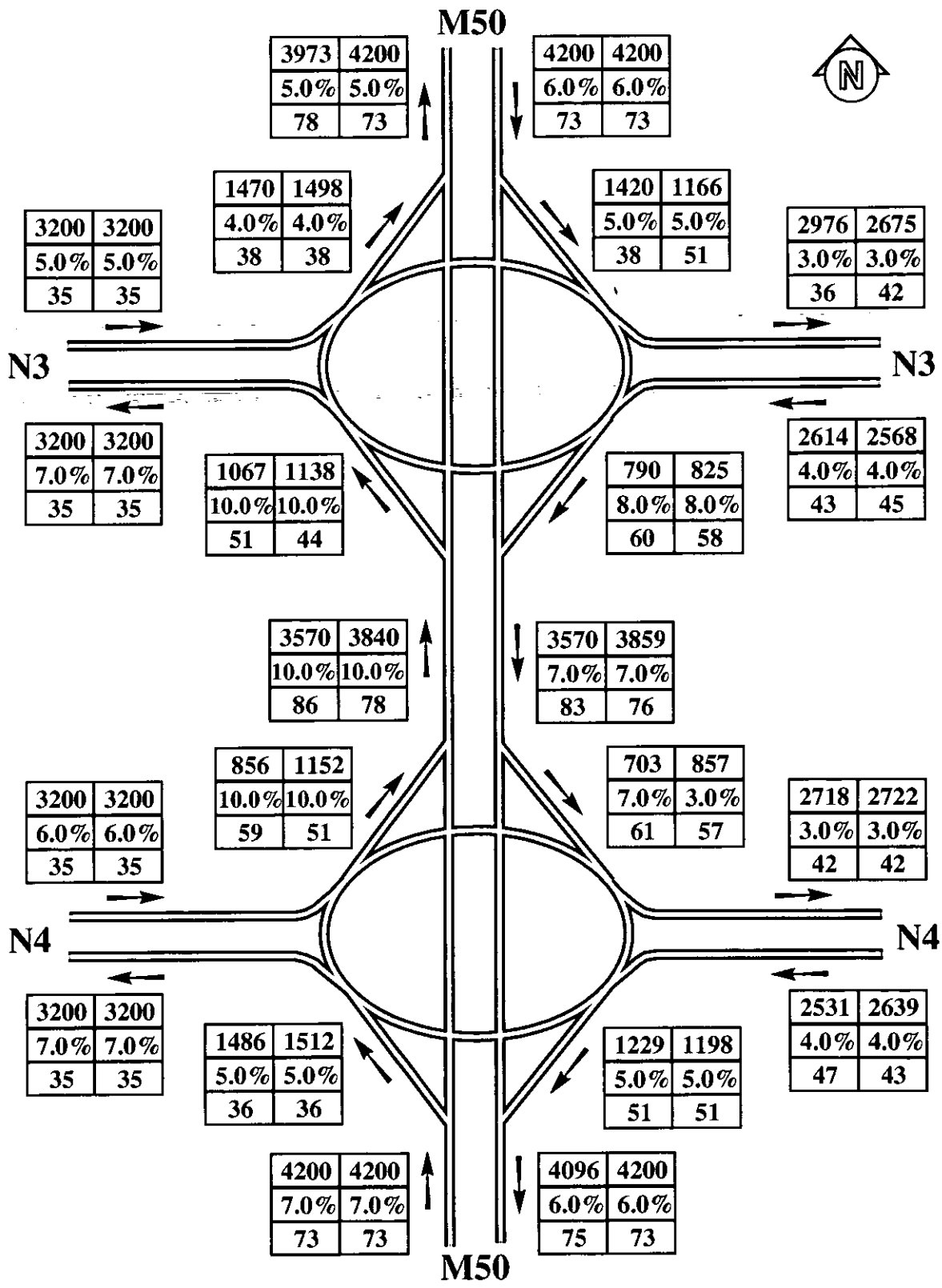


LEGEND:

DO MIN	DO SOME
FLOW (VEHS)	FLOW (VEHS)
%HGV	%HGV
SPEED (KPH)	SPEED (KPH)

FIGURE 7.3: 2001 PREDICTED TRAFFIC FLOWS AM PEAK HOUR

ARUP

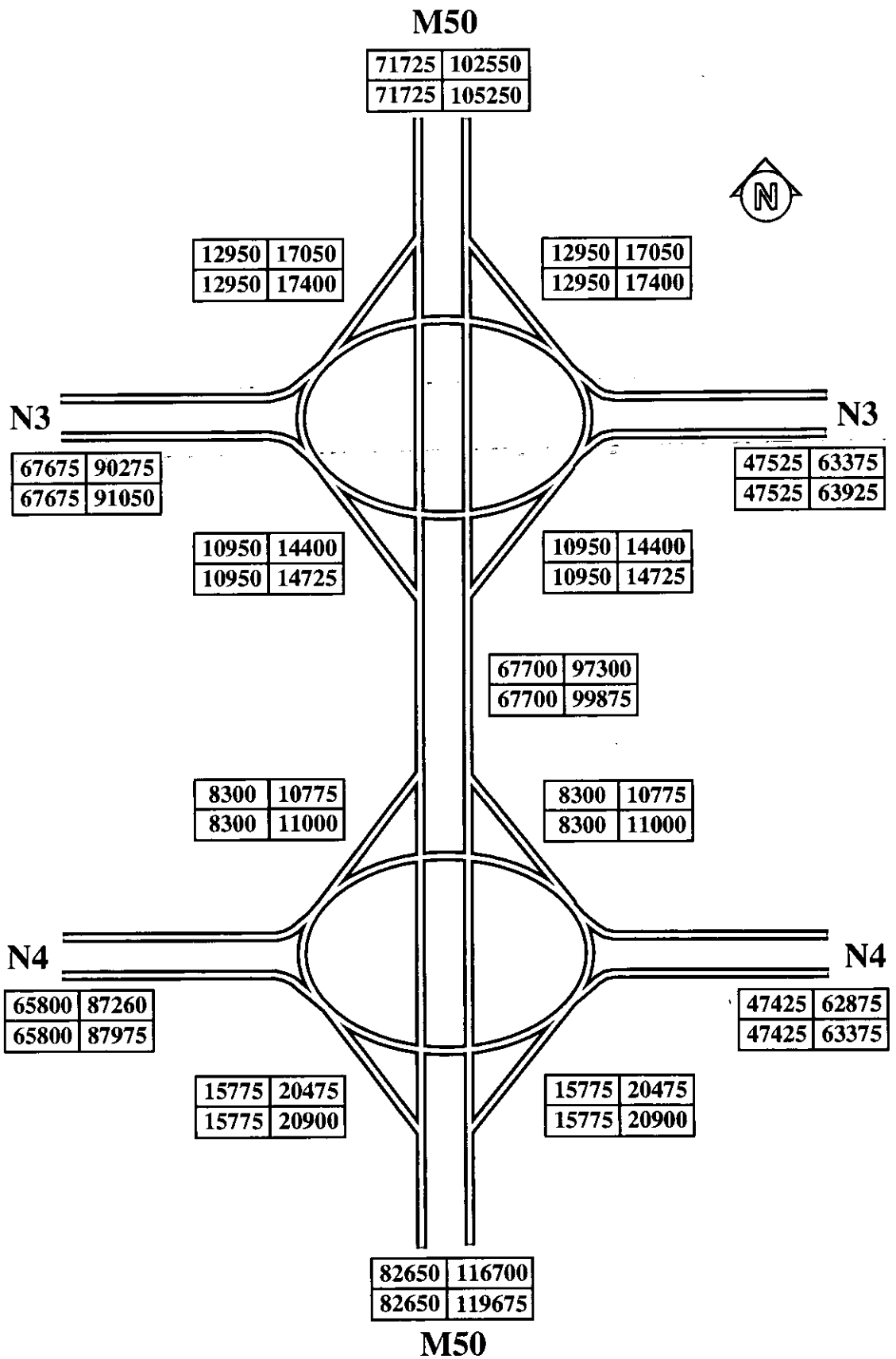


LEGEND:

DO MIN	DO SOME
FLOW (VEHS)	FLOW (VEHS)
%HGV	%HGV
SPEED (KPH)	SPEED (KPH)

