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**Bureau of the Committee for the activities of the Council of Europe
in the field of biological and landscape diversity**

(CO-DBP)

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**CODE OF PRACTICE FOR THE INTRODUCTION OF BIOLOGICAL
AND LANDSCAPE DIVERSITY CONSIDERATIONS
INTO THE TRANSPORT SECTOR**

*Document by the Secretariat General
established by
the Directorate of Culture and Cultural and Natural Heritage*

At their 769th meeting on 17 October 2001, the Ministers' Deputies took note of the Code of Practice for the Introduction of Biological and Landscape Diversity Considerations into the Transport Sector and agreed to transmit it to the Ministerial Conference "An Environment for Europe" (Kyiv, 2003) for endorsement.

CODE OF PRACTICE FOR THE INTRODUCTION OF BIOLOGICAL AND LANDSCAPE DIVERSITY CONSIDERATIONS INTO THE TRANSPORT SECTOR

FOREWORD

In 1998, the Committee for the Activities of the Council of Europe in the Field of Biological and Landscape Diversity CO-DBP established a group to examine the relationship between transport and the environment. This Group of Specialists - Transport and Environment met in Strasbourg on 29-30 October 1998, 21-22 October 1999 and 13-14 November 2000.

The Group was chaired by Mr L WYATT (United Kingdom) and composed of Mr C RANKL (Austria), Mrs C ALIBERT (France), Mr T VERSTAEEL (The Netherlands), Mr S RYBAKOV (Russian Federation), Mr S GUBAR (Ukraine). The Group concentrated its work on developing a Code of Practice for the introduction of biological diversity and landscape considerations into the transport sector. This was in accordance with the objectives of Action Theme 2 in the first Action Plan 1996-2000 of the Pan-European Biological and Landscape Diversity Strategy.

The Code of Practice provides a practical instrument that will help national governments and others involved in the linear transport sector to consider and implement measures relating to the maintenance and enhancement of biological and landscape diversity. The Code sets a political and social framework and proposes policy options for the development of new, and the maintenance of existing linear transport systems in relation to biological and landscape diversity. By building on examples, the Code has developed a series of Practice Pointers.

A number of specialist studies were completed in relation to the Code of Practice. These included the introduction of biological and landscape diversity considerations in the development of road, rail transport and navigable waterways and the legal aspects. In addition, a pilot project was carried out in the Losiny Ostrov National Park, Moscow. For a greater level of detail about the subjects involved, technical readers should refer to these and other reports arising from a number of international and national initiatives.

The Council of Europe Secretariat General appointed the following consultants to prepare the specialist studies and the Code itself:

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CONTENTS

FOREWORD

SUMMARY

MAIN TEXT

INTRODUCTION

Aims and objectives of the code

Structure of the code

Scope of the code

THE TRANSPORT NETWORK AND ASSOCIATED POLICIES

Introduction

The extent of the network the European transport context

Transport policy and sustainable development

Other relevant initiatives

COMMON PRINCIPLES

Introduction

Strategic and environment impact assessment

Protection (conservation+ enhancement) of habitats, species and landscapes

Knowledge + understanding

WAYS TO ADDRESS COMMON EFFECTS TO LINEAR TRANSPORT INFRASTRUCTURE

Introduction

Planning

Design

Implementation + construction

Site Management and maintenance

APPLYING THE CODE; COMPARATIVE EFFECTS AND SOLUTIONS

Introduction

Context

Problems + opportunities-Landscape

Problem + opportunities-Habitats/species

Implications of construction and improvement

Implications of use and management

RESEARCH

Introduction

Technical manuals and experience

Research

Monitoring and feedback

CONCLUSIONS

REFERENCES AND FURTHER READING

APPENDIX SUMMARY OF TECHNICAL PAPERS

SUMMARY

The Pan-European Biological and Landscape Strategy (1996) aims to halt the degradation of landscape and biological diversity across the European region. Action Theme 2 of the Strategy relates to the integration of landscape and biological diversity into other sectors including transport. This Code of Practice is a contribution to progress taking forward this Action Theme forward. The Code relates to linear transport systems, comprising roads, railways and inland navigation along waterways, such as canals and rivers. It aims to assist elected representatives, decision makers, and practitioners as well as nature conservation bodies in the understanding of the main issues and solutions associated with the planning, design and use of **linear** transportation networks i.e. roads, railways and inland navigation channels, in relation to the landscape and biological diversity. Other modes of transport are outside the scope of this Code.

The Code consists of three parts at different levels of detail:

- this summary including the Code of Practice Pointers – provides the main recommendations of the Code in an easily accessible form;
- the main text of the Code;
- supporting technical papers giving more detail and examples – provided the main source of information for the Code. A summary of each paper is included with the main text of the Code. The full versions are available separately.

The main text of the Code provides background information on the existing and proposed extent of the Strategic Pan-European transport network; and on the legal and policy background to transport and landscape and biological diversity within a sustainable development context.

Across the pan-European Region, the linear transport network is characterised by areas of growth and of consolidation. Both can result in significant adverse or beneficial effects for landscape and biological diversity. Importantly the effects of construction, and use of types linear transport systems extend beyond the immediate confines of the scheme. Examples include land use changes and the loss and fragmentation of habitats. Associated with construction the main negative impact on the landscape and biological diversity arises from differences in scale, land take and fragmentation. The ongoing user effects in particular relate to vehicle frequency and associated noise, air and water pollution. User safety can be affected by wildlife crossing the road/ track. Levels of animal mortality resulting from collisions can significantly affect populations of wildlife already under stress. Monotonous alignments and roadside landscapes can induce sleep resulting in accidents.

Areas protected for landscape and biological diversity are particularly vulnerable to transport schemes and should be avoided. As such areas only protect a small proportion of diversity the effects to the wider countryside should not be overlooked. Transport planning and design should adopt an approach which seeks to avoid impacts, where this is not possible, it should identify the best practical mitigation options and as a last resort use compensation measures such as translocation. With adequate planning, proposed and existing transport networks may be able to incorporate positive measures for enhancing landscape and biological diversity.

The planning of transport schemes is supported by legislation and conventions including for protected areas landscapes, habitats and species. Strategic Environmental Assessment provides an early overview of the implications of transport plans and is required under the Espoo Convention and the subject of a draft European Union Directive. Its application reduces the potential risk of transport infrastructure conflicting with valued protected landscapes and habitats.

Environmental impact assessment is a legal requirement for the approval of the majority of major transport schemes particularly in the European Union. Also, it is required by a number of Conventions. Regardless of any legal obligations Environmental Impact Assessment is recommended to aid decision-making in all transport schemes including those supported by donors. The Environmental Impact Assessment procedure should permeate every stage of the planning, design, construction and maintenance of schemes to enable sound decisions to be made in the light of the best information. This necessitates co-ordination across disciplines and an understanding of the dynamic character of the landscape, habitats and species as well as the design and user characteristics of the scheme itself. The attention to detail is all-important.

During the construction and maintenance stages environmental management procedures including monitoring assist with the successful incorporation of measures on the ground to reduce adverse effects.

Although sometimes restricted by land acquisition, a number of opportunities for landscape and wildlife enhancement are associated with the design and management of the soft estate particularly in degraded landscapes and to provide connections with networks such as the Pan-European Ecological Network.

The Code recognises that a number of principles are applicable across the transport sector, however in addition there are a number of significant differences between road, rail and waterways. Also, the application in detail will vary between states depending on the economy, landscape character, biological diversity and capacity. The Code of Practice Pointers presented below, are included in the main text in the section to which they relate. They have been subdivided under four headings: procedures affecting decision making including conservation, enhancement, knowledge and understanding. Project development and management, assessment, review and research. Inevitably there is a degree of overlap in their application between these headings.

Code of Practice Pointers

Procedures affecting decision-making including conservation + enhancement

- Greater integration of landscape and biological diversity is required in the development of transport policies and infrastructure. Its inclusion is fundamental to the development of a

more sustainable transport network across the European region. Already tested procedures are available to assist with sound decisions making but these need wider application.

Procedures affecting decision-making

- For all infrastructure developments governments and/or their agencies must apply strategic environmental assessment (SEA) and the more detailed environmental impact assessment (EIA). This should enable informed, sound decision making on the selection of modal choice, route corridors and subsequent fuller assessment of the effects of proposed schemes together with alternatives.
- Financial institutions/donors must require an EIA of transport projects that they propose to sponsor and consider SEA carried out, previously.

Protection (conservation + enhancement) of landscapes, habitats and species

- Transport routes should seek to avoid legally protected areas and species including under the European Union's Habitats Directive, and Birds Directive, and those protected by international agreements including the Convention on Biological Diversity, the Berne, Ramsar and World Heritage Conventions.
- Throughout the planning, design and implementation of transport schemes there is a need to promote an awareness and implement legislation relating to protected landscapes, habitats and species.
- Consideration of the wider countryside should include developing opportunities for enhancement of landscapes and habitats, and the establishment of links with the Pan European Ecological Network.

Knowledge + understanding

Greater integration requires specialist knowledge and understanding. It emphasises the need for dialogue between members of the engineering and environmental teams; and the need for public participation within the process including with those living locally. There is a particular need to understand and accommodate the dynamic nature of both landscape and biological diversity.

- Document and communicate base data locating valued and/or sensitive landscapes, habitats and species including data from national and local voluntary sources. Encourage the establishment of databases for biological records.
- Understand landscape and ecological processes including the spatial and temporal aspects of landscape, habitat and species.
- Progress the level of data in relation to the stage of scheme design, but when collecting data remember to accommodate seasonal constraints.
- Understand the interactions with other aspects such as the engineering requirements and socio-economic linkages.
- Consult and inform those affected and interested in the scheme as soon as possible and throughout the process.

- Develop a mutual understanding between the client, engineer and environmental specialists including using techniques such as training and workshops.

Project development + management

In the development of transport schemes a multidisciplinary approach is required at all stages with a need to incorporate an interactive approach to both the design and subsequent management. Environmental management and risk assessment procedures assist in informing those involved with constructing and managing schemes as well as those living in the locality. Project development and management subdivide into the stages of planning, design, implementation, and site management.