FIGURE 7.4: 2016 PREDICTED TRAFFIC FLOWS AM PEAK HOUR

ARUP

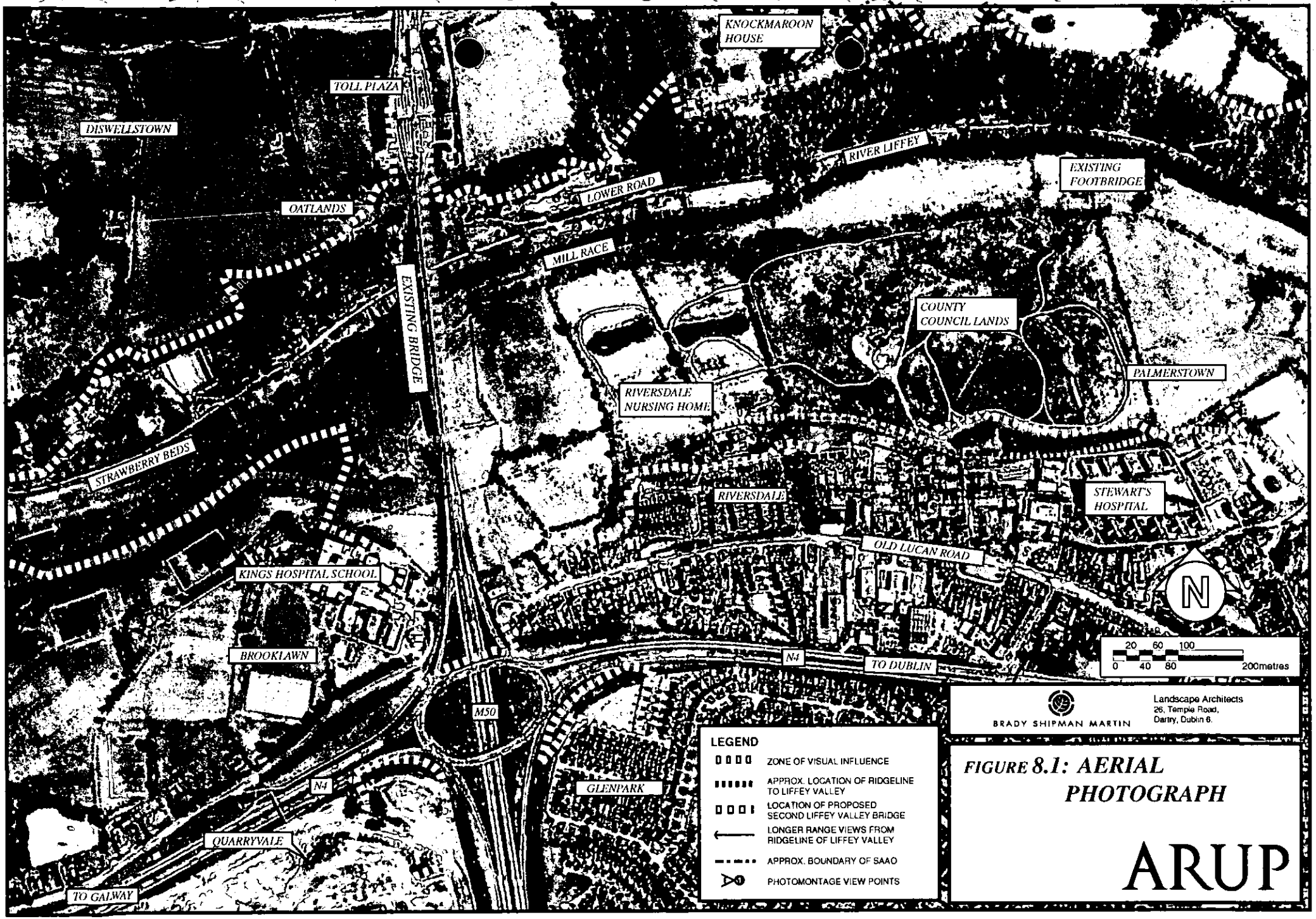


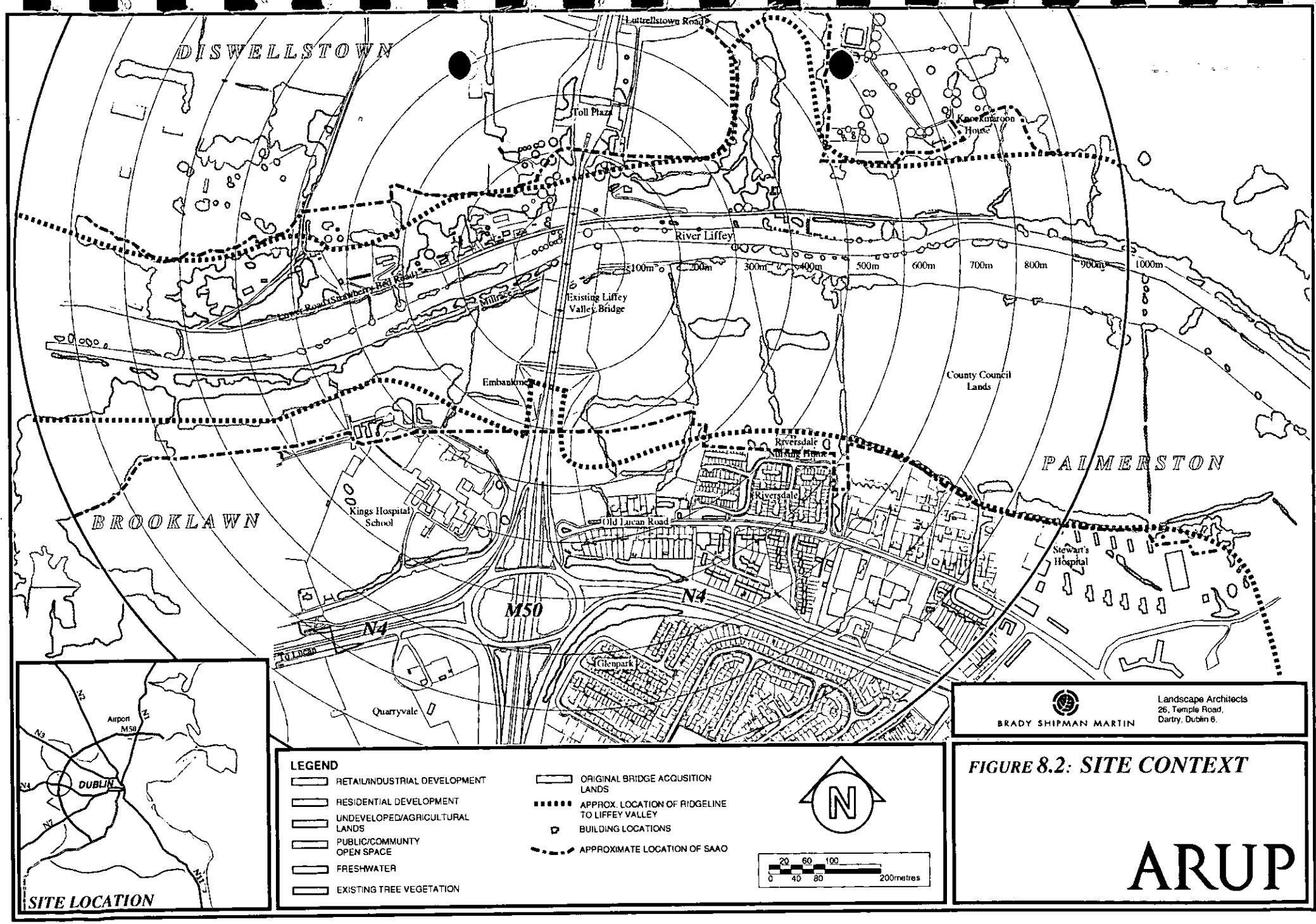
LEGEND:

2001 'DO MINIMUM'	2016 'DO MINIMUM'
2001 'DO SOMETHING'	2016 'DO SOMETHING'

FIGURE 7.5: PREDICTED ANNUAL AVERAGE DAILY TRAFFIC (AADT) FLOWS

ARUP


KNOCKMAROON HOUSE
TOLL PLAZA
DISWELLSTOWN
RIVER LIFFEY
EXISTING FOOTBRIDGE
LOWER ROAD
OATLANDS
MILL RACE
EXISTING BRIDGE
COUNTY COUNCIL LANDS
PALMERSTOWN
RIVERSDALE NURSING HOME
STRAWBERRY BEDS
RIVERSDALE
STEWART'S HOSPITAL
OLD LUCAN ROAD
KINGS HOSPITAL SCHOOL
N
BROOKLAWN
N4
TO DUBLIN
M50
GLENPARK
N4
QUARRYVALE
TO GALWAY
20 60 100
0 40 80 200metres
LEGEND
ZONE OF VISUAL INFLUENCE
APPROX. LOCATION OF RIDGELINE TO LIFFEY VALLEY
LOCATION OF PROPOSED SECOND LIFFEY VALLEY BRIDGE
LONGER RANGE VIEWS FROM RIDGELINE OF LIFFEY VALLEY
APPROX. BOUNDARY OF SAAO
PHOTOMONTAGE VIEW POINTS
BRADY SHIPMAN MARTIN
Landscape Architects
26, Temple Road,
Dartry, Dublin 6.
FIGURE 8.1: AERIAL PHOTOGRAPH
ARUP


DISWELLSTOWN
BROOKLAWN
PALMERSTON
Lutrellstown Road
Toll Plaza
Kave Rmaroon House
River Liffey
100m
200m
300m
400m
500m
600m
700m
800m
900m
1000m
Strawberry Beg
Millrace
Existing Liffey Valley Bridge
Embankment
County Council Lands
Riversdale Nursing Home
Riversdale
Kings Hospital School
Old Lucan Road
Stewart's Hospital
M50
N4
N4
To Lucan
Glenpark
Quarryvale
Airport
M50
DUBLIN
N2
N3
N4
N7
N11
SITE LOCATION
LEGEND
RETAIL/INDUSTRIAL DEVELOPMENT
RESIDENTIAL DEVELOPMENT
UNDEVELOPED/AGRICULTURAL LANDS
PUBLIC/COMMUNITY OPEN SPACE
FRESHWATER
EXISTING TREE VEGETATION
ORIGINAL BRIDGE ACQUISITION LANDS
APPROX. LOCATION OF RIDGELINE TO LIFFEY VALLEY
BUILDING LOCATIONS
APPROXIMATE LOCATION OF SAAO
N
0 20 40 60 80 100 200metres
BRADY SHIPMAN MARTIN
Landscape Architects
26, Temple Road,
Dartry, Dublin 6.
FIGURE 8.2: SITE CONTEXT
ARUP