Planning

- Adopt an approach, which seeks to avoid, mitigate and compensate. In the first instance consider the less harmful options.
- Include an early consideration of landscape and biological diversity within the planning process.
- Focus on significant landscapes/habitats species, for example resolving the effects on threatened species; but do not overlook commonly occurring features of the wider landscape.
- Co-ordinate schemes in transboundary locations

Design

- Relate scheme design and management to the character of the landscape/ scenery and biological diversity in the area
- Adopt a flexible approach to engineering design standards/criteria to accommodate the character and value of the landscape/habitat/species in the area. Consider the appropriateness of standard solutions in the local context.
- Be reactive to opportunities for enhancement/maximising benefits, and minimising disbenefits including fitting the scheme into the wider landscape and relating it to the biological context.

Implementation + construction

- Pay attention to detailed design with respect to the visual and ecological aspects including the use of fauna-friendly designs.
- Initiate/implement procedures to enable the acquisition of appropriate land for environmental mitigation.
- Apply best available technology, including surface materials, feasibility of recycling and recycling of materials/surplus spoil.
- Assess the environmental effects of siting construction camps, storage areas and future associated developments, e.g. service station/marinas, maintenance depot.

- Retain specialists to monitor environmental compliance on site, including during the construction period.
- Inform and involve local organisations/people in these stages.

Site management + maintenance

- Incorporate natural life cycles into maintenance plans, for example the long term development of vegetation.
- Understand and incorporate maintenance requirements and relate to local practices,.
- Establish and review management practices with respect to opportunities for landscape and wildlife enhancement.
- Monitor functioning/performance of environmental measures, for example passages for wildlife, water quality, and adjust as necessary.

Assessment, review and research

To ensure that effective solutions are being applied, monitoring and research is required. The findings of tested and tried methods should be disseminated to a wide audience and include an exchange of ideas.

- Co-ordinate and encourage a pan-European-wide exchange of Design Manuals and Method Statements. Relate these to landscape and habitat types, and encompass languages.
- Encourage an exchange of approach between those involved with the design of roads, railways and waterways.
- Monitor and evaluate the effectiveness of environmental measures and disseminate information relating to new or improved techniques.
- Encourage the application of scientific research to the development of practical procedures and methods.
- Promote further research into the special ecological and landscape implications associated with railways and waterways.

"The biological and landscape diversity of Europe – the variety of flora, fauna, ecosystems and landscapes – is one of our greatest riches. The importance of European nature extends far beyond the boundaries of the continent – it is a vital element in the global ecosystem.

In recent years, European biological and landscape diversity has been in decline: important natural habitats and man-made landscapes have been lost, plant and animal species are under threat. Stopping and reversing this decline is the shared responsibility of the people and nations of Europe. We must pass on our natural heritage – in all its diversity – to future generations as a sustainable system."

Philosophy of the Pan-European Biological and Landscape Diversity Strategy, Council of Europe 1996

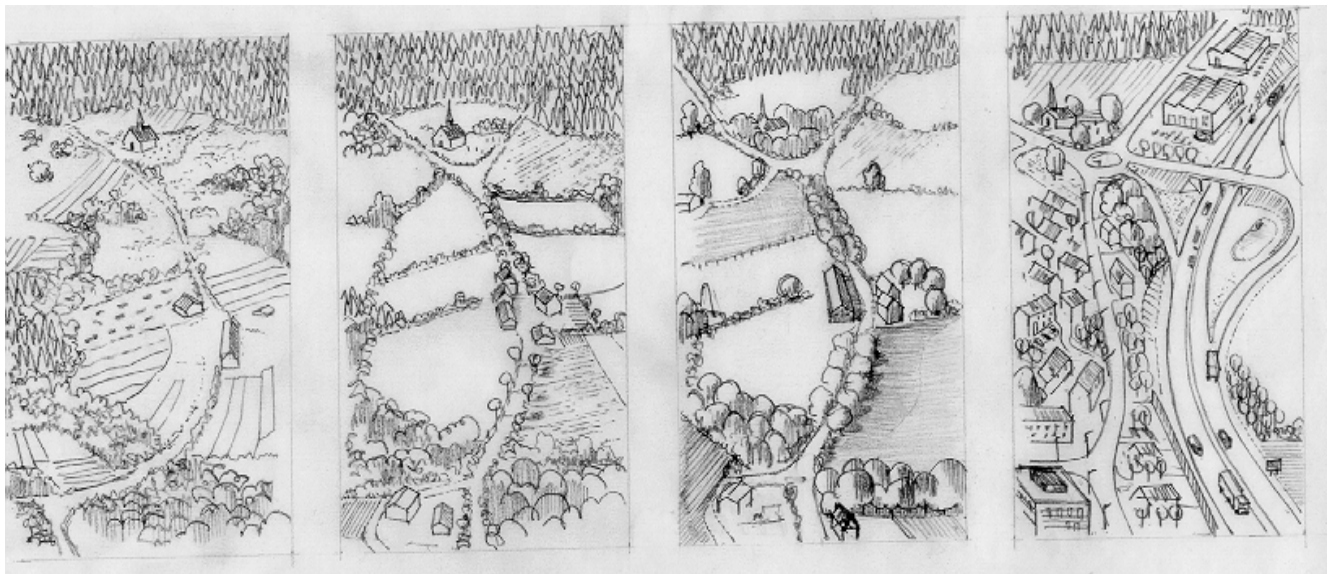
INTRODUCTION

Aims and objectives of the Code

The Code of Practice has been produced as part of the Pan-European Biological and Landscape Strategy (Council of Europe 1996). It aims to assist elected representatives, decision makers, and practitioners as well as nature conservation bodies in the understanding of the main issues and solutions associated with the planning, design and use of **linear** transportation networks i.e. roads, railways and inland navigation channels, in relation to the landscape and biological diversity.

The Code addresses concerns over a number of planned transport routes in Europe, which threaten protected areas and species. The effects of existing poorly planned and designed transport routes are only too apparent including;

- scars on the landscape visible over a wide area;
- dramatic change of landscape character particularly on account of differences of scale resulting from built structures;
- fragmentation of the landscape/ habitats;
- reduction in tranquillity;
- direct loss of protected and therefore valued habitats and species;
- indirect and cumulative/more subtle detrimental effects on landscapes/habitats and species with implications relating to the environment as well as the vehicle/ user safety.



A landscape that has matured through centuries of slow growth, is suddenly rendered susceptible to rapid change. (Adapted from Landskab No.6 1972 illustration by Vidar Asheim.)

Such effects can reduce the value of the natural environmental capital or features of an area and add to the problems of conserving and enhancing already threatened protected areas and species. These detrimental effects can be more exaggerated by lack of coordination in trans boundary locations. Improved planning and knowledge can provide solutions by adopting an approach, which seeks to avoid, mitigate, and for negative effects. Also, improved planning

and maintenance along existing and new routes can realise the value of the soft estate areas usually with some form of vegetation within transport corridors but which transport users do not travel along provide the catalyst to enhance degraded landscapes and habitats.

Structure of the Code

By way of background the rest of this section provides details on the Pan-European Biological and Landscape Strategy and the extent of the transport network across its region. Related transport and sustainable development policies, and other initiatives are described in Section 2. Section 3 considers a number of common principles applicable to roads, railways and waterways including critical legislation and requirements for knowledge. A comparison of common effects is given in Section 4. By way of illustration Section 5 examines problems and opportunities arising from the design, construction and use of roads, railways and waterways. Section 6 considers monitoring the need for exchanges of experience and research requirements. Conclusions are presented in the final section. Code of Practice Pointers have been inserted at the beginning of each sub section and are printed in italics.. Summaries of supporting technical papers are given in the Appendix and the full versions of the papers are presented in a separate volume.

The Pan-European Biological and Landscape Strategy

The Pan-European Biological and Landscape Strategy is an initiative developed in response to the Convention on Biological Diversity (UNCED 1992). The Strategy aims to halt the degradation of landscape and biological diversity in Europe through the encouragement of the conservation and sustainable use of the natural environment.

The initiative was endorsed by the Ministerial Conference in Sofia in 1995. It is co-ordinated by the Council of Europe and runs for a 20-year period from 1996-2016. The Strategy has a joint secretariat provided by the Council of Europe and United Nations Environment Programme (UNEP). It is part of the European implementation of the Convention on the Biological Diversity.

Within the Strategy biological and landscape diversity are defined as follows;

- Biological Diversity; the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Article 2 of the Convention Biological Diversity).

- Landscape Diversity; the formal expression of the numerous relations existing in a given period between the individual or a society and a topographically defined territory, the appearance of which is a result of the action, over time, of natural and human factors and a combination of both (Council of Europe Recommendations on the Integrated Conservation of

Cultural Landscape Areas as part of Landscape Policies).’ (Council of Europe (1996) No. R (95) 9).

The Strategy sets out ten Principles for action:

- careful decision making,
- avoidance,
- precaution,
- translocation,
- ecological compensation,
- ecological integrity,
- restoration and (re)creation,
- best available technology and best environmental practice,
- polluter pays,
- public participation and public access to information.

"To achieve wise management of biological and landscape diversity it requires the application of these principles through all sectors using natural resources including transport."
(Council of Europe 1996).

The Strategy comprises a series of five-year action plans, that for the period 1996-2001 relates to 12 action themes. Theme 2 considers the integration of biological and landscape diversity into a number of socio-economic sectors, one of which is transport, the subject of this Code of Practice. The action theme requires each sector to be examined with respect to the positive and negative implications for landscape and biological diversity.

The Strategy attempts to build on existing legal instruments and considers landscape and biological diversity in relation to socio-economic factors. With respect to transport the Strategy seeks to:

"Integrate biological and landscape diversity considerations into transport policies and infrastructure development, avoiding areas of high value as much as possible, prevent or mitigate negative impacts of infrastructure works and transportation activities on landscapes and ecosystems."
(Council of Europe 1996)

Scope of the Code

For the purpose of this Code of Practice transport includes existing and proposed **linear** transport comprising roads, railways and inland navigable waterways along rivers and canals. It concentrates on major transport infrastructure although many of the principles are applicable also to minor facilities such as byways or narrow gauge railways. To avoid repetition the Code identifies a number of similar features associated with the three types. It illustrates the differences between the types by way of comparison.

Transport terminals such as harbours, stations and airports are omitted from the Code as are marine shipping and aviation. Also, a number of indirect impacts of transport are outside the scope of this Code including the use of fuel, aggregate quarrying, improved access to remote

areas, the increase in development potential and land compensation. These omissions are designed to enable the Code to focus on certain transport issues and do not reflect their environmental effects which can be far ranging.

The pan-European region covers an extensive area comprising a physically and culturally diverse landscape. This Code recognises the major differences in approach between countries reflecting the development of the transport network and the economy as well as natural characteristics such as the scale of the landscape and types of habitat. Thus, a number of recommendations of the Code apply throughout the Pan-European region, but the application of certain details will differ between countries depending on the economy, landscape, biological diversity and traffic flow capacity.

THE TRANSPORT NETWORK AND ASSOCIATED POLICIES

Introduction

This section by way of background considers the extent of the Pan-European transport network. Associated policies including recent Declarations and other initiatives are described.

The extent of the network: the European transport context

The size and variability of the pan-European region significantly influences landscape and biological diversity and needs to be understood in the context of the transport sector. For the most part Western Europe has an established, highly developed transport infrastructure dominated by roads with relatively few proposals for strategic expansion. For example, both Austria and the Netherlands consider that saturation has been reached. The Netherlands is concentrating on enhancing its existing network for biological diversity (Ministerie van Vekeeren Waterstaat 2001). In comparison many Central and Eastern European states are seeking to improve access with plans to upgrade and expand the transport networks.

The density of motorways in Western Europe is two to five times as high as in Central and Eastern Europe (CEE) (Ruppert, 2000) and emphasises the differences between these two parts of the Region. However, in CEE there has been a dramatic growth both in car passengers and in road freight, for example between 1990 and 1995 from 9 to 102 billion car passenger kilometres. Ownership has likewise increased; for example in Slovenia between 1980 and 1994 car ownership increased by 57 per cent. In Poland, Hungary and the Czech Republic levels of car ownership are approaching those typical of EU countries (Fergusson

2000) with the associated problems of congestion. Likewise, the growth in road freight in CEE exceeds the average yearly increase of 3.5 per cent in Western Europe. This is partly related to the decline in rail freight.

The extent of the railway and navigable waterway network across Europe is more variable than highways. Following a rapid growth in the nineteenth century, sections of the network, partly outmoded to transport requirements, either became redundant or in need of modernisation. Recent technological advances have enabled some upgrading to a system capable of supporting high speed and/or larger trains/boats with associated infrastructure. There are plans to expand the waterway network, especially in connecting East/Central Europe to Western Europe.

Transport policy and sustainable development

A basic concept of the Common European Market is the free movement of people, goods and services. In 1992, the European Union issued a White Paper on transport. This identified the serious imbalances in Europe's transport system including bottlenecks such as the Brenner transalpine route in Austria and the poor network in a number of peripheral parts of the Union. In addition, road transport was creating significant increases to atmospheric pollution and dangerous roads resulted in 44,000 deaths a year.

To address these problems the common transport policy established a Trans-European Network for Transport (TEN-T). Other objectives of the policy embrace the concept of modal choice and related to the integration of transport networks to encourage switching to less polluting or underused modes including rail and inland waterways; protecting the environment relating principally to pollution control; and safety including the harmonisation of construction standards and improved infrastructure. Also the European Union is encouraging a reversal to the decline in rail freight.

Seven objectives were approved for TEN-T, in particular objective 1 states:

“Ensure the sustainable and safe mobility of persons and goods within the area without internal frontiers under the best possible social conditions, while contributing to the attainment of the Community's environmental objectives”.

The associated guidelines approved by the European Parliament in 1996 support the objective under Article 2 which requires that TENs should contribute to the Community's environmental objectives.

The 1996 extent of the TEN-T throughout EU member states comprised the construction and upgrading of 140 road schemes including:

- c. 15,000 km of new motorway;
- 11 rail links;

- 57 combined transport projects;
- 26 inland waterways.

The development of the TEN-T remains one of the European Union's top priorities and has received significant funding; for example ECU 38.4 billion in 1996-97 from Community funds and European Investment Bank loans. For the period 2000-2006 the Commission's budget is ECU 5 billion and it seeks to encourage public – private partnerships.

A more recent initiative of the European Union and arising from TEN-T is the Pan-European Corridor for Central and Eastern Europe. The planning and development of these routes is known as TINA (*Transport Infrastructure Needs Assessment*).

Alpine Convention

The Convention on the Protection of the Alps (Alpine Convention) 1991 recognises the ecological importance of the Alps including for a number of endangered species. In addition it appreciates the importance of transport routes across the region. Article 2 of the Convention requires signatories to undertake a number of measures such as to protect and conserve the natural environment and the countryside, and reduce the volume and dangers of Alpine traffic so that it is not harmful to humans or animals or plants, in particular by encouraging road freight traffic to use the railways. To meet these objectives a number of Protocols have been established, with one for transport in 2000.

Vienna Declaration

The Vienna Declaration was adopted in 1997 by the Regional Conference on Transport and the Environment of the UN-ECE. Within the context of an anticipated increase in demand for transport, the Declaration called for its development to be undertaken “within the framework of sustainable development” including the principles of protection, precaution, prevention and ‘polluter pays’ to meet objectives such as preserving public health and ecosystems. The Declaration sets out recommendations and an Action Plan relating to the promotion of energy efficient and less polluting vehicles and fuels including:

- III Efficient and sustainable transport systems
- IV Protection of sensitive areas
- V Safe transport of dangerous goods
- VI Prevention of water pollution

The Action Plan encourages the application of strategic environmental assessment in the transport planning process at the international and national level, with obligatory environmental impact assessment relating to individual schemes at a national level. Also at the national level, it calls for the protection of landscape and ecologically sensitive areas with

respect to the existing and proposed road and rail infrastructure. A review of the Action Plan is proposed in 2002 and 2007.

“Environment for Europe”, Aarhus

In 1998, the year following the Vienna Declaration, the fourth Ministerial Conference “Environment for Europe” held at Aarhus declared that further action was required with respect to the growth in traffic, the associated biological diversity/habitat loss and the need “to secure a sustainable and environmentally sound pattern of transport”. The same conference saw the requirement to develop economic and financial incentives to assist with the integration of biological diversity and landscape conservation into sectional policies.

Hanover Conference (CEMAT)

The Guiding Principles for Sustainable Spatial Development of the European Continent, adopted in 2000 at the Hanover Conference of the European Conference of Ministers responsible for Regional Planning (CEMAT), emphasise the importance of both the TEN-T and TINA network, in particular the need for a rapid completion of missing links so as to improve regional accessibility (Council of Europe 2000, para 20, 21, 34).

Euro-corridors are presented as a priority in the implementation of the Guiding Principles on account of the perceived (but not necessarily proven) association with economic development. Importantly (para. 61) states that the investment in Euro-corridors should take account of the ‘needs of environmental protection’. It goes on to say:

“Major transport projects should not therefore be undertaken without assessing their direct and indirect impact. Structural planning measures must be introduced to reduce any negative effects and highlight their positive impact at local and regional level. Such measures should include spatial and environmental impact assessments for plans, programmes and projects, the co-ordination of regional and inter regional major infrastructure, large-scale landscape planning, securing protected areas or concentrations of roads, railway lines and navigable waterways in a single corridor.”

with respect to transport paragraph 61 is particularly important as it directly relates to one of the main objectives of the Guiding Principles. In relation to the transport network the ten point programme stresses that: -

“the networks should, if necessary, be reviewed and augmented taking sustainable development and environmental aspects into account.”

In addition to the consideration of transport needs CEMAT recognised the role of enhancing and protecting natural resources and the natural heritage in an integrated spatial planning policy.

European Landscape Convention

Recognition is given to landscapes in Europe including the importance of “protecting, managing and enhancing landscapes” thereby introducing the European Landscape Convention (Council of Europe 2000). Signatories to the Convention undertake to encourage public authorities to adopt policies to protect, maintain and improve landscape quality including the need to consider landscapes in public decision making, of particular relevance to this Code of Practice. Article 9 of the Landscape Convention emphasises the need for trans-frontier co-operation including to establish joint programmes. For the purposes of the Convention landscape is defined as:

"an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors".

Thus, in the last decade of the 20th century in the context of the increased demand for transport and the development/upgrading of transport infrastructure, the European region has made Declarations and implemented laws and policies in response to repeated environmental concern including aspects relating to biological diversity and landscape. The Code of Practice provides support for and the delivery of these policies and contributes to the development of a more sustainable transport system.

Other relevant initiatives

Also, the Code of Practice should be viewed in the light of a number of other European and national initiatives such as those summarized below.

COST

The European Union has initiated a number of research programmes including the European Co-operation in the fields of Scientific and Technical Research (COST). Transport forms a principle component of the programme. The associated Technical Committee is made up of representatives of 32 national governments and co-ordinates COST Actions. COST Action 341, “Habitat Fragmentation due to Transport Infrastructure” is of direct relevance and compliments this Code. In particular, it provides a greater level of detail at a technical level on fragmentation (European Commission 2000).

Action 341 seeks to address issues arising from transport-related schemes causing habitat fragmentation including adverse effects on habitats and species as well as on vehicular accidents. The outputs of the programme due for completion in 2003 will comprise:

- the production of a European review of habitat fragmentation due to linear transport infrastructure;
- the production of a European handbook of best practice providing solutions for dealing with the fragmentation effect of existing and proposed linear transport;

- the establishment of an online database of research and expertise in the subject to include existing literature, projects, mitigation measures and databases across Europe.

OECD

The Organisation for Economic Co-operation and Development (OECD) has a road transport research programme. This provides member countries with an opportunity to contribute to the development of transport policies. Programmes encompass activities relating to sustainable transport development. Publications include the “Environmental Impact Assessment of Roads” (1994) and “Strategic Environmental Assessment – the Transport Sector” (1998). The latter arose from a European Conference of the Ministers of Transport.

Other OECD work on transport includes the ‘Environmentally Sustainable Transport’ project. This involved partners from 25 countries and UNEP. The project resulted in a series of guidelines, which received Ministerial endorsement. UNEP Regional Office for Europe is continuing this work on Environmentally Sustainable Transport.