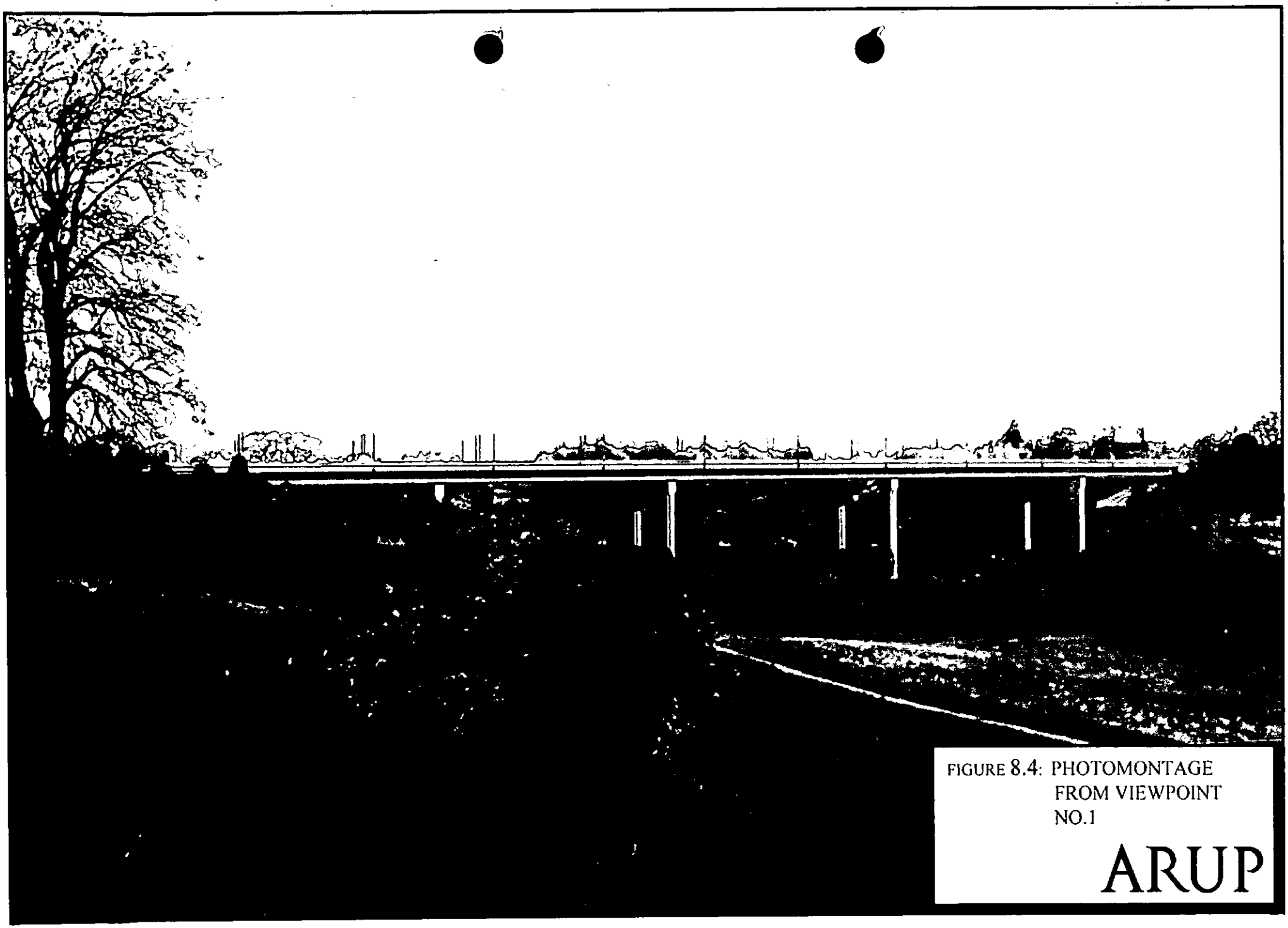


FIGURE 8.4: PHOTOMONTAGE FROM VIEWPOINT NO.1

ARUP

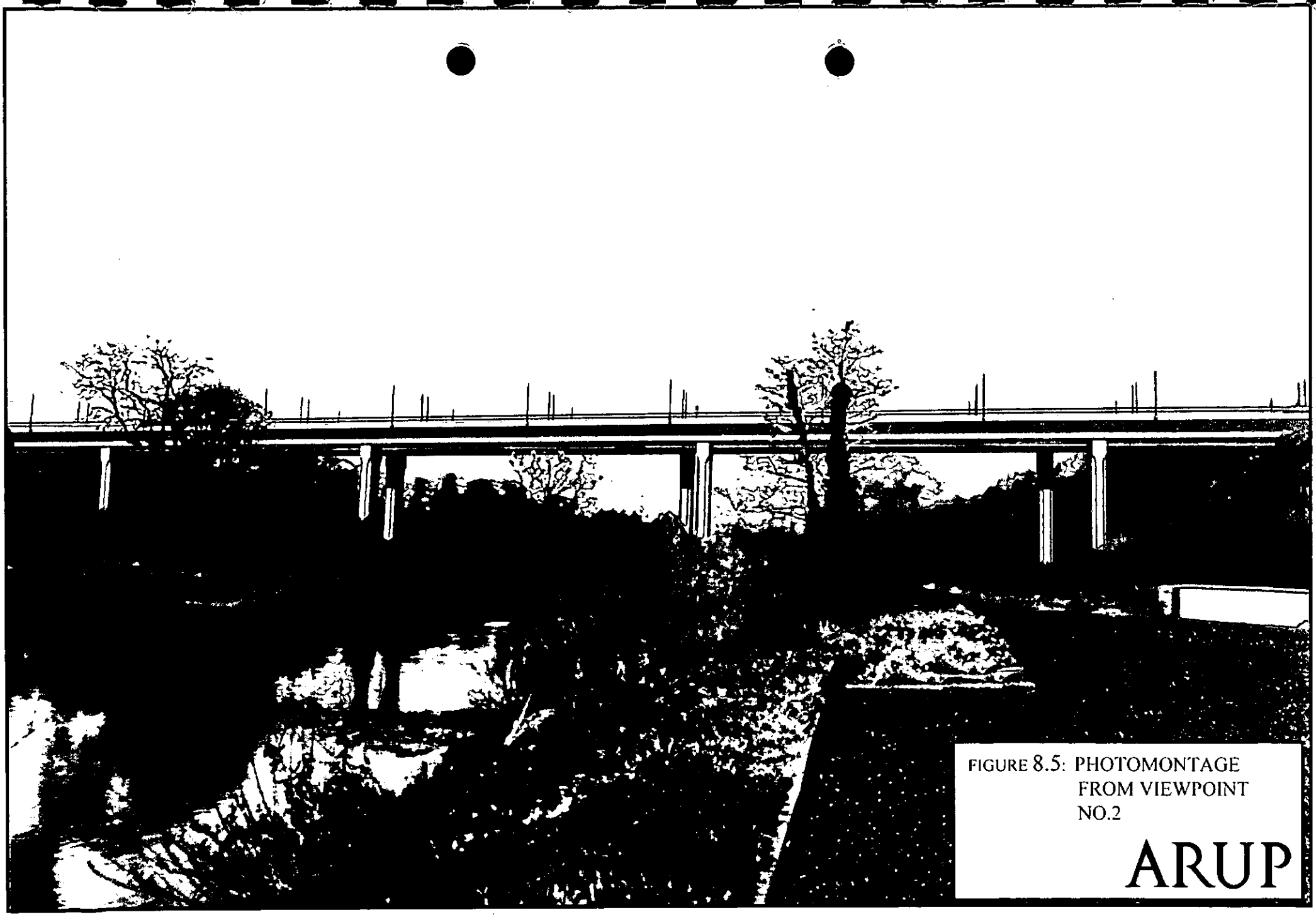


FIGURE 8.5: PHOTOMONTAGE FROM VIEWPOINT NO.2

ARUP

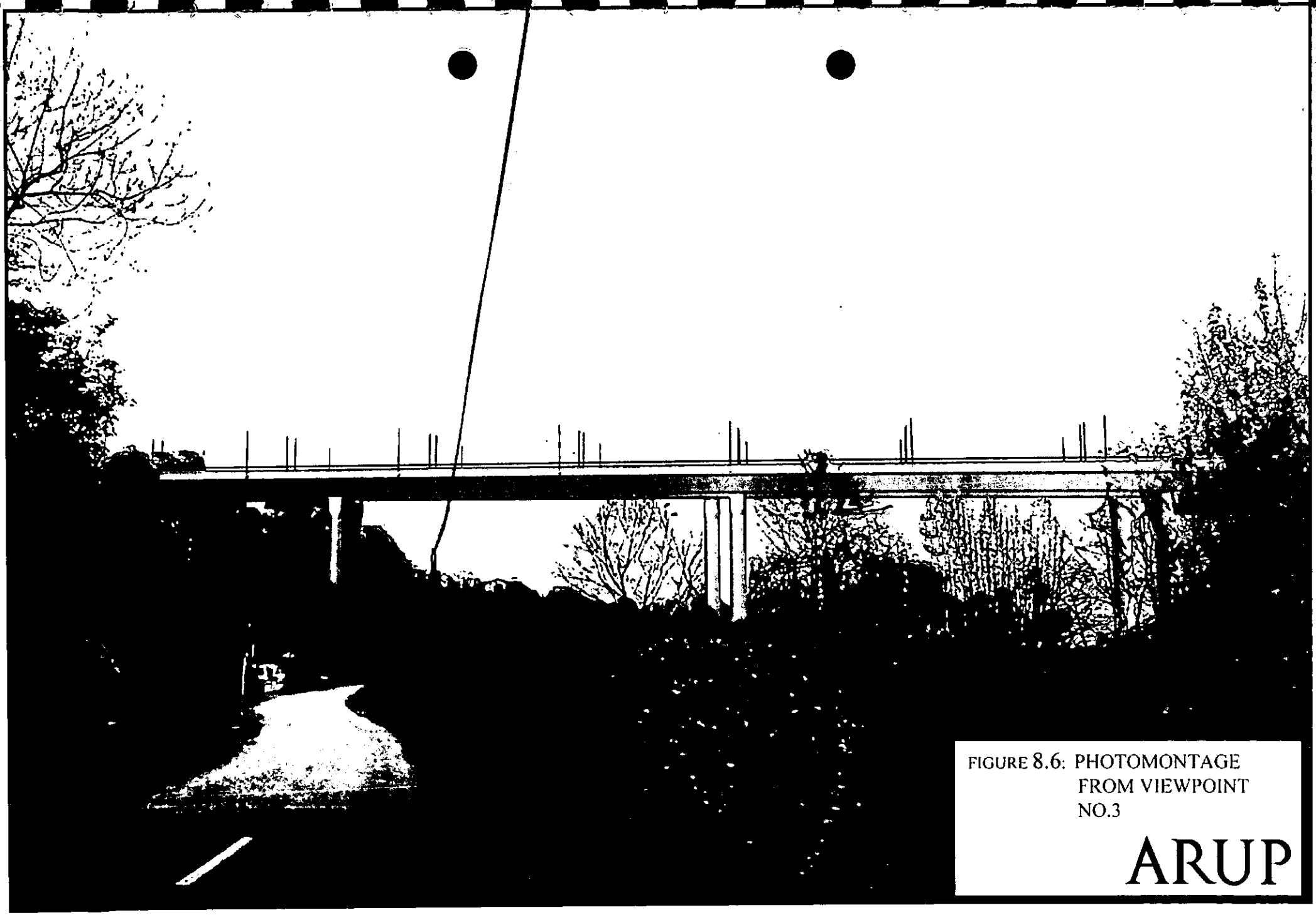


FIGURE 8.6: PHOTOMONTAGE FROM VIEWPOINT NO.3

ARUP

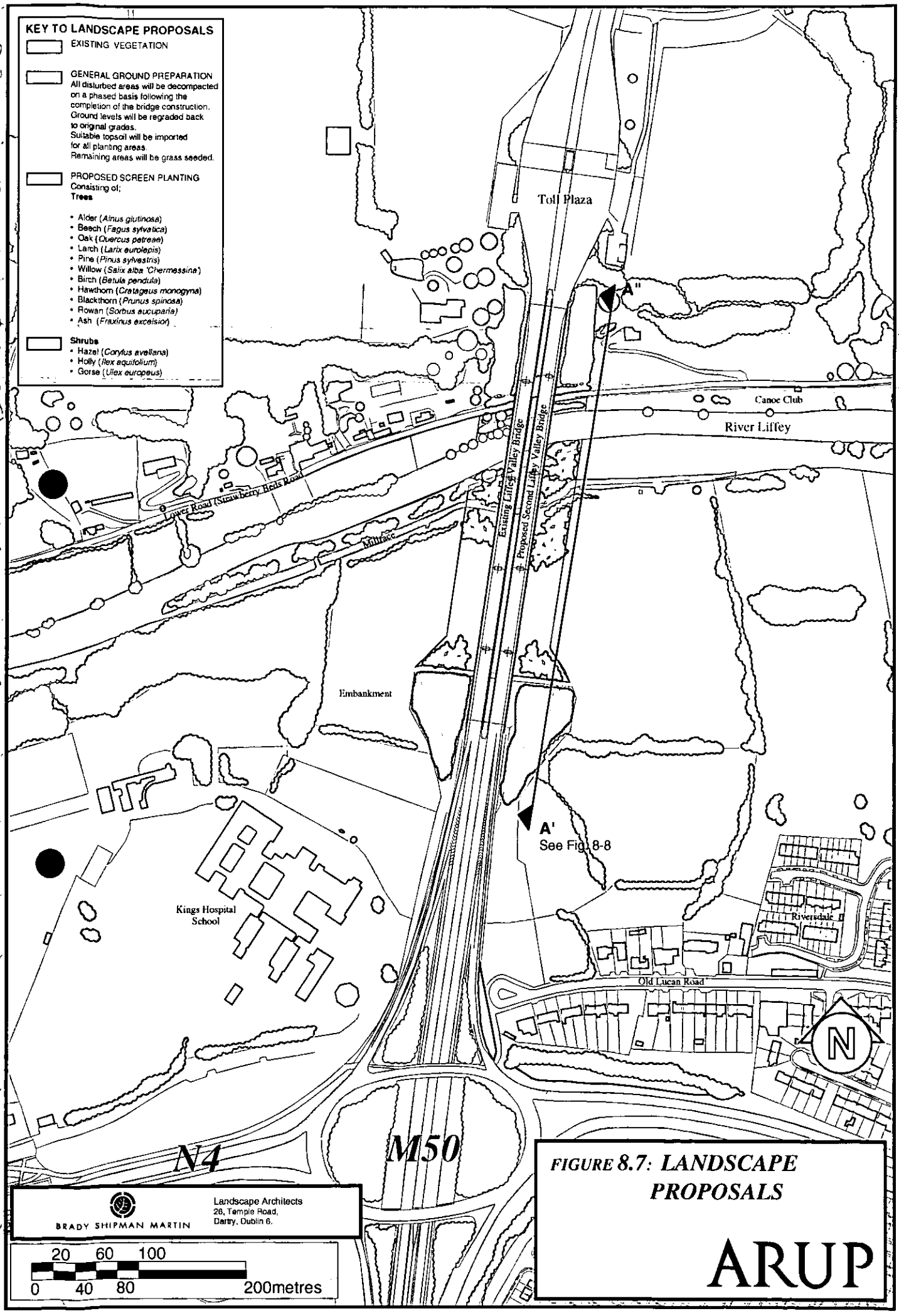
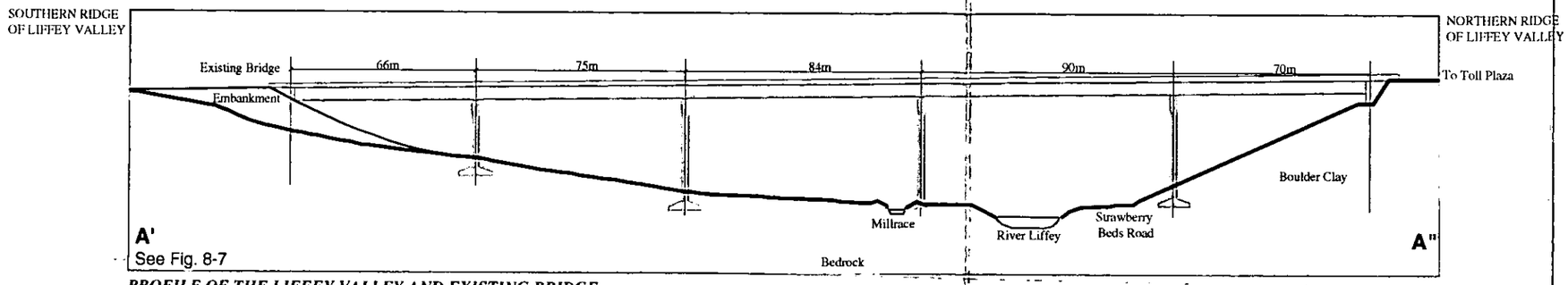
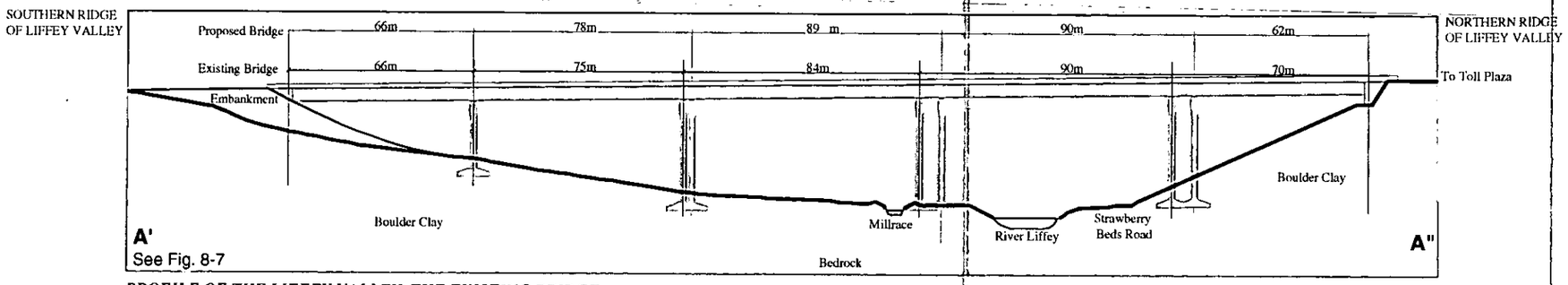


FIGURE 8.7: LANDSCAPE PROPOSALS

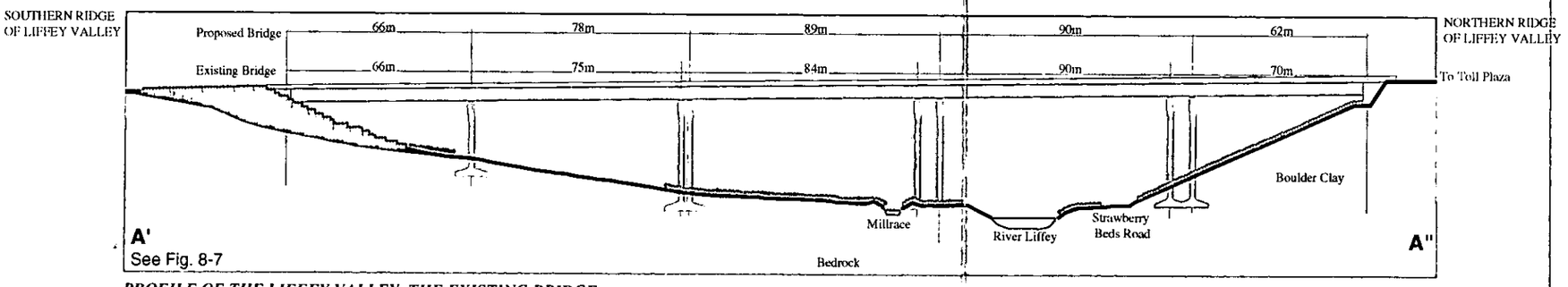
ARUP



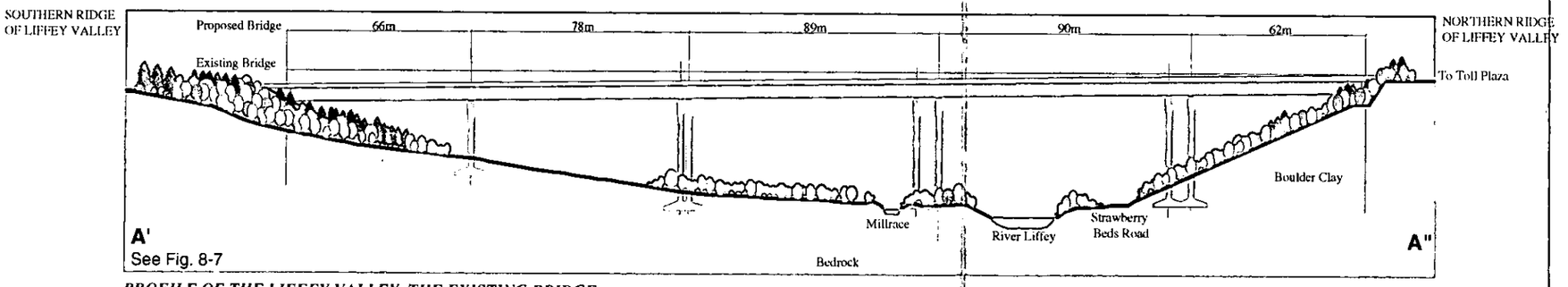
PROFILE OF THE LIFFEY VALLEY AND EXISTING BRIDGE