National initiatives

At a national level, several governments and research institutions have co-ordinated research programmes relating to the landscape and biological diversity implications of transport schemes, some forming part of the COST 341 programme. A number of technical manuals have been produced including Norway, Scotland, England and Wales, Switzerland, Netherlands, France and Spain (Cur (1999), Dinetti (2000), Department of Environment, Transport and the Regions (1993) Ministerio de Medio. Ambiente (2000) Muller and Berthoud (1999)). Mostly these relate to highways but may have application to railways and navigable waterways. Following the example set by COST Action 341; a comprehensive list of such Pan-European documents should be compiled to enable their use by a wider audience and encompassing languages.

COMMON PRINCIPLES

Introduction

The previous section provided some illustrations of the extent of the existing transport network together with an indication of planned proposals and noted the major differences in requirements within the Pan-European region. This section seeks to describe a number of principles common to the planning and design of transport schemes. The first part considers the legal framework and methods of approach.

Strategic and environmental impact assessment

Code of Practice Pointers

- For all infrastructure developments governments and/ or their agencies must apply strategic environmental assessment (SEA) and the more detailed environmental impact assessment (EIA). This should enable informed, sound decision making on the selection of modal choice, route corridors and subsequent fuller assessment of the effects of proposed schemes together with alternatives.

- Financial institutions/donors must require an EIA of transport projects that they propose to sponsor, and consider SEA carried out previously.

Background

Environmental impact assessment (EIA) has been variously defined and comprises a method and process whereby information about the environmental effects of a scheme is collected, assessed and used to inform decision-making. As such it should be a continuous process related to the various stages of scheme design and implementation. The application to strategic plans and policies is known as ‘strategic environmental assessment’ (SEA).

The formal application of EIA was first required in the United States in 1969, under the National Environmental Policy Act, since when it has been made a legal requirement in a number of other states world wide including the European Union. A draft European Directive has been prepared on SEA.

Strategic Environmental Assessment

The building of new transport routes requires funding and consent including compliance with legal obligations. Environmental assessment and protected area status therefore are particularly important with respect to the maintenance of landscape and biological diversity. Strategic environmental assessment (SEA) enables an appraisal of plans policies and programmes including strategic alternatives or groups of transport projects and multi-modal networks. SEA is an essential step in the delivery of the transport policies discussed earlier and is particularly relevant for plans, policies and programmes covering several states (trans-boundary). Such forward planning should provide a logical basis for decision-making, including the avoidance of sensitive environmental components like protected areas possibly in the adjoining state.

In isolation the environmental impact assessment of short sections of strategic routes can result in major problems on account of the lack of an overview. The Via Egnatia Motorway

across Greece (Box 3.1) and the road/rail Øresund link between Denmark and Sweden are two examples of how strategic environmental assessment could have informed decision makers of the consequences on habitats of European importance (Bina et al,1997).

The application of *geographical information systems (GIS)* (a type of software for managing and displaying geographical information often using a thematic layering technique) in SEA has proved a useful tool (Box 3.2). However, as with any data its value is dependent on the quality of the database with interpretation guided by understanding the context and limitations of that data. For example, planning a route only to avoid protected areas could overlook the dynamic aspects of landscapes such as migration paths between protected areas, or the relationship between protected areas and other dependent landscapes, such as a river catchment.

The Declaration of the Fourth Ministerial conference at Aarhus in 1998 clearly recognised:

"strategic environmental assessment facilitates the systematic analyses of the environmental impacts of proposed policies, plans and programmes and invite countries and international finance institutions to introduce and/or carry out strategic environmental assessments with the appropriate participation of NGOs and citizens. We emphasise that –with a view to the integration of environmental considerations in the decision-making process in other policies – assessments of international sectorial policies, plans and programmes in the UN/ECE region in areas such as transport, energy and agriculture should be undertaken as a matter of priority".

Much of the European Union network crosses through accession states seeking to join the Union. Under the Espoo Convention (1991) signatories from 34 states agreed to co-operate in assessing the environmental impact of trans-boundary projects. This includes major highways and long distance railways as well as policies, plans and programmes.

The Community Guidelines for TEN-T (No 1692/96/EC, CEC 1996) under Article 8 require the Commission to develop methods for the analysis of the environmental effects of the whole transport network and corridors. A manual has been produced setting out an overview of strategic environmental assessment methods to be used for transport infrastructure (CEC 1998). Currently there is no legal requirement for its use in assessing transport plans, policies and programmes other than in certain member states such as France. A SEA Directive is due to be accepted by the European Union for the assessment of transport plans and programmes.

A meeting of the European Federation for Transport and the Environment (Fergusson 2000) noted the current absence of SEA for the TINA proposals. With the advancement of the proposals, concern was expressed that the undertaking of SEA would not necessarily ensure that significant changes could be made. A variety of other organisations, in particular Birdlife International, have likewise expressed concern.

Box 3.1 Example of where SEA would have been beneficial

Strategic environmental assessment would have been beneficial in the case of 780 km Via Egnatia motorway across Greece. The entire motorway was divided into short 25 km sections to assess the environmental effects. This piecemeal approach prevented an assessment of the cumulative effects including meaningful alternatives. In particular, the assessments of sensitive nature conservation areas were omitted. One section of the motorway would have crossed the habitat of brown bear, a species protected under the EC Habitats Directive. However, as a result of the action of a non-governmental organisation, this particular section was cancelled. (Bina *et al*, 1995), (EC DG VII 1998)

Box 3.2 Examples of the use of SEA

In Germany an ecological risk assessment was undertaken of the Federal Transport Infrastructure Plan. The risk analysis included consideration of information on land use and conflicts with protected areas. Alternatives with a low score were downgraded or rejected. A similar approach using GIS has been applied in Flanders, Belgium, for a new highway between Jabbeke and Knokke.

A pilot study undertaken by BirdLife International examined the potential impacts of some of the TEN-T programme. Also this used a SEA in combination with GIS but was frustrated at a European level by the lack of availability of data sets including sites protected under the Habitats Directive. A more detailed assessment was undertaken of France on account of a more complete data base. The findings indicated that a large number of designated sites would be in close proximity to, and therefore at risk from, proposed roads and railways. (Bina *et al*, 1997)

Environmental Impact Assessment

At a more detailed level than SEA, EIA tends to be applied on an individual project basis and can be informed by the findings of SEA. Numerous EIA publications and Good Practice Guides have been produced and indicate how to apply the method in a general way, and in accordance with legal requirements, including some specific guidance on the application to transport schemes.

European Union Directive on Environmental Impact Assessment (85/337/EEC) (CEC 1985) as amended by Directive 97/11/EEC (CEC1997) requires member states to assess the significant environmental effects of certain public and private projects. This is compulsory for the types of transport project listed under Annex I and discretionary for projects listed under Annex II including inland waterways, railways and roads not covered by Annex I (Box 3.3).

The requirement for an environmental assessment for Annex II projects either can be determined on a case by case basis, or by adopting a threshold criteria, or by a combination of the two, Special attention is needed in environmentally sensitive locations including those covered by the Birds Directive (79/409/ECC), and Habitats Directive (92/43/EEC).

The amended EC Directive on EIA (97/11/EEC) demands consideration of the main alternatives studied and the reasons for the final choice – for example, to avoid a protected area. The developer is required to provide certain specified appropriate information to the case to enable a decision to be made by the authorities. The information supplied should consider significant direct and indirect effects including to flora, fauna and landscape and the interrelationship of these with other aspects. Details of measures to reduce significant adverse effects should be included within the assessment. Cumulative effects must be assessed also (Box 3.4). Cumulative effects can result in significant changes in the landscape and to biological diversity. For example, an existing railway and a proposed road crossing the same valley together may exacerbate the visual effects and severance problems.

Public consultation forms an important part of the process of environmental impact assessment. The application for consent and the information received should be made available for comment by the “public concerned”.

The EIA Directive (85/337/EEC) has been variously implemented by EU member States (IUCN 1990) with particular laws relating to transport schemes. Under the *acquis communautaire* States are required to take on a variety of legislation relating to transport and the environment. This includes adopting the Environmental Impact Assessment Directive. The Vienna Declaration requires the implementation of EIA in planning and building transport infrastructure and is in line with the Espoo Convention 1991. Thus, throughout the European region the application of EIA is strongly recommended even in cases where there is no legal requirement.

Care is needed to ensure that compliance with the legal/ funding requirements of an EIA do not overlook the need to continue the EIA process in subsequent post planning stages of scheme design and implementation. This is very important if features relating to the landscape and biological diversity are to be maintained.

Post construction monitoring provides a check on whether proposals put forward in the EIA have been implemented and are functioning. Feedback can enable fine adjustments to be made. Secondary benefits of monitoring include improvements in prediction techniques. A shortcoming is that the EIA Directive makes no provision for the “*posteriori* examination” included in Article 7 of the Espoo Convention. Generally monitoring is omitted unless supported by a legal requirement/agreement as part of the consent (as in Spain, France and the Netherlands (Fauconnier 2000 2e).

In addition to EIA, other relevant European Directives need to be considered including those on local air quality, noise and water pollution (CEC 2000).

Box 3.3 Type of transport schemes requiring EIA under 97/11/EEC

Annex 1

Construction of lines of long-distance railway traffic.

Construction of motorways and express roads

Construction of a new road of four or more lanes, or realignment and/or widening of an existing road of two lanes or less so as to provide four or more lanes, where such new road, or realigned and/or widened section of road would be 10 km or more in a continuous length

Inland waterways and ports for inland waterway traffic which permit the passage of vessels of over 1,350 tonnes.

Annex II

10. Infrastructure projects:

c) Construction of railways and intermodal trans shipment facilities, and of intermodal terminals (included projects not in Annex I);

(e) Construction of roads, harbours and port installations, including fishing harbours (projects not included in Annex I);

(f) Inland-waterway construction not included in Annex I, canalisation and flood-relief works;

(h) Tramways, elevated and underground railways, suspended lines or similar lines of a particular type, used exclusively or mainly for passenger transport;

Box 3.4 Types of environmental impact

Indirect Impacts: Impacts on the environment, which are not a direct result of the project, often produced away from or as a result of a complex pathway. Sometimes referred to as second or third level impacts, or secondary impacts.