PROFILE OF THE LIFFEY VALLEY, THE EXISTING BRIDGE AND THE PROPOSED BRIDGE (Without Landscape Mitigation Measures)



PROFILE OF THE LIFFEY VALLEY, THE EXISTING BRIDGE AND THE PROPOSED BRIDGE (With Landscape Planting 5 years old)

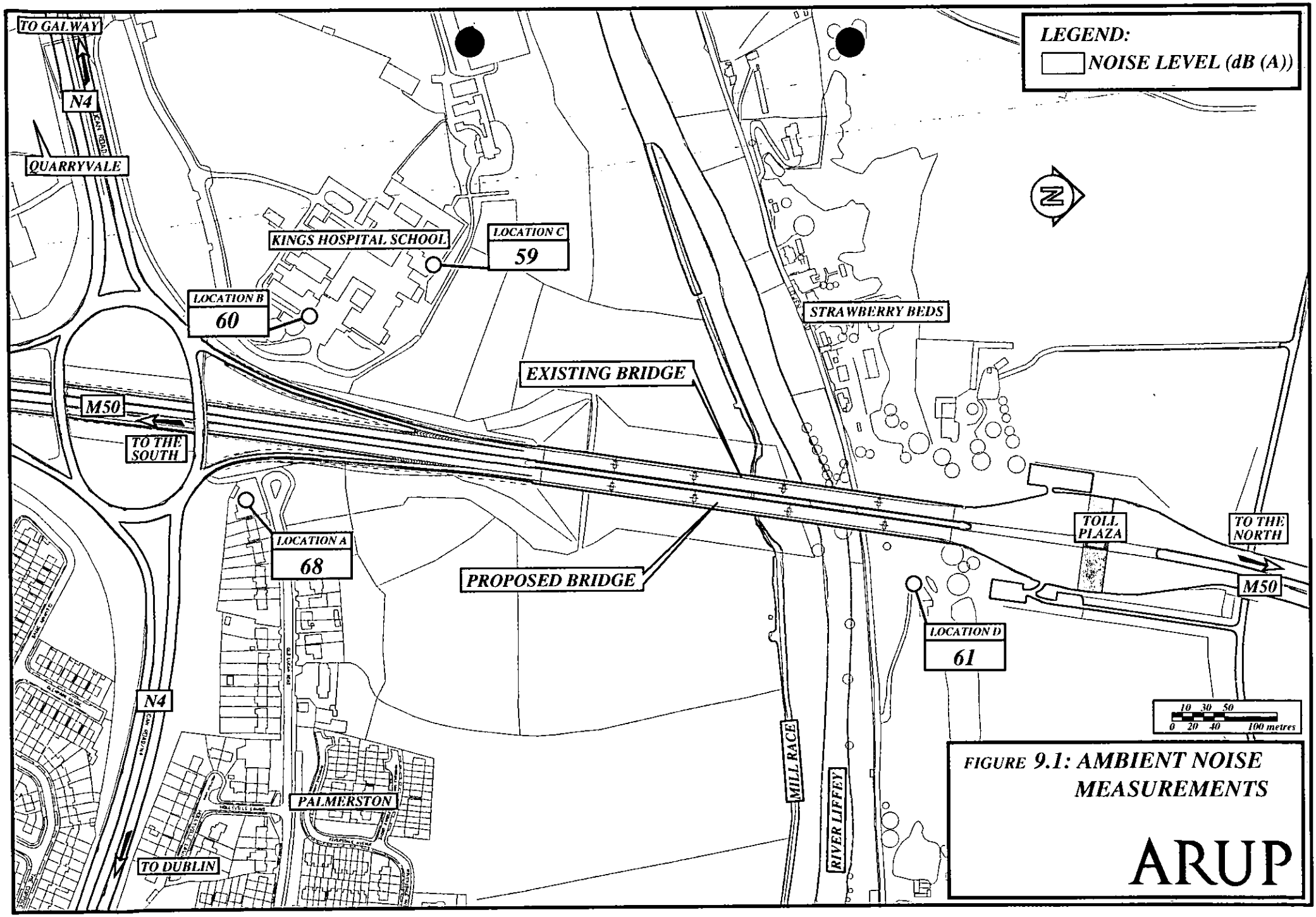


PROFILE OF THE LIFFEY VALLEY, THE EXISTING BRIDGE AND THE PROPOSED BRIDGE (With Landscape Planting 20 years old)

BRADY SHIPMAN MARTIN
Landscape Architects
26, Temple Road,
Dartry, Dublin 6.

FIGURE 8.8: LANDSCAPE SECTIONS

ARUP


LEGEND:
NOISE LEVEL (dB (A))
TO GALWAY
N4
QUARRYVALE
KINGS HOSPITAL SCHOOL
LOCATION C
59
LOCATION B
60
STRAWBERRY BEDS
EXISTING BRIDGE
M50
TO THE SOUTH
LOCATION A
68
PROPOSED BRIDGE
TOLL PLAZA
TO THE NORTH
M50
LOCATION D
61
N4
PALMERSTON
TO DUBLIN
MILL RACE
RIVER LIFFEY
10 30 50
0 20 40 100 metres
FIGURE 9.1: AMBIENT NOISE MEASUREMENTS
ARUP

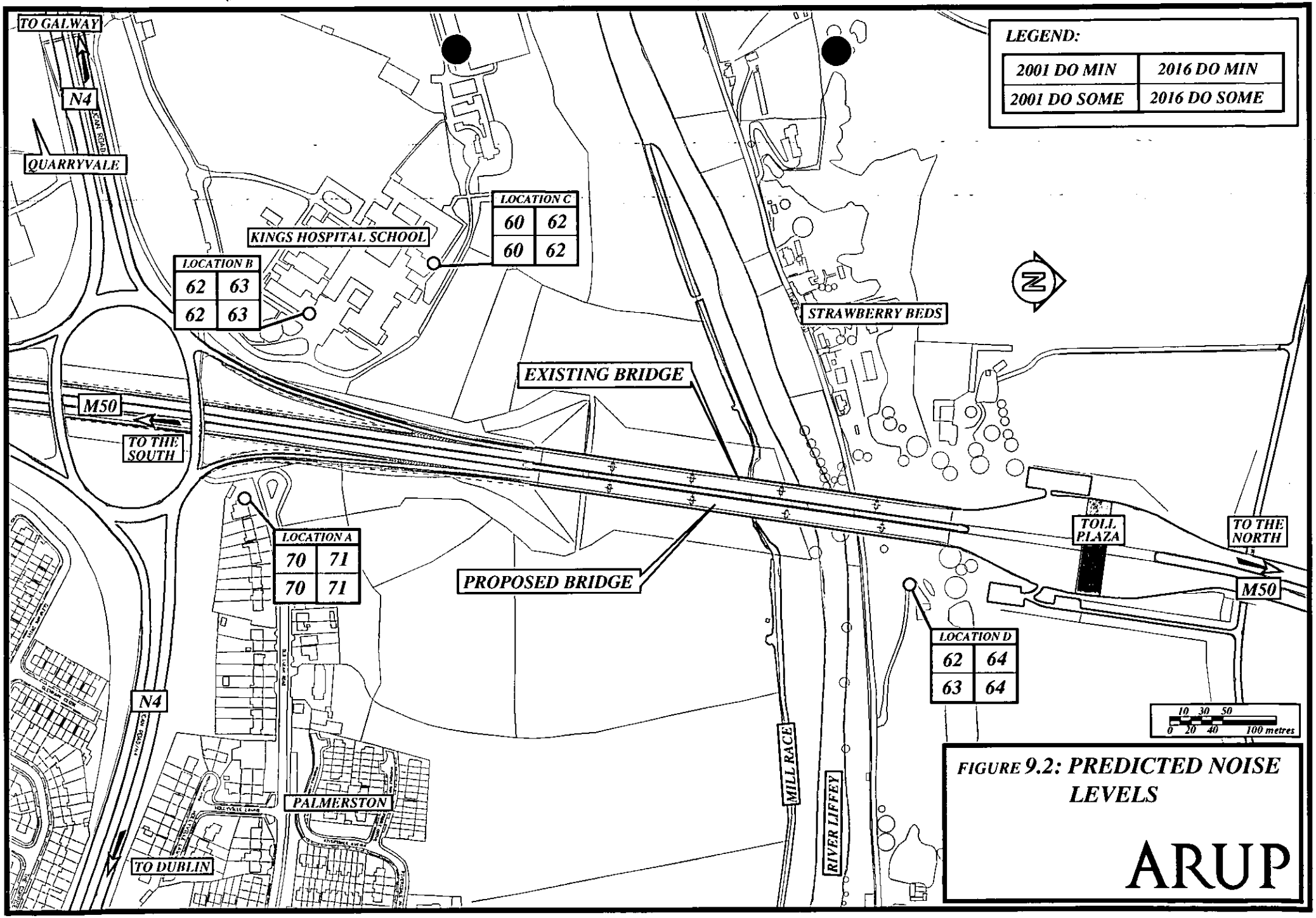
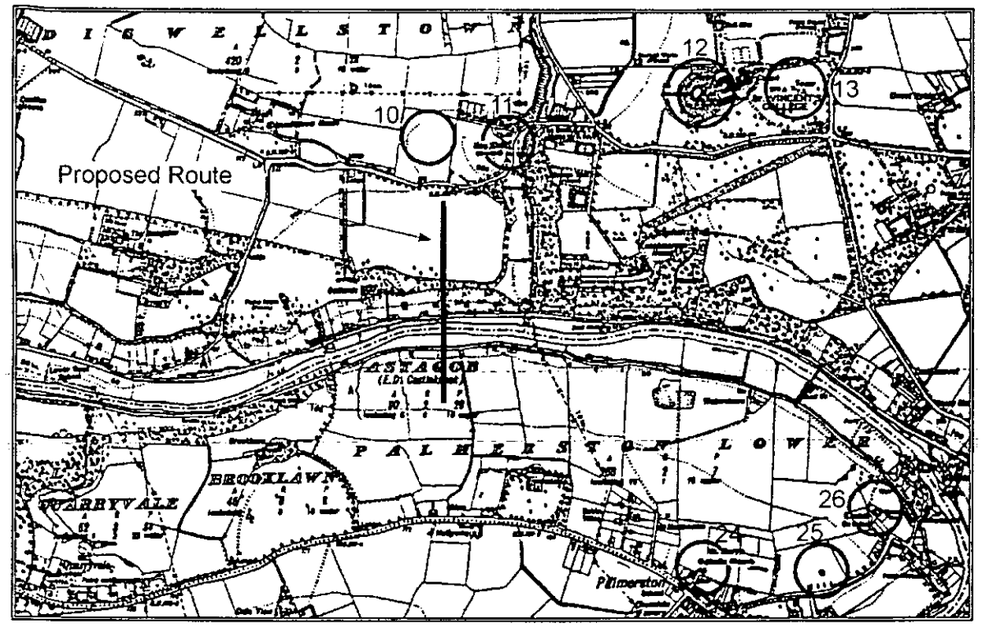
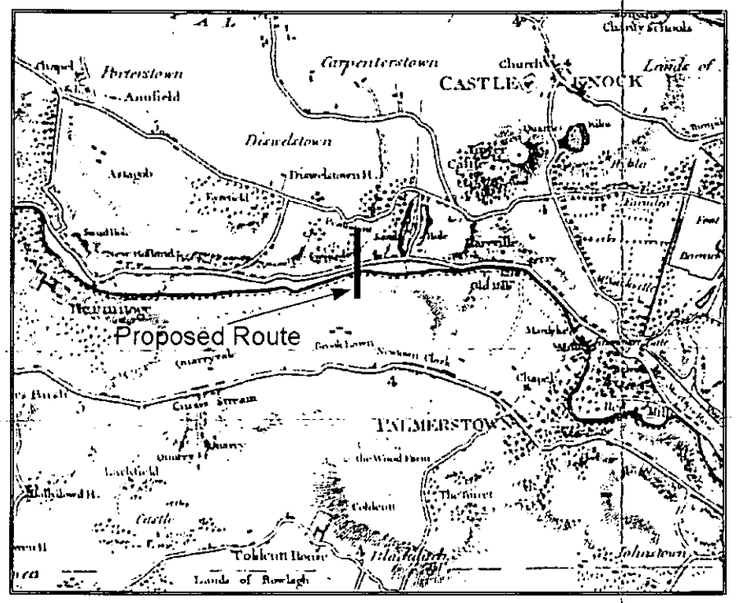


FIGURE 9.2: PREDICTED NOISE LEVELS

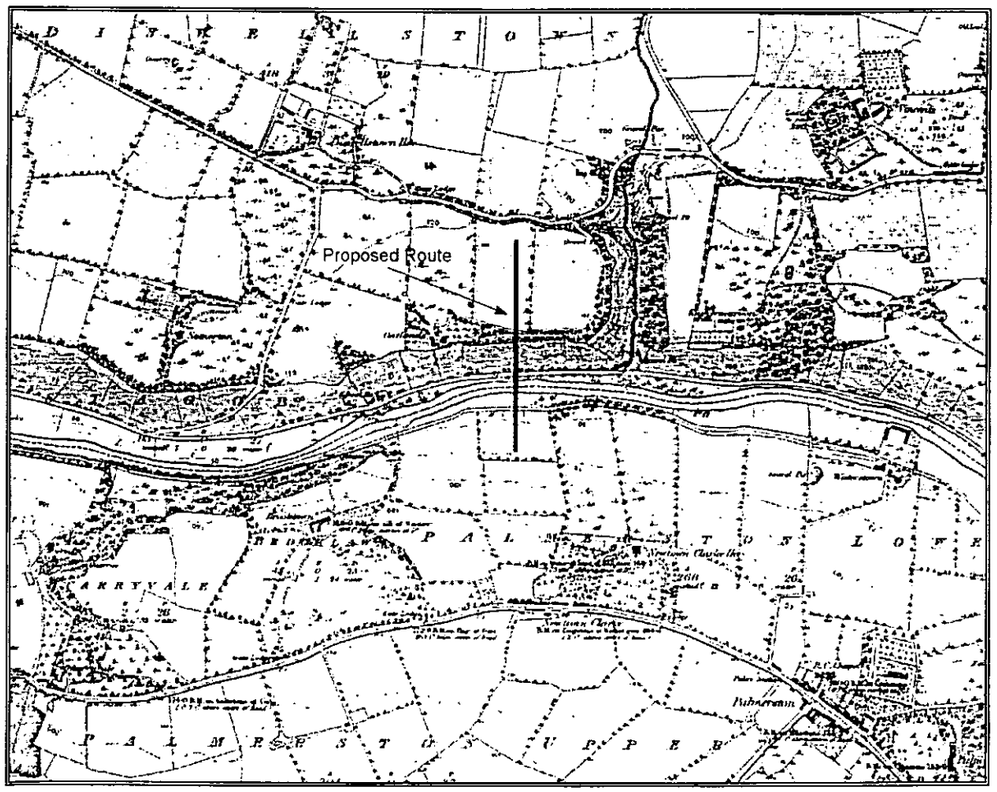
ARUP



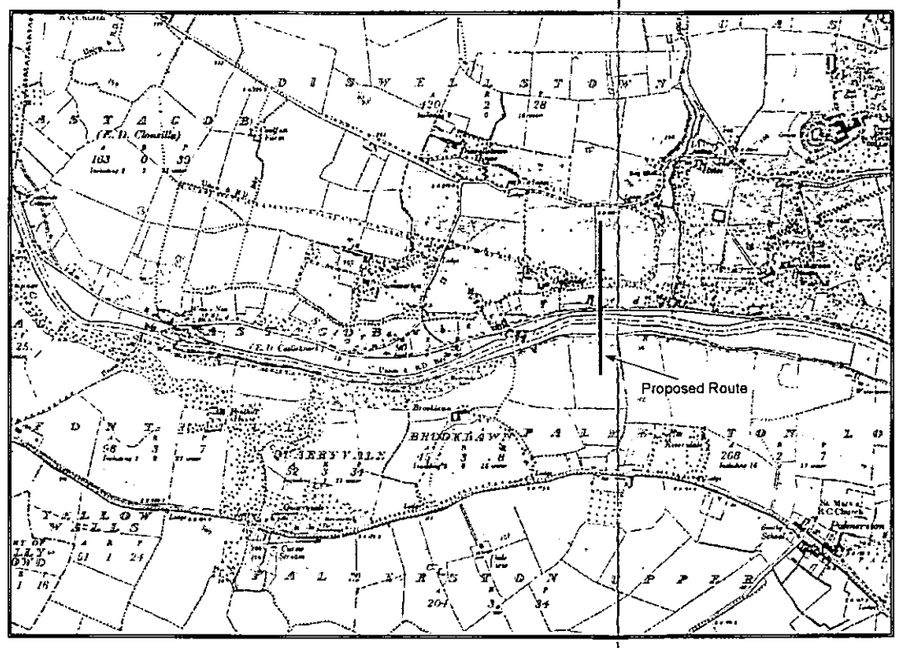
SITE LOCATION



JOHN TAYLOR (1816)



O.S. MAP (1907-8)