Cumulative Impacts: Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project.

Impact Interactions: The reactions between impacts whether between the impacts of just one project or between the impacts of other projects in the areas".

(From European Commission DGXI (1999) Guidelines for the assessment of indirect and cumulative impacts as well as impact interactions.)

Protection (conservation + enhancement) of habitats, species and landscapes

Code of Practice Pointers

– *Transport routes should seek to avoid legally protected areas and species including under the European Union's Habitats Directive and Birds Directive, and those protected by international agreements including the Convention on Biological Diversity, the Bern, Ramsar and World Heritage Conventions.*

- *Throughout the planning, design and implementation of transport schemes there is a need to promote an awareness and implement legislation relating to protected landscapes, habitats and species.*
- *Consideration of the wider countryside should include developing opportunities for enhancement of landscapes and habitats, and the establishment of links with the Pan-European Ecological Network.*

Habitats, species and landscapes receive varying degrees of protection at a European and local level. Protected sites and species may be adversely affected by transport schemes and therefore are of particular relevance during the planning and construction phases.

The alignment of a proposed transport route is a crucial consideration in the assessment of the magnitude and significance of the effects particularly in environmentally sensitive locations. In these areas such routes should be screened for the need for an EIA.

The Habitats Directive and the Birds Directive

Within the European Union, the Habitats Directive (92/43/ECC) and the Birds Directive (79/409/EEC) establish a network of protected areas (Special Protection Areas (SPAs) and Special Areas of Conservation (SACs)) together forming the Natura 2000 series. This series aims to maintain and restore those listed habitats and species at a favourable conservation status.

Under the Habitats Directive appropriate action must be taken by Member States to avoid the significant deterioration of, or disturbance to the designated habitats and species:

"Member States shall take appropriate steps to avoid, in special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive." (Article 6 (2) 92/43/ECC April 2000).

Member states are encouraged to establish corridors and other landscape features between the protected areas. This could include land associated with transport schemes.

"Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Such features are those which, by virtue of their linear and continuous structure." Article 10 92/43/ECC.

To preserve listed habitats from developments likely to alter their ecological balance, Article 6 (3) and (4) of the Habitats Directive provides for an appropriate assessment:

"any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects..."

This requirement is irrespective of the EIA Directive and is much more stringent. If the assessment predicts a negative effect the development may go ahead only if there are no alternatives, or if there are imperative reasons of overriding public interest, including those of an economic or social nature. In such cases the state concerned must still reduce the impact of the project and adopt compensatory measures.

In addition to sites, the Habitats Directive protects certain priority species listed in Annex IVa. The list is subject to review. Listed animal species living in the wild must be protected from deliberate capture or killing, disturbance, destruction or taking of eggs and the deterioration or destruction of breeding sites or resting places (Article 12 and 13 of 92/43/EEC). Listed plants growing in the wild must be protected from deliberate picking, collecting, cutting or uprooting or selling or exchanging. These conditions may be waived to enable a development to proceed if there is no satisfactory alternative and the development will not be detrimental to the maintenance of the listed population at a favourable conservation status in their natural range. They may be waived also if the development is required:

"for imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment".

The application of Articles 12 and 13 in this section of the Directive is strict, often with significant effects for pending development, for example the presence of a protected species can stop construction works with consequential delay to the programme and with associated additional costs to the developer. A survey immediately prior to tendering or construction should help alleviate such consequences and is especially important when there has been a significant time lapse between the completion of the EIA and the start of construction works. In this intervening period, which for transport schemes can sometimes amount to around ten years, significant changes can occur in the landscape particularly as a response to other development pressures. For similar external reasons the protected status of species can change.

Convention on Biological Diversity

The Convention on Biological Diversity 1992 (UNCED 1992) was a significant outcome of the UNEP Earth Summit held in Rio Janeiro in 1992. At least 175 countries are signatories to the Convention. Article 14 of the Convention requires an EIA for policies and projects that are likely to have significant adverse effects on biological diversity.

The Ramsar Convention

The Ramsar Convention on Wetlands (1971) came into force in 1975 and is concerned with wetlands, particularly those of importance for waterfowl. Contracting Parties are required to designate sites - 'Ramsar Sites'. In Europe, these cover over 5 million ha.

The Convention includes a stringent condition with respect to development:

"designate alternative sites of the original habitat type should the development of any of the presently designated sites become necessary in the urgent national interest".

Bern Convention

The Convention on the conservation of European wildlife and natural habitats, known as the Bern Convention (1979), aims to conserve wild flora and fauna and their natural habitats, especially those species and habitats whose conservation requires the co-operation of several States, and to promote such co-operation. Particular emphasis is given to endangered and vulnerable species, including endangered and vulnerable migratory species. Signatories to the Convention must implement measures to maintain populations of wild flora and fauna. (Council of Europe 1996) Such listed habitats and species should be considered in the planning, design and implementation of transport schemes.

Areas of Special Conservation Interest are established through the Bern Convention 1979. The network of these areas is known as the Emerald Network (Council of Europe 1989). The network makes special reference to transport routes and the need to safeguard crossing routes for migrating animals.

World Heritage Convention

Other international designations protecting habitats or areas of landscape include sites nominated under the World Heritage Convention, adopted by United Nations Education, Scientific and Cultural Organisation (UNESCO) in 1972. The Convention includes Natural and Cultural Sites as well as more recently combined works of 'nature and man'-Cultural Landscapes. Within Europe there are some 15 natural sites. Mainly on account of the prestigious nature (rather than legal) of such a designation the Convention has assisted in the prevention of damage of designated sites (IUCN 1994 Parks for Life) and as such may have political implications in the planning of transport infrastructure.

Biosphere Reserves and other designations

A world network of biosphere reserves has been designated under the UNESCO Man and Biosphere Programme 1971. The reserves represent the world's major biological diversity regions. They are selected on a number of defined criteria and under Article 9 of the Statutory Framework each reserve is subject to a review on a ten-year cycle. Following the Review, if the reserve does not satisfy the criteria it can be excluded from the network, for example as a result of significant detrimental changes from a transport route.

The European Diploma of Protected Areas is an award given to protected areas on account of their outstanding landscape or biological diversity and the efficiency of their protection system. This prestigious award is reviewed every five years and can assist in the protection of sites (Council of Europe 1965).

The Baltic Sea and the Mediterranean Sea are associated with two separate conventions (Helsinki Conventions Helsinki Convention (1974) and Barcelona Convention (1976/1995) and Geneva/Barcelona Protocol (1982 & 1995)). These establish a system of coastal and marine protected areas to conserve biological diversity.

National legislation

At a national level there is a range of legislation providing varying degrees of protection for landscapes, habitats and individual species (ICUN 1992), and Council of Europe 2000). Such legislation may encompass a series of national parks and nature reserves including those on a very local level of importance, and other protected landscapes with an estimated 10,000-20,000 across Europe.

The IUCN World Conservation Union has provided an international classification system for protected areas defined as:

"Area of land and /or sea especially dedicated to the protection of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means." (IUCN 1994)

These areas have been classified into six management categories. Category II National Parks, Category IV Habitat/Species Management Area, and Category V Protected Landscape are those most used in Europe. In spite of such status, many legally protected areas are under strong pressure from development proposals including transport schemes but also from inadequate management (IUCN 1994 Parks for Life). Their ultimate protection from adverse development is dependent on the robustness of the legal system, including the application as appropriate of the Habitats, or Birds Directives, the EIA process, for example the European Union can enforce these Directives.

Pan-European Ecological Network

Valued landscapes and habitats are not restricted to protected areas and there is a need to consider the wider countryside. In this respect, the Pan-European Network was established to form a network of linked areas to ensure the favourable conservation status of traditional landscapes, habitats and species. It was set up as part of the Pan-European Landscape and Biological Diversity Strategy and aims to encourage the coherence and complementarity of the different networks in an ambitious initiative which covers the entire pan-European geographical area and which brings together diverse partners at the different decision levels. The Network is made up of three tiers: core areas, corridors and buffer zones.

Transport networks provide an opportunity to form sections of the corridor and/or buffer areas, in particular by adapting the associated green estate to form specified habitats. Such opportunities can apply to proposed and existing schemes and in both cases landscape management is likely to be a critical issue. To some extent the realising of such opportunities may partly offset other negative effects directly, or indirectly arising from transport schemes.

Knowledge + understanding

Code of Practice Pointers

- *Document and communicate base data locating valued and/or sensitive landscapes, habitats and species including data from national and local voluntary sources. Encourage the establishment of databases for biological records.*
- *Understand landscape and ecological processes including the spatial and temporal aspects of landscape, habitat and species.*
- *Progress the level of data in relation to the stage of scheme design, but when collecting data remember to accommodate seasonal constraints.*
- *Understand the interactions with other aspects such as the engineering requirements and socio-economic linkages.*
- *Consult and inform those affected and interested in the scheme as soon as possible and throughout the process*
- *Develop a mutual understanding between the client, engineer and environmental specialists including by training and workshops.*

Application of SEA or EIA should assist in balanced decision making for the approval of transport plans and projects. Greater emphasis needs to be given to the application of environmental assessment where required, throughout the decision making process, rather than a one-off examination required for building consent only. Within this process knowledge and understanding are essential at a political and technical level.

Knowledge

Knowledge is a fundamental part of the planning process associated with the development of the linear transport schemes (Box 3.5) Three perspectives interplay:

- an understanding of what the scheme comprises in relation to the overall objectives including aspects such as design and safety standards with associated implications relating to vertical and horizontal alignment, construction method, and user characteristics i.e. type and quantity;
- an understanding of the landscape and biological diversity features involved, including their importance, internal dynamics and external influences; and the effects of the transport infrastructure on them.
- an understanding of the effects of the infrastructure beyond the immediate confines of the proposals within the assessment.

Data relating to biological and other environmental records are essential in the application of EIA. The co ordination and establishment of such data bases greatly assists with EIA and should be encouraged. The level of detail required for this information partly relates to the stage of the scheme as well as what is practicable and reasonable. “Snap shot” biological records can be misleading and seasonal constraints to data collection need to be accommodated in the overall programme of the scheme. Apparently premature or on going

collection of data can be important even if the collection is not in line with requirements of the proposals at that time. Statutory and non-governmental bodies may be able to assist in the provision of data.