O. S. MAP (1836-7)

FIGURE 10.1: ARCHAEOLOGICAL MAPS

Margaret Gowen & Co. Ltd
Archaeological Consultants & Project Managers

ARUP

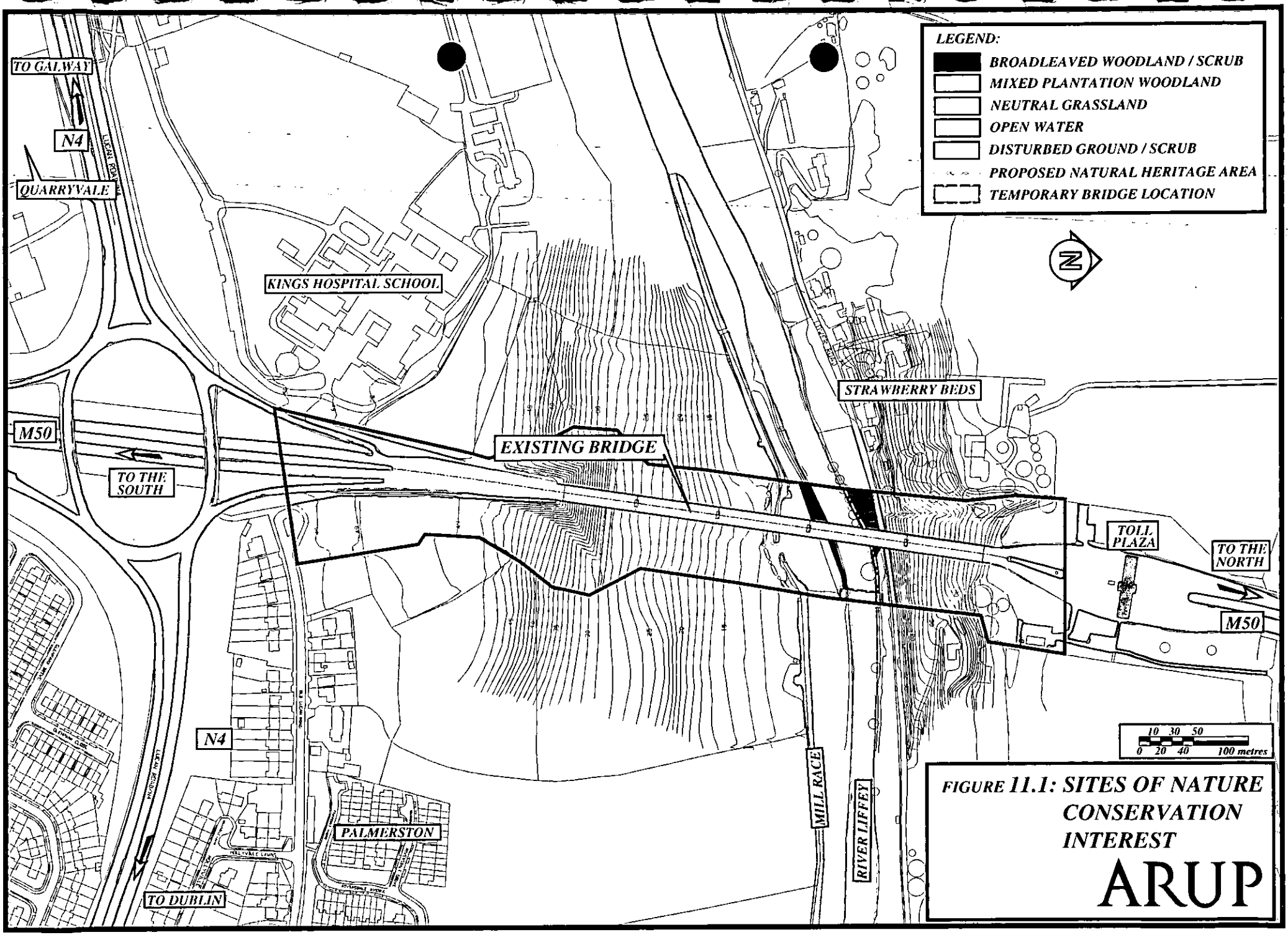


FIGURE 11.1: SITES OF NATURE CONSERVATION INTEREST

ARUP

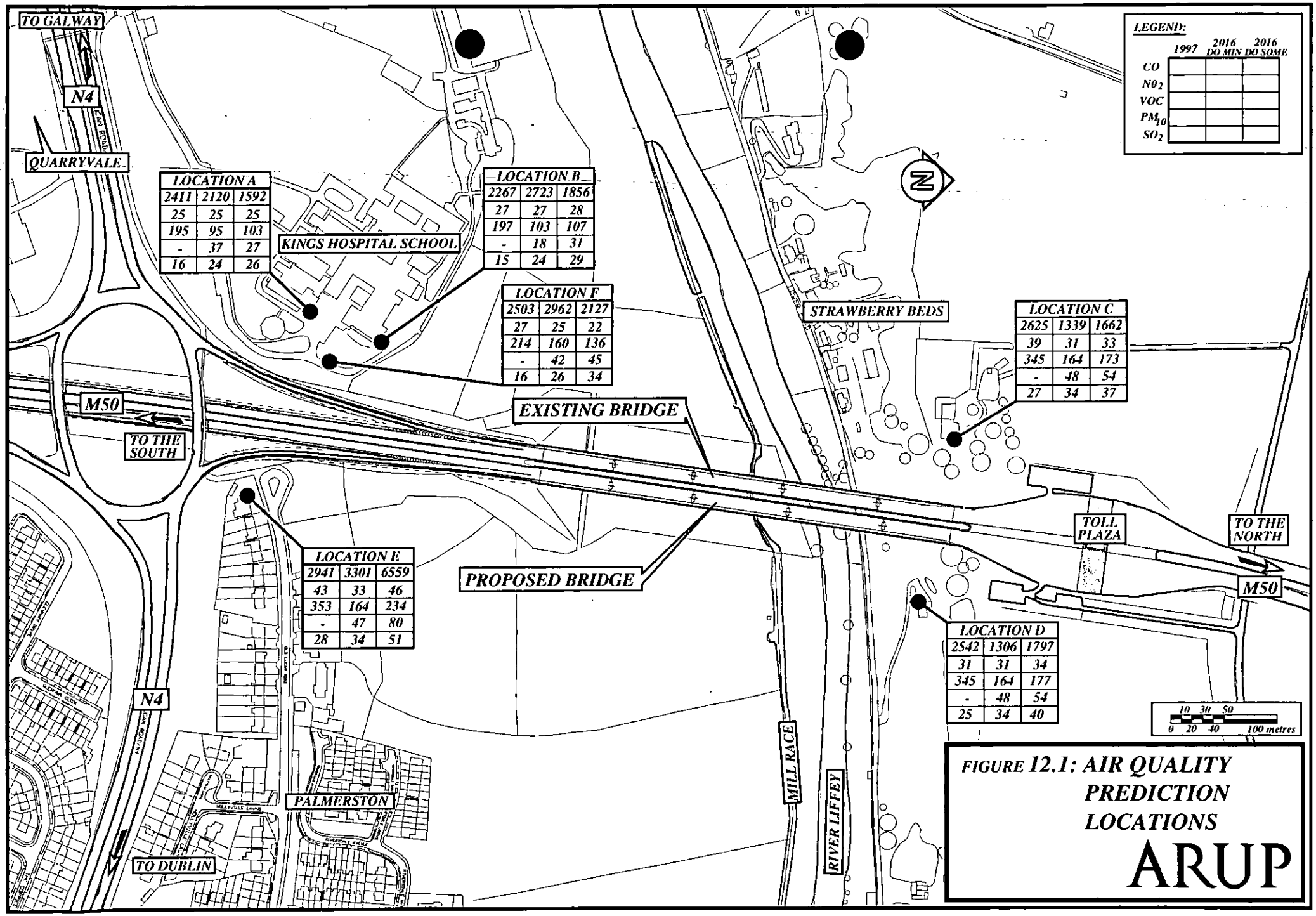


FIGURE 12.1: AIR QUALITY PREDICTION LOCATIONS

ARUP

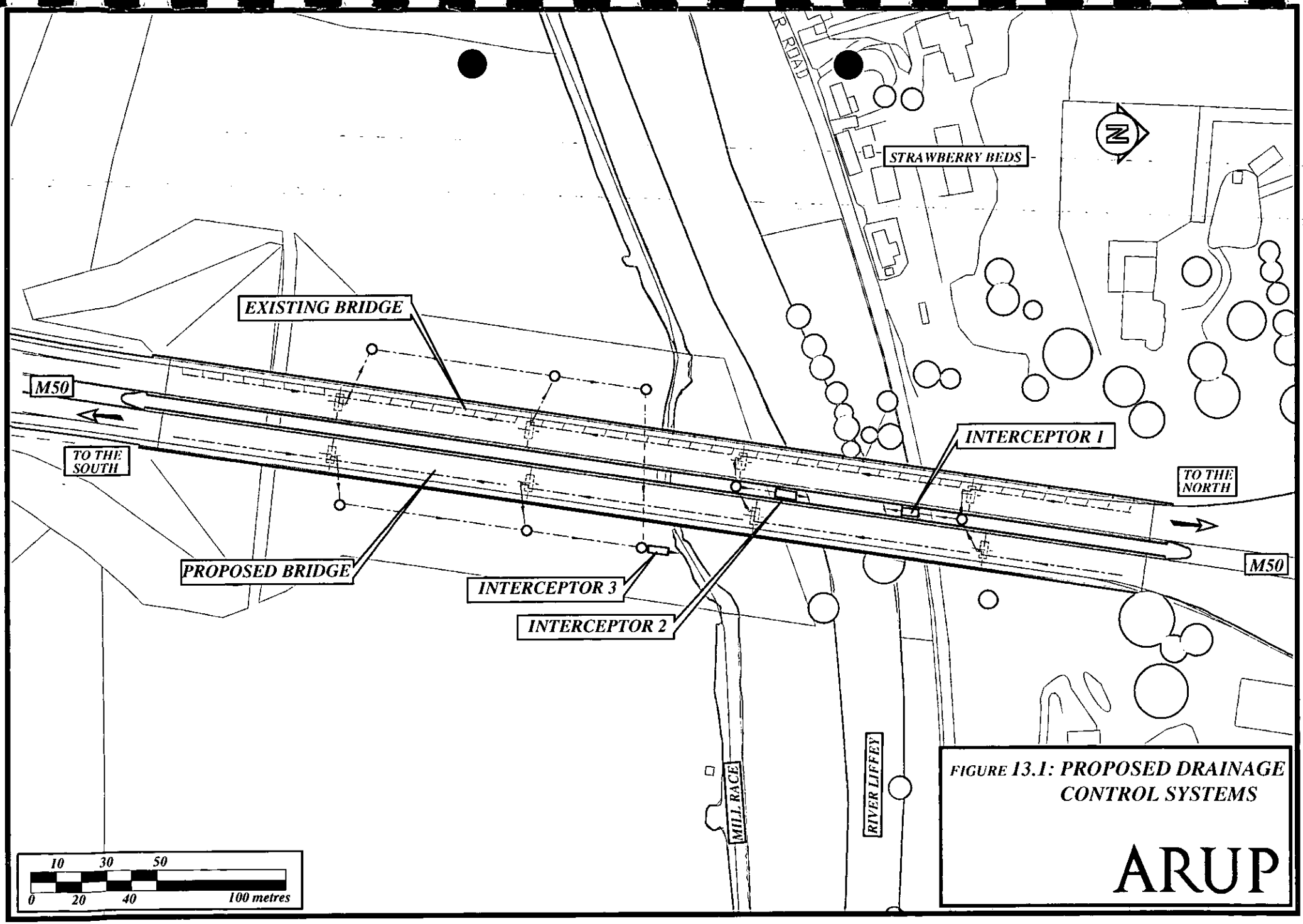


FIGURE 13.1: PROPOSED DRAINAGE CONTROL SYSTEMS

ARUP

Appendix A

Special Amenity Area Order

Special Amenity Area Order 1990
Schedule 1

Objectives for the preservation or enhancement of the Character or Special Feature of the Area

1.1 The Council having consulted with local and national organisations, with amenity and naturalist interest groups and with the major local landowners, will produce a Management Plan for the Valley.

The Management Plan will establish priorities for the development and enhancement of the area for the amenity and recreational use, by the way of agreements with landowners, direct works or other statutory procedures. It will include costings for necessary works and acquisitions, and will propose an annual budget system for monitoring progress.

1.2 The Council will prepare Tree Preservation Orders where appropriate to protect trees of amenity value.

1.3 The Council will consider, in consultation with the prescribed authorities the making of Conservation Orders to protect any flora and fauna of special amenity value or special interest. The Council will if necessary, take any interim steps for the protection of flora and fauna as are open to it.

1.4 The following items will be considered for inclusion in List 2 in the next review of the County Development Plan. In the interim it will be an objective to secure their conservation.

Oatlands House

Luttrellstown Gate Lodge, Lower Road

Thatched Cottage, Summerton Lane

Anna Liffey Mills

Brooklawn House, Palmerstown

Riversdale House, Palmerstown

Terrace of Houses, Mill Lane

Mill Building, Rivermount House and Dwelling at foot of Mill Lane

Weirs at Anna Liffey Mills, Wren's Nest and Palmerstown

Mill Race from Wren's Nest Weir to Glenside, Palmerstown

Metal Bridge over River Liffey at Palmerstown

Graveyard adjoining pre Norman Church at Palmerstown

Wren's Nest Public House.

1.5 It will be an objective to secure the preservation of the sites of geological interest at Hermitage / Fonthill (Goniatite Fossils) and King's Hospital (Mica Impurities based in Limestone Bedrock).

1.6 It will be an objective of the Council to preserve and enhance views and prospects of special amenity value or special interest, in particular views from Lower Road, Rugged Lane, Tower Road and from the Head of the Glen.

The Council will consider making agreements with local landowners to lower or remove walls which obscure views to provide viewing places. The Council will consider serving statutory notices requiring removal or alteration of hedges where appropriate.

1.7 The Council will consider in detail the need to secure public control over some of the lands in the area covered by the Order with a view to the development of a Liffey Valley Park with public access to the river banks.

1.8 The Council will consider in detail the provisions of public rights-of-way and / or public footpaths along both sides of the river. Public rights-of-way may be created under the Planning Acts either compulsory or by agreement.

1.9 The Council will seek the removal of items which are injurious to amenity as follows:-

The phased restoration of the landfill site at Waterstown;

The restoration of the tiphead at Palmerstown Lower; and

The removal of eyesores / casual dumping at Mill Lane, Glenmaroon, Luttrellstown and Lower Road.

In consultation with the E.S.B. the council will consider the removal or alteration of power lines so as to minimise their adverse effects on the visual amenity of the area.

1.10 The Council will seek to acquire and restore the metal bridge across the river. The Council will also investigate in detail the need for further pedestrian bridges across the river in conjunction with the provision of new-rights of way.

1.11 The Council will review the need for major road improvements and new roads in the context of the special amenity value of the area. Detailed consideration will be given to the amenity aspects of new roadworks including the Western Parkway Motorway bridge across the Valley.

1.12 The Council will consider in detail, the need for additional car parks in the area and will seek to secure by negotiation with the owners, the improvement of the existing car parks in the area.

1.13 The Council will encourage the development of facilities for anglers and canoeists. The Council will consider in conjunction with the Eastern Regional Fisheries Board, the Irish Canoe Union and local fishing and canoe interests, possible conflicts which might arise between the two sports and methods of overcoming these.

1.14 The Council will investigate in consultation with other interested parties, the reconstruction of Glenmaroon Weir (which was washed away in a flood in the 1950's).

1.15 The Council, having regard to the Water Quality Management Plan which has been commissioned by Eastern Regional Development Organisation from the An Foras Forbartha, has an objective that the availability of compensation water be not reduced below its present level (38 Million G.P.D.).

It is an objective of the Council that the water quality of the river be maintained and that existing outfalls to the river be reviewed and upgraded as necessary.

Appendix B

Landscape Design Objectives and Planting Specification

Landscape Design Objectives

During the early stages of the bridge design it became very obvious that any bridge structure should take its place within the valley landscape with a minimum amount of visual intrusion and impact. The following environmental design considerations were, therefore, adopted within the overall criteria for the scheme design:

- The natural 'flow' of the valley topography and views up and down its curving alignment should be maintained by an appropriate setback of bridge abutments and of the embankment at the southern end of the bridge
- The bridge deck supports should be minimal in number and volume and not restrict future access along either river bank
- Spacing of the bridge supports across the valley should relate to the valley profile, its curving alignment, avoidance of the river and millrace channel and the provision of a future second bridge
- The entire bridge structure should appear well in varied light conditions when viewed:
  - At a distance and seen against the background valley landscape
  - From nearby or beneath, and when seen against an open sky
- Embankments and other associated earthworks should be integrated with the adjoining topography and at gradients appropriate for amenity use and maintenance
- The entire area of disturbed ground on the north slope should be reinstated with stabilising planting and a footpath from the top of the slope down to the Strawberry Beds
- River and millrace channels should be reinstated and planted with appropriate riparian (riverside) vegetation
- For the design and construction of the second bridge crossing this set of objectives is still very much valid. Thus the layout of the bridge piers for the second bridge were designed to reflect these objectives and are therefore to be skewed in relation to the piers of the existing bridge in order to reflect the natural 'flow' of the valley
- It will be essential to replicate an identical scale and surface finish, in terms of hue and texture, to that of the existing bridge to minimise visual impact of the second bridge.

Planting Specification

The proposed planting will employ established landscape treatment techniques, i.e., through the use of 'bare root transplants', 'whips', and 'feathered trees' which adapt readily to disturbed ground conditions. These plantings will be supplemented by a proportion of taller, mature, 'standard' trees.

1. **Trees** to be planted will be selected from the following list of species:

Alder	*Alnus glutinosa*
Beech	*Fagus sylvatica*
Oak	*Quercus petraea*
Larch	*Larix eurolepis*
Pine	*Pinus sylvestris & P. contorta*
Willow	*Salix alba 'Chermessina'*
Birch	*Betula pendula*
Hawthorn	*Crataegus monogyna*
Blackthorn	*Prunus spinosa*
Rowan	*Sorbus aucuparia*
Ash	*Fraxinus excelsior*

2. **Shrubs** to be planted will be selected from the following list of species:

Hazel	*Corylus avellana*
Holly	*Ilex aquifolium*
Gorse	*Ulex aquifolium*

3. **Grass Areas**

Grass seeding areas will be topsoiled and seeded with a general grass seed mix for areas to be regularly mown.

Appendix C

Noise

Baseline Ambient Noise Levels

(Receptors A-D)

Sound Pressure Level dB				
Time	LAeq,T	LA01,T	LA10,T	LA90,T
01:00	61.8	67.8	64.6	55.7
02:00	61.5	66.9	62.4	48.3
03:00	57.5	65.4	61.3	48.5
04:00	58.1	66.3	62.1	47.1
05:00	58.4	66.9	62.6	47.2
06:00	60.9	67.4	64.4	51.3
07:00	65.1	69.7	67.4	60.7
08:00	68.8	75.5	67.9	66.0
09:00	67.6	73.5	69.0	64.4
10:00	68.4	75.9	70.2	63.8
11:00	69.2	79.8	69.8	64.6
12:00	68.6	78.7	69.3	64.3
13:00	67.8	74.8	69.2	64.3
14:00	66.8	71.5	68.6	63.7
15:00	67.3	77.5	68.1	63.1
16:00	67.5	74.8	68.6	64.3
17:00	67.0	71.7	68.5	64.3
18:00	68.0	79.3	67.5	63.4
19:00	68.4	78.6	67.9	63.8
20:00	67.0	77.2	67.7	63.3
21:00	65.2	69.0	67.0	62.4
22:00	64.7	69.0	66.7	61.8
23:00	63.7	69.5	65.9	59.3
24:00	62.8	68.4	65.3	58.3
L(A10,18h) =		68		68.03

Sound Pressure Level dB				
Time	LAeq,T	LA01,T	LA10,T	LA90,T
01:00	53.1	58.5	55.0	49.5
02:00	50.1	56.5	52.5	44.5
03:00	49.8	57.0	52.5	44.5
04:00	51.1	58.5	54.0	45.0
05:00	52.3	59.0	55.5	45.5
06:00	54.9	59.5	57.5	49.0
07:00	58.2	62.0	60.0	55.0
08:00	62.4	70.5	63.0	59.0
09:00	61.4	65.0	63.0	58.5
10:00	59.3	64.0	60.5	57.0
11:00	61.7	75.0	60.0	55.5
12:00	58.3	61.5	59.5	55.5
13:00	58.5	67.0	59.0	55.5
14:00	59.8	67.0	61.0	56.0
15:00	62.5	75.0	61.0	55.5
16:00	62.3	73.0	61.0	56.5
17:00	60.4	65.0	61.5	58.5
18:00	60.3	66.0	61.0	57.5
19:00	60.5	71.5	60.5	56.0
20:00	58.0	66.5	58.5	55.0
21:00	58.4	62.5	59.5	56.0
22:00	57.6	62.0	59.0	55.0
23:00	55.9	60.5	57.5	52.5
24:00	54.2	58.5	56.0	51.0
L(A10,18h) =		**60**		**60.08**

Sound Pressure Level dB				
Time	**LAeq,T**	**LA01,T**	**LA10,T**	**LA90,T**
01:00	50.2	57.5	53.5	43.0
02:00	47.4	56.0	51.0	37.0
03:00	47.2	57.0	51.0	37.0
04:00	47.4	57.0	51.0	37.5
05:00	47.3	57.0	51.0	36.5
06:00	50.7	58.5	54.0	41.0
07:00	54.1	59.5	57.0	48.5
08:00	59.3	68.5	61.0	49.5
09:00	55.6	64.5	59.0	52.0
10:00	58.1	64.0	59.5	55.0
11:00	60.3	71.0	61.0	54.5
12:00	57.6	62.5	59.0	53.5
13:00	58.6	70.5	59.0	53.0
14:00	56.1	61.5	57.5	52.5
15:00	61.3	73.0	61.5	53.5
16:00	61.3	72.5	62.0	54.0
17:00	59.0	65.0	60.5	56.0
18:00	58.2	63.0	59.5	55.0
19:00	59.8	72.0	59.0	53.5
20:00	57.2	64.5	58.5	54.0
21:00	56.0	61.0	57.5	52.5
22:00	55.6	61.0	57.5	51.5
23:00	53.8	59.5	56.5	49.0
24:00	51.3	58.0	54.0	45.5
L(A10,18h) =		**59**		**58.86**

Sound Pressure Level dB				
Time	**LAeq,T**	**LA01,T**	**LA10,T**	**LA90,T**
01:00				
02:00				
03:00				
04:00				
05:00				
06:00				
07:00				
08:00				
09:00				
10:00				
11:00				
12:00				
13:00	60.7	66.6	62.0	57.9
14:00	66.6	64.3	61.7	57.4
15:00	60.7	70.2	61.4	57.1
16:00				
17:00				
18:00				
19:00				
20:00				
21:00				
22:00				
23:00				
24:00				
MEAN		**62**		**61.7**
L(A10,18h) =		**61**		

N.B. The shortened measurement procedure used to calculate the current L10 (18hr) T is L10(18 hour) = L10 (3 hour) - 1dB(A)

Appendix D

Sites and Monuments Record

Sites and Monuments Record

Archaeological sites are generally classified for the purpose of impact assessment in such a way that their importance in the archaeological record is suggested. The **Classification** carries a notional, and necessarily broadly-based, costing for the full excavation of each category.

An **Area of Interest** is suggested for each site. This is a zone of archaeological potential around the known extant remains in which related archaeological features are likely to occur.

The numbers used to identify the sites are those of the Sites and Monuments Record. The sites are numbered according to the O.S. 6 inch sheet on which they are located, so that Site No. 019 on O.S. 6 inch sheet 3 is listed as 003:019.

The SMR sheet which is relevant to the proposed Liffey Bridge is 17. Apart from 017:010 all the sites listed within the SMR catalogue are outside the specified zone of development. They have been described, however, to convey the general archaeological character of the area:

SMR No. ~ 017:010	**Townland/Ward** ~ Diswellstown
Site Type ~ Habitation Site	**NGR** ~ 30803/23643
Classification ~ D	**Area of Interest** ~ 20 m
Distance ~ This is located immediately north of the study area.	
Description ~ This site is not marked on any Ordnance Survey maps (1837 and/or 1937). A habitation site with associated stone axe find was exposed during the monitoring of the North Eastern gas pipeline (Gowen 1984, 56; Fig 18, 22). The site consisted of a group of poorly preserved hearth sites and areas of burning which yielded a range of chert flakes, a flint hollow scraper and a fragment of a stone axe (Gowen 1984).	

SMR No. ~ 017:011	**Townland/Ward** ~ Diswellstown
Site Type ~ Holy Well	**NGR** ~ 30803/23643
Classification ~ E	**Area of Interest** ~ 10 m
Distance ~ c. 250 m	
Description ~ This site is marked on both the 1st and 3rd editions of the Ordnance Survey maps. The site is known locally as 'Rag Well' and is located on the side of the road, beside a cul-de sac above the west bank of the Liffey. The well is now covered over but can be identified by a wall tablet. Traditionally it was formerly visited on the eve of May where it was credited that the water cured sore eyes and the cloth used to bathe the eyes was hung on a bush, giving the site its name.	

SMR No. ~ 017:012 /01/02/03/04/05		**Townland/Ward** ~ Castleknock	
Site Type ~	Motte and Bailey	**NGR** ~	30855/23657
	Castle		30859/23659
	Well		30850/23652
	Well		30857/23661
	Graveyard		30854/23658
Classification ~ C		**Area of Interest** ~ 30 m	
Distance ~ c. 800 m			

Description ~ The site of the Motte and bailey is located on a steep natural rise west of the Vicentian College. The motte is oval in plan (dimensions H 18.50m NE-SW *c.*30m; NW-SE *c.*25m; Ball 1920, 2-5). The upper fosse is only visible along the NW and is silted up in the ESE where there is a pathway to the keep (017:012/02). Dimensions of the upper fosse (Ball 1920, 2-5) are that it is 5m wide and 3m in diameter, the lower fosse is *c.*10m wide and has a diameter of *c.* 4.50m.

The west side of a polyognal keep with its western section of curtain wall stand at the eastern end of the motte. The keep is two storeys high and is built of regular blocks of coursed limestone masonry with slate packing. Traces of a staircase are visible to the first floor level where the wall is *c.*2.25m wide. An opening through the western section of the keep is now supported by concrete additions. Traces of machicolations survive above this opening. There is a straight seam between the curtain wall and keep which indicates two phases of construction. The area enclosed by the curtain wall is irregular in plan (dimensions *c.*30m E-W, *c.*20m N-S and 2.60m high). It served as a cemetery for the Vicentian Order. In the junction between the keep and curtain wall there are traces of a vaulted opening overlooking the earthen defences. The inner face of the curtain wall is under-cut. There is a base batter around the exterior in the western section and remains of a gardrobe chute, the arched recess in the interior of the curtain wall is probably a later addition (Ball 1920, 2-5; Leask 1941, 43)

SMR No. ~ 017:013/01/02		**Townland/Ward** ~ Castleknock	
Site Type ~	Earthwork unclassified	**NGR** ~	30881/23659
	Windmill possible		30881/23658
Classification ~ D		**Area of Interest** ~ 15 m	
Distance ~ *c.*1.1km			

Description ~ These sites are not marked on the 1st edition of the Ordnance Survey (1836-7) and are described as a 'tower' on the 3rd edition (1936-70). According to the OPW record the site occurs on a natural hillock and there is no indication that it was altered to form a rath. The windmill is no longer present.

SMR No. ~ 017:024	**Townland/Ward** ~ Palmerstown Lower
Site Type ~ Chapel possible	**NGR** ~ 30857/23544
Classification ~ E - F	**Area of Interest** ~ 20 m
Distance ~ c. 1 km	
Description ~ This possible site is not marked on any editions of the Ordnance Survey. There are no other details available in the file.	

SMR No. ~ 017:026/01/02/03	**Townland/Ward** ~ Palmerstown Lower
Site Type ~ Church Graveyard Holy tree	**NGR** ~ 30905/23528
Classification ~ D	**Area of Interest** ~ 30 m
Distance ~ c. 1.2 km	
Description ~ This site is marked on the 1st and 3rd editions of the Ordnance Survey maps. The site is located off Mill Lane on a natural shelf overlooking the River Liffey. The present church is multi-period in date and comprises a nave and chancel, aligned NW-SE. The walls survive to the eaves with steeply pitched gables and are built of large blocks of randomly coursed masonry. There is a belfry over the western gable. The nave is entered from the west gable. The doorway has inclined jambs indicating a pre-Norman origin, with a later round-headed window inserted. Also inserted into the southern wall is a later featureless window. The nave is lit in the north by a double-light window with chamfered jambs and signs of drafting present. The chancel arch which rises from roughly squared uniposts and contains moulding. The eastern window is a double light, the mullion is missing and originally had a pointed arch.	

SMR No. ~ 017:025	**Townland/Ward** ~ Palmerstown Lower
Site Type ~ Ring Barrow	**NGR** ~ 30890/23528
Classification ~ D	**Area of Interest** ~ 10 m
Distance ~ c. 1.3 km	
Description ~ This site is not marked on any edition of the Ordnance Survey map. The site is located on a hillock overlooking the Liffey Valley on the grounds of Stewarts Hospital and comprises a circular raised platform (0.80m high) defined by a slight bank. The slightly domed interior is completely overgrown (diameter *c.*15 m) and it could possibly be an overgrown tree-ring (Healy 1974, 22).	

SMR No. ~ 017:072	**Townland/Ward** ~ Palmerstown Upper
Site Type ~ Mound	**NGR** ~ Not available
Classification ~ G	**Area of Interest** ~ 10 m
Distance ~ c. 1 km	
Description ~ This site is not marked on the 1st Ordnance Survey map but is hachured on the 3rd edition. The site was inspected on 26/2/93 by G. Stout. The mound had been tested by the owner to see 'what was in it'. A JCB trench was cut into the base of the mound on the south side, to a depth of 2.4m and *c*.3m long. Below the topsoil was a 0.60m thick layer of stones and below that a layer of stones and clay *c*.0.50m thick with boulder clay at a depth of *c*.1.80m. The mound is in a prominent position on the crest of a rise. It is elongated, with a flat top, *c*.8m wide, and is *c*.16 m at the maximum western exterior. It falls steeply on the western side where it is 5m high and the southern side of the mound has been robbed. The site is of no archaeological significance.	

Appendix E

Archaeology and Cultural Heritage Significance Evaluation Criteria

EPA Impacts	Impact Level	Criteria for EIS	Category	Status	Implications
Profound or significant, (negative effect only)	Severe	Reserved for adverse effects only. Applies where mitigation would be unlikely to remove such effects. The effects are generally but not exclusively associated with sites and features of international or national importance.	A	National Monument and/or State owned buildings or structures which have been identified for preservation or buildings or structures included in List 1 for preservation.	Sites must be avoided.
Significant impact, (positive or negative)	Major	Important considerations at a national to regional level. If adverse a major effect has the capacity to become a key component in the structuring of the project. Mitigation measures are unlikely to remove all effects upon the affected communities or interests.	B	Nationally important site/ or very rare in the archaeological record. Also buildings or structures included in List 2 for preservation consideration and/or intrusion into the setting of buildings included in List 1.	Sites must be avoided.
	Moderate	Represents issues where mitigation measures and detailed design work may ameliorate/ enhance some of the consequences upon affected interests. If adverse they are important but not likely to be key decision makers on the EIS. The effects can be mitigated against.	C	Extensive, well-preserved sites (ringforts, castles, churches, graveyards, burial mounds) not necessarily rare in the archaeological record. Also intrusion into the settings of buildings or structures included in List 2.	Sites should be avoided, if possible. All archaeological investigation work should take place pre-development well in advance of construction.
			D	Sites similar to those in category C, but not as well preserved or extensive.	Avoidance is recommended. If not an option full archaeological excavation ensuring preservation by record, would be required. Archaeological work should be conducted at the pre-development stage.
			E	Historical Building or Sites, post 1700AD and industrial buildings. Loss of sites which, although not listed, are of some cultural and/or historical interest beyond a local value.	Archaeological/ architectural building survey, sites are assessed by survey, photographic and historic record. To take place at the pre-construction and/or construction phase.

EPA Impacts	Impact Level	Criteria for EIS	Category	Status	Implications
			F	Low visibility sites/features i.e fuluchta fiadh/lithic scatters.	Monitoring prior to the construction phase if archaeological material is found excavation or avoidance can then be cited.
	Minor	Not significant in the decision making process. Can be of relevance to the subsequent design of the project.	G	Sites of sites, destroyed or delisted, marked on the OS, or known from documentary sources. Affects unlisted buildings/structures of a local significance and extent only.	Area needs to be archaeologically assessed in the field. Sometimes monitoring is required during the construction phase.
	Unknown		UC	Sites of possible archaeological potential but of unquantified extent and significance.	Trial excavations for a detailed evaluation would be required and a full excavation may be recommended. To take place pre-construction.
Neutral or slight Impact	Not significant	The forecasting framework cannot envisage any effect on the environment.	N/A	N/A	An area of archaeological potential must be observed around all sites.
No impact	N/A	N/A	N/A	No effect on any feature of an historical, cultural and/or archaeological interest.	

Appendix F

Terrestrial Habitat Descriptions

Grassland

The southern slopes comprise grassland grazed by cattle and horses. The sward has a reasonable diversity of grass species which include perennial rye grass (*Lolium perenne*), cock's foot (Dactylis glomerata), crested dog's tail (*Cynosurus cristatus*). Other herbaceous species occurring are ribwort plantain (Plantago lanceolata), white clover (*Trifolium repens*), daisy (*Bellis perennis*), nettle (*Urtica dioca*), ragwort (*Senecio jacobaea*), docks (*Rumex sp.*) and an unidentified moss. It was not possible to classify this grassland under the NCC system because of the status of the vegetation when the survey was undertaken. However, depending on the full range of species and the proportion of perennial rye grass cover, the grassland is likely to be classified as either improved or semi-improved.

Neutral Grassland

The vegetation of the river banks which are not covered in scrub or woodland is predominantly neutral grassland. On the southern side of the river the grassy banks are grazed but there is evidence of other species such as nettle (*Urtica dioca*), meadowsweet (Filipendula ulmaria) and dock (*Rumex sp.*). On the northern side, winter heliotrope (*Petasites fragrans*) is abundant in places. The banks of the mill race are grass-dominated and grazed between the patches of scrub. As cattle have access to the water, the banks have been poached in places. Where the banks have slumped into the stream, reed canary grass (*Phalaris arundinacea*) grows at the base of the bank.