Knowledge of the geographical distribution of assets should be accompanied by specialist knowledge on the functioning of the landscape/habitat /species. On account of the indirect wide reaching effects of transport schemes this needs to relate to an area beyond the immediate confines of the engineering structures depending on the features involved.

Early involvement of specialists within the design team assists with developing cost-effective solutions in an interactive way; for example the location and type of crossing facility for animal movement (Box 3.6) and user safety; or the alignment over steeply sloping land so as to minimise long distance views; or the need to acquire land in order to implement mitigation measures outside the immediate confines of the engineering structure or boundary fence line. Sometimes little scientific information is available on the distribution or habitat requirements of a particular species affected by the scheme. In such cases the precautionary principle should apply.

Understanding

Actions of the client/developer can be driven by legislation and funding as well as advice from the technical team and/or public pressure, neither of which the client need accept. Traditionally, engineers have led the design and construction of transport schemes, with some fine results. Today, the speed of development pressures together with the multi-faceted and technical nature of schemes demands specialist knowledge including that relating to environmental considerations and legal requirements. Balanced mixed discipline teams assist in this process, but ultimately it is the “client” who has overall control of the work.

The client needs to understand the basis for decisions and any legal requirements. Mutual understanding between the client, engineer and the environmental specialists is needed. For example, so that the engineer understands the broad ecological and landscape objectives and constraints. Likewise, in order to make practical rather than theoretical recommendations, the landscape or biological specialist should have a pragmatic understanding of the nature and scale of large civil engineering transport schemes, including the contractual process. An interactive approach to design and management together with team meetings are advocated to develop an understanding of requirements as well as keeping abreast of the range of ongoing issues.

In a similar way at the construction stage, a relationship needs to be developed between the designer and the contractor to make certain that specified written environmental objectives are correctly implemented on the ground. A culture of awareness is required to ensure that the

right messages are passed through to the machine operators on the “cutting face”. The application of environmental management for example ISO 14001, training and workshops are ways of assisting in this process.

Box 3.5 General landscape and biodiversity effects associated with the structural and user characteristics of linear transport.

Structural Characteristics

Horizontal and vertical alignment influenced by safety/speed standards of user, e.g. steam v. high-speed train.

Land take affected by alignment.

Tunnels/ bridges have set clearance standards.

Ancillary structures and equipment including lighting, fencing, provision of drainage,

Construction activity dominated by earthworks.

Cut across landscapes/habitats providing linkages or fragmentation.

Potential to fragment habitats and landscapes with associated wide-reaching implications.

Potential to disturb natural drainage patterns and microclimate,

Embankments and cuttings available for habitat creation and/or visual integration,

Land acquisition/ redistribution can limit scope of mitigation measures.

Habitat destruction can result in wider indirect effects.

User Characteristics

Linear conduits provide access for goods/people/services as part of transport hierarchy.

Link centres of population or economic activity.

May contain and/or encourage other development resulting in changes in land use.

Structural characteristics influenced by type of locomotive/ vehicle and this is subject to technological change.

Out-moded infrastructure such as abandoned railways or canals may have associated wildlife/ historical/ amenity value, including for recreation.

Air, water and soil/vegetation pollution risk associated with users.

Maintenance programmes of verges essential for users, but provide opportunities for enhancement of associated wildlife/amenity/historical value.

Box 3.6 Animal crossings

In Estonia, until recently traffic has not been a problem to animals. This has changed. An underpass was built on the Tallinn to Tartu road but is not used, largely on account of insufficient study of their movements.

In the United Kingdom, a proposed motorway passed between two separate woodlands. A large roe deer population were present in both woods and moved between them. Deer fencing was required along the road and an underpass incorporating a small stream was identified as a crossing point, however the original proposed dimensions would have been off putting for use by roe deer. A change in embankment design enabled a more suitable size of underpass with associated cost savings.

In the Netherlands, the dense transport network has partly caused the fragmentation of green spaces with associated detrimental effects to certain wildlife. In an attempt to reverse the process the government has established a policy of de-fragmentation covering existing and proposed sections of the network. Work has included the construction and enhancement of eco ducts (special animal crossings), and verge management. Monitoring is undertaken to check for the effectiveness of the measures.

WAYS TO ADDRESS COMMON EFFECTS TO LINEAR TRANSPORT INFRASTRUCTURE

Introduction

This section provides a summary of ways to address common effects to landscape and biological diversity of transport and infrastructure. This is discussed in terms of the planning, design, construction and subsequent management of schemes. Inevitably there is an overlap between these four stages, partly dependent on local permits and procurement procedures.

Planning

Code of Practice Pointers

- *Adopt an approach, which seeks to avoid, mitigate and compensate. In the first instance consider the less harmful options.*
- *Include an early consideration of landscape and biological diversity within the planning process.*
- *Focus on significant landscapes/habitats and species, for example resolving the effects on threatened species; but do not overlook commonly occurring features of the wider landscape.*
- *Co-ordinate schemes in transboundary locations.*

The benefits of strategic and scheme environmental assessment have been discussed in section 3. The planning of a scheme should aim to avoid sensitive valued landscapes and habitats. Inevitably a balance is required with these and other factors. To complete an assessment requires knowledge of the characteristics of the scheme, the likely effects and the measures required to reduce the negative effects. Examples of this type of information are summarised in Table 5.1 to 5.4. The earlier the involvement of landscape and ecological specialists the easier it is to accommodate changes to the engineering scheme, In the first instance least harmful alternatives should be considered.

Whilst initial effort should focus on specially protected areas and species, still it is necessary to consider more commonly occurring features which contribute to the diversity of the locality, for example the type of field boundary. Positive benefits can be achieved by co-ordinating the transport infrastructure with adjacent land uses, for example to assist with the development of landscape/habitat corridors (as suggested for the Pan-European Ecological Network).

Where schemes cross national boundaries differences in legislation can lead to a double standard and unnecessary confusion. Co-ordination is required and for practical reasons it is easier to adopt one set of standards. Other problems relate to the mismatch of a scheme either side of the border with one section/terminal unknowingly determining the alignment of the section in the adjacent state with potential repercussions for protected areas. These matters should be addressed during the planning stage.

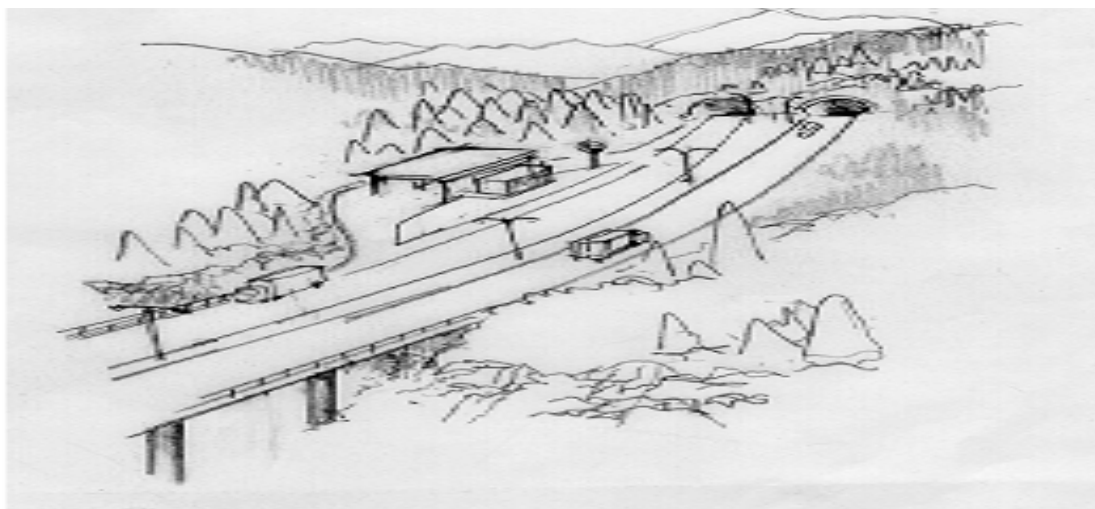
Design

Code of Practice Pointers

- Relate scheme design and management to the character of the landscape/scenery and biological diversity in the area.*
- Adopt a flexible approach to engineering design standards/criteria to accommodate the character and value of the landscape/habitat/species in the area. Consider the appropriateness of standard solutions in the local context.*
- Be reactive to opportunities for enhancement/maximising benefits, and minimising disbenefits including fitting the scheme into the wider landscape and relating it to the biological context.*

Roads are associated with greater environmental effects than either rail or water transport but this largely reflects the demand and associated extent of the network. In some locations railways and waterways can be equally or more damaging than roads. Strategic environmental assessment should help to draw out such major differences as part of the evaluation of alternative solutions. At a much more detailed level, the application of EIA to the design

process of the scheme should enable decisions to be taken to accommodate local characteristics.



Example of a transport corridor which is inherently alien to the countryside through which it passes.

The engineering design standards of a scheme relate to the provision of safe conditions for the user with consequential differences in landtake (Table 4.1). Thus the need for gentle curves and gradients on motorways or high-speed trains (HST) have the potential to cause a greater negative effect than a more local scheme. However, larger schemes are associated with a greater need for funding and legal control, including an EIA. Such control can regulate the need for the scheme and ensure the quality of detailed design including adopting a flexible approach to engineering and other design criteria and/or standards in order to accommodate local features of landscape and ecological value. As new technologies are developed the design will need to consider their environmental effects.

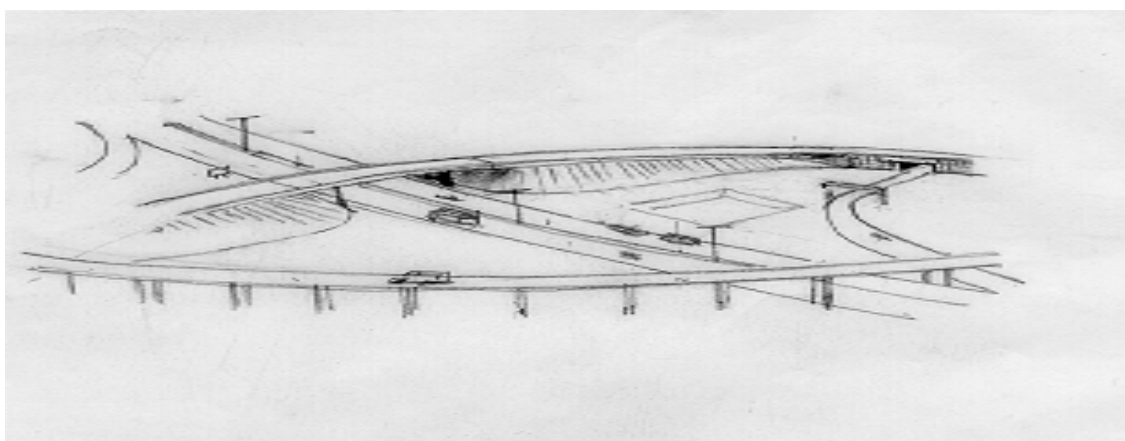
Minor (local) and upgrading transport schemes may be subject to fewer legal restrictions but can cause significant negative effects, particularly in locations where the scale of the landscape is small and the value of biological diversity high. Such effects should be identified in an environmental impact assessment. This highlights the benefits of following the environmental assessment approach in all cases.

Table 4.1 Comparative land take for different design standards of road and rail

	Design Standard	Total cross-section (m)	Surface area (ha/km)
Rail	classic	25	2.5
	AST upgraded	32	3.2
	HST	35	3.5
Road	2x1 traffic lanes	60	6.0
	2x2	90	9.0
	2x3	100	10.0
	2x4	120	12.0

Source: CEC 1993

Particularly in degraded or intensively developed localities opportunities for the enhancement of landscape or biological diversity can result from the construction of transport infrastructure (Verheyden and Meunier, 1998). This can be more successful when enhancement focuses on particular landscape features, habitats or species. Other initiatives may be able to achieve such enhancement outside of the transport corridor for example, agri environment schemes which change agricultural practice.



Geometry dominates the transport network.

Implementation and construction

Code of Practice Pointers

- Pay attention to detailed design with respect to the visual and ecological aspects including the use of fauna-friendly designs.
- Initiate/implement procedures to enable the acquisition of appropriate land for environmental mitigation.
- Apply best available technology including surface materials, feasibility of recycling and recycling of materials/surplus spoil.

- *Assess the environmental effects of siting construction camps, storage areas and future associated developments, e.g. service station/marinas, maintenance depot.*
- *Retain specialists to monitor environmental compliance on site, including during the construction period.*
- *Inform and involve local organisations/people in these stages.*

Land acquisition is a crucial stage in the construction process. The procedures vary between states but where possible the area acquired should include land needed to ensure the implementation of mitigation and compensation measures. Without the acquisition of such land there is no certainty that land occupiers will agree to the proposed measures with a greater risk of consequential long-term environmental problems.

Available information on the scheme at the approved time of submission for planning approval can vary. The level of detail in the environmental impact assessment can vary and also is mostly led by the engineering design including information on ground conditions from the site investigation. Prior to construction work there is an opportunity for a further level of detail design where landscape and ecological matters need to be re considered alongside engineering, for example the design of the drainage to integrate with the setting or protect wildlife including water balancing facilities, and the benefits of different types of surface materials. Just before construction starts the need for additional surveys should be considered, especially for species which may have moved since the original surveys were undertaken.

The best environmental and cost benefits are achieved where there is a balance in the earthworks i.e. cuttings and embankments. But this is not always possible, for example site investigation may find that excavated material is unsuitable to re-use for construction purposes and requires land for disposal. Knowing that this is likely will assist the development of more sustainable solutions and the application of best available technology. For example, using surplus or recycled material to integrate the scheme into the landscape, or restoring borrow pits to benefit waterfowl. The ‘need’ to import material can extend the ripple of environmental effects of the scheme but is outside the scope of this Code.

Transport infrastructure differs from many other forms of development on account of its linear nature and the associated extensive interface of construction works. Earth storage areas/borrow pits and plant may be established along the route to reduce haulage costs. Access for construction vehicles may require widening/upgrading of the local transport network so spreading the environmental effects of the transport line over a wider corridor. The fine detail of such proposals may be known only at a relatively late date in the programme but at the time of scheme approval can be controlled by the placement of “no go” areas within and adjacent to the construction corridor. As an absolute minimum it is important to locate sensitive areas in the corridor to avoid risk of damage.

Procurement and contractual arrangements vary with the traditional separation between the client, “designer” and the builder where the designer acts on behalf of the client supervising the works. More recent arrangements include “design and build” where the contractor is responsible for the detailed design and construction to meet the overall objectives of the scheme. In this case, an agent may represent the client. The agent checks that construction work is implemented following procedures set out in a number of agreed method statements. This approach can provide a closer relationship between those advising on landscape and

ecological aspects, and those directly undertaking construction work. It requires the retention of specialists within the construction team.

The application of Environmental Management, i.e. ISO 14001 (ISO 1996), enables the planning of construction operations so as to reduce the environmental risk including programming of work, for example, to relate to the seasonal requirements of certain species, such as clearing trees outside the bird breeding season. Compliance with legal requirements gives greater weight to the management system and this in turn is fundamentally dependent on the robustness of the local legislation and regulations.

Inevitably, construction activities directly affect land occupiers as well as local residents. Relationships with both these groups will be eased considerably if they are kept informed. This assists with community relations and can have additional environmental benefits with respect to monitoring and early warnings of accidents. Specialist interest groups, for example local conservation or hunting organisations can assist with monitoring movement patterns of certain species and supplement other data collected on a professional basis.

Site management and maintenance

Code of Practice Pointers

- *Incorporate natural life cycles into maintenance plans, for example the long term development of vegetation.*
- *Understand and incorporate maintenance requirements and relate to local practices.*
- *Establish and review management practices with respect to opportunities for landscape and wildlife enhancement.*
- *Monitor the functioning/performance of environmental measures, for example passages for wildlife, water quality, and adjust as necessary.*

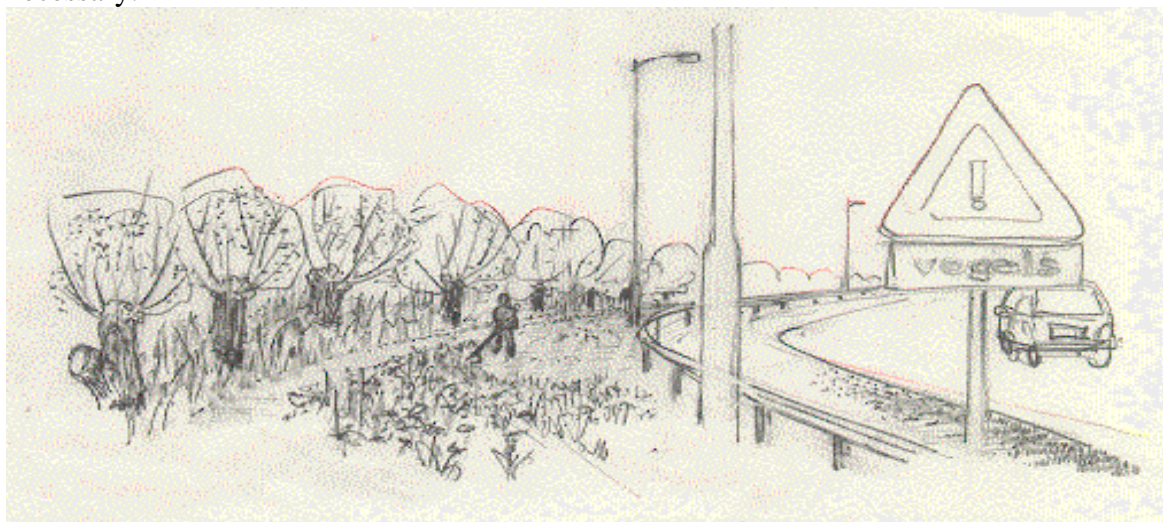
For the safe functioning of the scheme, ongoing management is required for the hard and soft estate. This too can have environmental consequences, for example combating icy conditions by application of salt, or the application of herbicides can result in the pollution of local watercourses and/or the contamination of the soil with consequential affects to the flora and fauna.

For landscape maintenance programmes the setting and reviewing of management objectives for the soft estate is helpful in order to accommodate the growth of vegetation. Functional or

safety requirements can be combined with those for visual purposes and wildlife i.e. to include regular checking of fence designed to protect the road from crossing vertebrates, or relate the cutting frequency of grassland maintenance to encourage butterflies.

Opportunities are available to enhance the soft estate within the scheme boundary. These should form part of the long-term management plan over say a 20-30 year period. Enhancement of existing transport infrastructure may be driven by wider environmental objectives (Box 3.6) although associated cost advantages have a role also, for example the provision of a wildlife crossing can reduce accidents and thereby save money. These measures have been implemented on some roads and there is a need for similar considerations along both the rail and waterway network.

The design of a scheme may include special measures to protect biological diversity and landscape. In addition to checking that these measures have been constructed correctly, monitoring should be undertaken as to the effectiveness. This is needed on account of unpredictable responses of wildlife to external changes and to changes arising from the route itself. Monitoring should enable the effectiveness of measures to be reviewed and adapted if necessary.



Management of the soft estate should seek to "encourage" biodiversity and landscape integration.

Box 4.1 Pilot Project: Losiniy ostrov National Park

The “Losiniy ostrov” National Park is located on the north-eastern side of Moscow, between Moscow and the cities of Korolyov and Miytischi. The Park includes a variety of ecosystems including primary forest. A large number of types of animals are present in the Park including those that use it for a migration route. The Park has an important social and educational function.

The Park is influenced by the presence of built up areas, and by the Moscow Ring Highway (MKAD)/Lesser Ring of the Moscow Railway (MK MZhD) on its boundaries. The proposed Third High Speed Ring Expressway is likely to cross the park, and will require interchanges/crossings of the existing roads and railway line.

The pilot project reviewed the current MKAD and proposed Expressway with respect to animal movements along existing and potential crossing points; and wider environmental effects.