Marginal Vegetation

Marginal flora comprise those species found at the margins of river banks and other water bodies. The establishment of marginal vegetation in this part of the Liffey Valley is very limited because of the river banks' steep gradients and the fast-flowing water. Narrow strips of marginal vegetation occur occasionally and include yellow iris (*Iris pseudacorus*) and meadowsweet. In the mill race water cress (*Nasturtium officinale*) is common at the edge of the watercourse adjacent to where cattle have access.

Scrub

On both sides of the river bank are areas of scrub dominated by alder (*Alnus glutinosa*) and willows (*Salix sp.*) At the lower part of the bank nearer the river and higher up the bank, blackthorn (Prunus spinosa), hawthorn (*Crataegus monogyna*) and brambles (*Rubus fruticosus* agg.) occur.

Broad-Leaved Woodland

A small area of woodland on the southern bank comprises mixed alder, willow, ash (*Fraxinus excelsior*) with occasional sycamore (*Acer pseudoplatanus*). The shrub layer is mainly holly (*Ilex aquilinum*) and brambles, while the ground flora is grass-dominated with occasional violets (*Viola sp.*), ground ivy (Glechoma hederacea), cow parsley (*Anthriscus sylvestris*) and ivy (*Hedera helix*).

Plantation Woodland

At the top of the slope on the northern side is an area of planted mixed woodland comprising broadleaf species (such as beech (*Fagus sylvatica*), oak (*Quercus sp.*), birch (*Betula pendula*)) and conifers, for example, larch (*Larix sp.*), pine (*Pinus sp.*) and spruce (*Picea*). The shrub layer is fairly dense and contains mainly holly and snowberry (*Symphoricarpos albus*). Ivy is common on the ground. This woodland has broader nature conservation value as a habitat for birds and mammals, but is of limited ecological significance in its own right because it is a planted woodland.

Scattered Trees

Occasional mature trees of willow and alder occur along the banks of the River Liffey.

Disturbed Land

Much of the northern slope east of the bridge was disturbed during construction of the first bridge. The slopes are steep (>30°) and were planted with a grassland sward dominated by fescue grass (*Festuca sp.*) and white clover (*Trifolium repens*) and occasional shrubs (dogwood (*Cornus sp.*) and laurel (*Prunus lauocerasus*)). Native species typical of disturbed ground are beginning to colonise the area and include winter heliotrope (*Petasites fragrans*), yarrow (*Achillea millefolium*), teasel (*Dipsacus fullonum*) and creeping thistle (*Cirsium arvense*). Young alder, hazel (*Corylis avellana*), gorse (*Ulex europaenus*) and ash saplings are colonising the area also. This area, if left to develop naturally, will ultimately become scrub.

Appendix G

Macrofauna Recorded in the River Liffey and Mill Race

Macrofauna Recorded in the River Liffey and Mill Race

Taxa	Number of Specimens*	
	River Liffey	Mill Race
Turbellaria		
Dendrocoelum lacteum	2	-
Polycelis tenuis	30	3
Planaria torva	11	6
Annelida		
Oligochaeta, Family Lumbricidae	3	-
Oligochaeta, Family Tubificidae	-	600+
Oligochaeta, others	-	80+
Family Erpobdellidae	1	1
Piscicola geometra	-	1
Helobdella stagnalis	-	5
Glossiphonia complanata	-	1
Mollusca		
Lymnaea peregra	8	-
Valvata macrostoma	-	28
Bithnia leachi	-	7
Physa cf. heterostropha	16	52
Planorbis carinatus	8	-
Acroloxus lacuatris	-	4
Crustacea		
Crangonyx pseudogracilis	100+	
Asellus aquaticus	1200+	500+
Ostracoda	1	17
Collembola	-	-
Isotomurus palustris	-	2
Zygoptera		
Ischnura cf. elegans	-	2
Corixidae		
Sigara dorsalis	20	2
Notonectidae	-	-
Notonecta glauca	10	-
Trichoptera		
Athripsodes sp.	1	1

Taxa	Number of Specimens*	
	River Liffey	Mill Race
Limnephilus flavicornis	-	2
Limnephilus marmoratus	2	-
Limnephilus nigriceps	-	3
Family Limnephilidae	1	5
Diptera		
Chironomidae larvae	2	63
Ceratopogonidae larvae	-	3
Coleoptera		
Hyphydrus ovatus	1	-
Haliplus confinis	1	-
Haliplus larva	3	-

*N.B. Absolute numbers are given for organisms throughout. Numbers for dominant taxa: *Asellus aquaticus*, *Crangonyx pseudogracilis* and tubifex worms, are estimates and hence, rounded off.

Taxa	Number of Specimens*	
	River Liffey	Mill Race
Limnephilus flavicornis	-	2
Limnephilus marmoratus	2	-
Limnephilus nigriceps	-	3
Family Limnephilidae	1	5
Diptera		
Chironomidae larvae	2	63
Ceratopogonidae larvae	-	3
Coleoptera		
Hyphydrus ovatus	1	-
Haliplus confinis	1	-
Haliplus larva	3	-

*N.B. Absolute numbers are given for organisms throughout. Numbers for dominant taxa: *Asellus aquaticus, Crangonyx pseudogracilis* and tubifex worms, are estimates and hence, rounded off.

Appendix H

Air Quality Evaluation Results

Table H.1.

Maximum predicted peak hour carbon monoxide concentrations (µg/m³)

Site Locations	Base Year 1997	Do Minimum for design year 2016	Do Something for design year 2016
Kings Hospital School (Site A)	2411	2120	1592
Kings Hospital School (Site B)	2267	2723	1856
Strawberry Beds (Site C)	2625	1339	1662
Residential House (Site D)	2542	1306	1797
Residential House (Site E)	2941	3301	6559
Kings Hospital School (Site F)	2503	2962	2127

Table H.2.

Maximum predicted peak hour nitrogen dioxide concentrations (µg/m³)

Site Locations	Base Year 1997	Do Minimum for design year 2016	Do Something for design year 2016
Kings Hospital School (Site A)	25	25	25
Kings Hospital School (Site B)	27	27	28
Strawberry Beds (Site C)	39	31	33
Residential House (Site D)	31	31	34
Residential House (Site E)	43	33	46
Kings Hospital School (Site F)	27	25	22

Table H.3.

Maximum predicted peak hour volatile organic compound (VOC) concentrations (µg/m³)

Site Locations	Base Year 1997	Do Minimum for design year 2016	Do Something for design year 2016
Kings Hospital School (Site A)	195	95	103
Kings Hospital School (Site B)	197	103	107
Strawberry Beds (Site C)	345	164	173
Residential House (Site D)	345	164	177
Residential House (Site E)	353	164	234
Kings Hospital School (Site F)	214	160	136

Table H.4.

Maximum predicted peak hour fine particulate (PM_{10}) concentrations ($\mu g/m^3$)

Site Locations	Base Year 1997	Do Minimum for design year 2016	Do Something for design year 2016
Kings Hospital School (Site A)	-	37	27
Kings Hospital School (Site B)	-	18	31
Strawberry Beds (Site C)	-	48	54
Residential House (Site D)	-	48	54
Residential House (Site E)	-	47	80
Kings Hospital School (Site F)	-	42	45

Table H.5.

Maximum predicted peak hour sulphur dioxide concentrations ($\mu g/m^3$)

Site Locations	Base Year 1997	Do Minimum for design year 2016	Do Something for design year 2016
Kings Hospital School (Site A)	16	24	26
Kings Hospital School (Site B)	15	24	29
Strawberry Beds (Site C)	27	34	37
Residential House (Site D)	25	34	40
Residential House (Site E)	28	34	51
Kings Hospital School (Site F)	16	26	34

Appendix I

Construction Dust Mitigation Measures

Code of Practice for the Control of Fugitive Dust Emissions from Construction Sites

The following Code of Practice has been drafted with the UK DoE guidelines in mind. It is intended to provide a focal point for discussion and agreement between the contractor and the regulatory authorities. Although not statutorily-binding, the Code of Practice will act as vehicle to ensure the satisfactory performance of contractors, with special regard to the proximity of the nearby residential properties.

It is proposed that this Code of Practice be linked with other environmental performance objectives during the construction phase, for example, noise control, with a view to producing a transparent and workable site environmental management system. Quantitative measurement and assessment of dust deposition at residential properties is not recommended. This is because firstly, there are no statutory standards to assess dust deposition nuisance should it occur, and secondly, the Code of Practice is directed towards avoiding dust nuisance occurring at all.

There is little point in measuring dust deposition and waiting for the nuisance to occur - at all times the properties adjacent to the site must be free of dust nuisance, and should it arise, a prompt and efficient system should be in place to prevent further emissions occurring, and to examine and remove the cause.

- The contractor shall demonstrate, in writing, a willingness to entertain whatever measure may be deemed necessary to control dust, and to ensure that fugitive dust impacts as a consequence of site working are avoided. It is the responsibility of the contractor to employ experienced staff aware of the issues and the need to comply with the Code of Practice, and to provide the necessary equipment for staff to use.
- During working hours, a Site Manager or delegated officer with full authority to order the cessation of all works if deemed necessary, shall be on site and available to direct dust control methods as appropriate. The identity of this Site Manager should be made known to, and agreed with the Project Managers or their nominated representative. Once nominated, the Site Manager or nominated officer shall not be replaced without prior written permission of the Project Managers. (Such permission will not be unreasonably withheld.)
- The contractor should establish a liaison committee to meet on a regular basis with representatives of the local authorities, local communities and any interested parties, to discuss issues which arise. This may include fears concerning the possible impacts caused by site dust, information on action taken following previous complaints, and measures being taken to control dust Minutes and notes of the meeting of the liaison committee will be recorded and kept and made available for inspection.
- The contractor should widely publicize, as appropriate, the existence of the liaison committee and the identity of the committee members together with relevant contact address and telephone numbers.
- A complaints register shall be kept on site detailing any telephone calls and letters of complaints received together with details of any remedial actions ordered, to be available for inspection on demand by the Project Manager or their nominated representative.
- The contractor shall formally appraise the Project Managers, in writing, of any significant complaints, or problems concerning dust which may arise during

construction, together with full details of the steps taken to resolve the matters and prevent recurrence.

- Dust control measures shall be agreed between the Project Managers and contractors prior to works commencing, but may be subject to change following formal written agreement between both parties.
- It is the responsibility of the contractor at all times to demonstrate full compliance with dust control conditions.
- The contractor should be able to furnish relevant records and details of dust control measures adopted at previous sites, indicating the role that site management took This information should include, where available, complaints registers, details of remedial action taken following complaint, action taken during adverse weather conditions and dust monitoring records.
- Site roads shall be regularly cleaned and maintained as appropriate. Hard surfaced roads shall be swept to remove mud and aggregate materials from their surface. Roads which have been surfaced in loose aggregate shall be graded and maintained to prevent deterioration of the road surface and build up of contaminating site materials able to emit dust. Any unsurfaced roads shall be restricted to essential site traffic only. These unsurfaced roads must be regularly watered, as appropriate, during dry or windy weather to reduce dust emissions during use.
- Vehicles using site roads shall have their speed restricted, and this speed restriction must be enforced rigidly. On any unsurfaced site roads this shall be 20 km per hour, on aggregated roads 30 km per hour, and on hard surfaced roads as site management dictates.
- Loads carried by road licensed vehicles delivering materials to and from the site shall be enclosed or tarpaulined at all times to restrict escape of particulate matter.
- All vehicles exiting the site shall make use of a wheel wash facility, preferably automatic, prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads.
- Public roads outside the site shall be regularly inspected for cleanliness, and cleaned as necessary. Records of each inspection to be made and retained for inspection.
- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind. Potentially dusty operations, such as concrete batching, shall utilise modern equipment which contains dry aggregate and cement and reduces their exposure to wind.
- Water misting or sprays will be utilised as required if particularly dusty activities are necessary during dry or windy periods.
- It is not anticipated that dust deposition monitoring shall be undertaken around the site, for reasons stated above. However, in the event that dust monitoring forms a planning condition, all monitoring on and around the site shall be carried out by suitably qualified persons. Measured dust levels must be assessed against previously-agreed criteria, and the origins of the dust should be confirmed through stereoscopic analysis. The records of all such monitoring shall be kept and made available for inspection upon request by the regulatory authority, the Project Manager or his nominated representatives.

- If weather conditions become dry and windy, or if dust monitoring records indicate that fugitive site dusts are reaching unacceptable levels, or if sufficient public complaints are received, the Site Manager shall direct all activities to cease until such a time as the problems can be demonstrated to have been satisfactorily resolved.
- In summary, pro-active control of fugitive dust will ensure that the prevention of emissions, rather than an inefficient attempt to control them once they have been released, contributes towards the satisfactory performance of the site in this regard. An environmental management system will provide a formal means of ensuring that the Code of Practice is adhered to. The key features of an EMS with respect to the control of dust are:

1 the specification of a site policy on dust and environmental matters

2 the identification of site management responsibilities for dust and environmental issues

3 the development of a documented system for managing site practices and implementing management controls

4 the development of a means by which the performance of the site management system can be monitored and assessed.

Under the EMS, the following may be specified, as appropriate, according to the management system developed:

5 the specification of working practices and controls

6 the specification of measures that will be taken if problems occurs

7 a schedule of maintaining dust control equipment in a state of preparedness to act as soon as conditions require.