The conclusions and recommendations were that there was a need to:

1. Ensure that the crossing points are situated on routes where animals are known to cross, and the surfacing of those routes is as natural as possible.
 2. Ensure the animal crossing points are clear of snow and rubbish dropped by human beings, with the necessary coordination between road maintenance workers and park wardens.
 3. Provide Buffer zones between the road and forest, with consideration given to pollutant resistant trees to reduce the pollution of primary forest areas.
 4. Ensure that the highway maintenance protects the surrounding environment in the park, from problems caused by the overuse of herbicides and pesticides; dust from the road; and the overuse of de-icing materials.
 5. Design landscape measures to maximise the wildlife benefit rather than for purely aesthetic reasons.
 6. Ensure that all contract documentation relating to the new project, its design, construction and maintenance, fully take into account the importance of the Park.
- (Rybakov 2000)

APPLYING THE CODE; COMPARATIVE EFFECTS AND SOLUTIONS

Introduction

By way of illustration, this section makes comparisons between the effects associated with roads, rail and navigable waterways and suggests solutions applying principles of the Practice Pointers relating to landscape and biological diversity. Further detail is included in the specialist technical reports (Appendix). Tables 5.1 to 5.4 located at the end of the section provide a comparative summary of much of the information.

Context

There are a number of essential differences between roads, railways and waterways. The context for the differences needs to be understood particularly when considering modal choice (Table 5.1).

Roads

Possibly on account of the extent of the road network, the associated implications relating to landscape and biological diversity have been studied in greater detail than for rail or waterways. The road network is well-documented and characteristically hierarchical including ancient lanes a few metres wide with occasional use. At the other extreme are motorways with numerous lanes in each direction with rapid movement of traffic, although occasionally it can standstill on account of the lack of traffic capacity

Continued building of further roads is not an automatic solution to congestion and more radical solutions are being sought, for example road pricing, modal split. In other cases roads are associated with specific types of development, for example the short-term abstraction of timber or minerals, or military objectives, or to benefit tourism.

Apart from obvious differences in the hierarchy such as the dimensions and the level of use, other differences relate to characteristics of interchanges (nodes) and (Table 4.1) associated facilities. Usually motorways have minimum curvature and gradients, junctions are grade separated often with lighting, service stations and resting areas are integral, the motorway is fenced and users are restricted i.e. no horses or learner drivers. Local roads may include sharp bends and steep gradients, have few crossing or entry restrictions, need not be fenced and generally service areas form part of adjacent development i.e. alongside housing etc. Such differences can have consequential implications with respect to the effects on landscape and biological diversity including those resulting from cumulative effects.

Railways

The extent of the European railway network is considerably less than that of the road network. The turn of the 21st century heralds a period of growth with technological advancements enabling faster trains with associated upgrading or construction of new tracks and rolling stock, and intermodal facilities. Rail freight is being encouraged to revitalise. A number of abandoned tracks are being re-opened for recreational purposes, for example cycle routes; as well as for new roads and commercial rail traffic.

A typical cross section width of a railway is about half that of the equivalent road (Table 4.1). Most lines are associated with additional land for sidings, maintenance depots and stations. Generally the line is accompanied by overhead cables and is fenced. Crossing points are either

at grade (level) or grade separated. High-speed trains require the most stringent standards of track with implications for the horizontal and vertical alignment.

Waterways

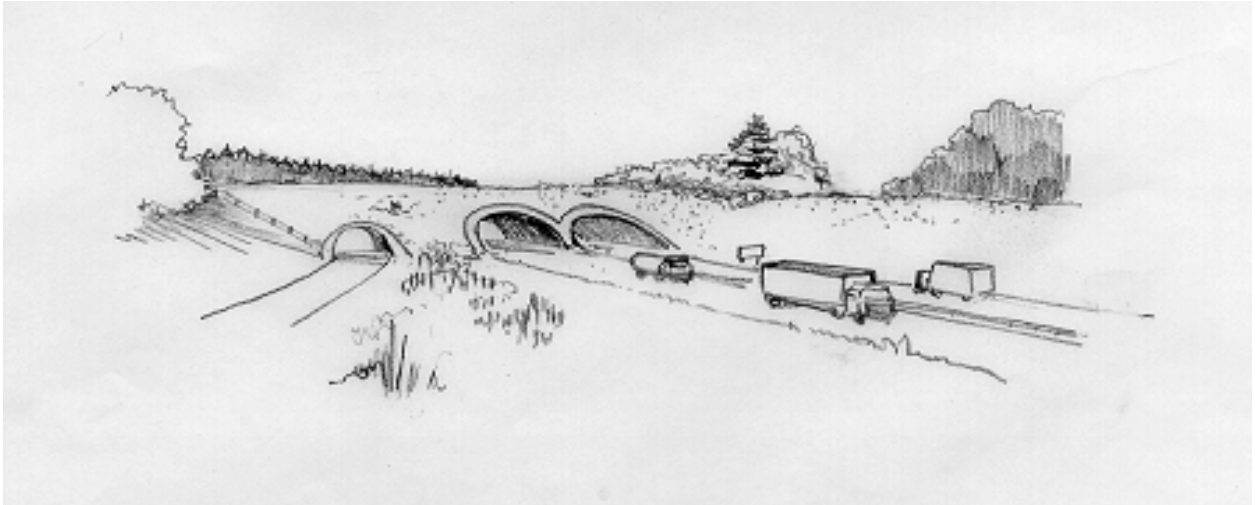
Inland navigable waterways comprise canals and navigable rivers. After an early expansion in the Industrial Revolution waterways were unable to compete with railways and later road freight. Subsequently recreational uses developed. Other uses of canals relate to drainage, routes for telecommunication cables and water transfer. The multi-purpose use of waterways distinguishes them from roads and railways.

Within the pan-European region the extent of waterways is a fraction of both the road and rail network. However, the waterway network plays a greater transport role in some lowland states and in the lower reaches of large rivers it is the main form of access, for example in parts of northern Siberia. In the Netherlands about a fifth of the total inland freight tonnage is conveyed by boat and half of the 5000 km of waterway is available for boats over 1000 tonnes but even here much of the network is used for recreational purposes. In contrast, in England and Wales well over half of the waterways are either abandoned or not navigable (DETR 2000); navigable sections contribute to the carriage of one percent of the domestic freight.

The carriage of freight along larger navigations seems set to continue and the size requirements of the industry increase, with implications for the upgrading or construction of new navigable waterways. Large vessels set the requirements for other users (Bekker G et al 1991).

Canals are artificial in origin although some have developed from watercourses; in contrast navigable rivers are natural. Compared with road and rail, the alignment of canals has the least flexibility due to the need to maintain the same level. This has resulted in some dramatic aqueducts as well as extensive embankments. Locks provide the means of descending slopes. Their width determines the maximum width of boats using the waterway. As with roads and railways some features on canals can be of historic or landscape importance e.g. aqueducts and pump houses.

Bank protection is required particularly for canals to accommodate shipping loads. Some canals need access tracks for maintenance purposes. Regulation of flows and the creation of navigation channels by dredging are required to enable transport use of rivers.



The ecoduct corridor for wildlife on the A50, Veluwe Netherlands, also provides visual connectivity across the corridor.

Long distance sight lines are necessary in the vicinity of structures over the channel which in themselves need a high clearance to accommodate boats. Such bridges may need large approach embankments. As with railways, terminals (ports, harbours, marinas) are an essential part of the network and require land.

Problems and opportunities - Landscape

Protected landscapes, beauty spots and sites of cultural significance (views in and out) including IUCN Category V (National Parks) and World Heritage Sites are areas where perhaps most care should be exercised in the planning of new schemes but not exclusively. Care needs to be exercised along the boundaries of such areas depending on their robustness; strict avoidance or breaching a boundary line could result in a greater landscape impact than an alignment within it. Much depends on landscape character, scale and grain in relation to the direction of the route, for example avoid creating nicks by earthwork cuttings and vegetation clearance on the skyline of an escarpment, avoid the need for great embankments on the valley floor or cuttings creating scars on bluffs of hillsides, avoid alignments along the immediate foreshore in lakeside locations (Cooper 2000).

The landscape assessment as part of the EIA requires an understanding of the character and the dynamics of the wider area through which a route passes including the way that the landscape is likely to respond in the longer term – for example loss of hedgerows in the adjacent area through land exchange, or pressures for built development associated with improved access. Early anticipation can assist in safeguarding significant features of landscape, historical and cultural value. Where possible the environmental assessment should enable the selection of an alignment which can flow with the landscape.

At a further level of detail, and to improve integration into the wider landscape is the design of structures. These should respond to the local landscape character and small adaptations may be able to provide facilities for wildlife crossings (Highways Agency (1996). Other structures such as noise barriers associated with certain roads and railways require integration and can double up as visual barriers (false embankments).

Roads

Roads can cause significant changes in the landscape with consequential implications to diversity. The assessment of roads in the landscape needs to be considered both from the road and of the road. The former relates the road user experience and influences driver safety for example induced drowsiness from a long straight alignment. The view of the road can dramatically alter the landscape with respect to the road itself and day and night time movement from vehicles. Lighting can be particularly disruptive in a remote landscape on account of the night-time "glow" and regular occurrence of lighting columns. Upgraded roads are vulnerable to future built development on account of improved access.

Planting of the road embankments and off site areas can provide screening for both the engineered structure and traffic movement but should be related to the landscape character. Close liaison with the ecologist should assist with the appropriate habitat enhancement/creation, for example species rich grassland, planting associated with animal crossing points as well as the longer term management of the soft estate.

Railways

Compared with roads, the more restrictive vertical and horizontal alignment required for the railway track reduce its flexibility to easily integrate with the landscape. In addition crossing structures may need to be substantial, and clearance zones, including cuttings are required to ensure safety from avalanches, falling rocks and trees. Safety requirements can reduce the potential screening benefit of planting on such embankments. Integration is simpler when the line is able to follow the landscape grain e.g. round the side of a hill.

There is a need to distinguish between long established parts of the network and those subject to recent upgrading or construction. With the benefit of time some sections may have integrated into the landscape but in other cases there is still discord between the alignment and the present day landscape character.

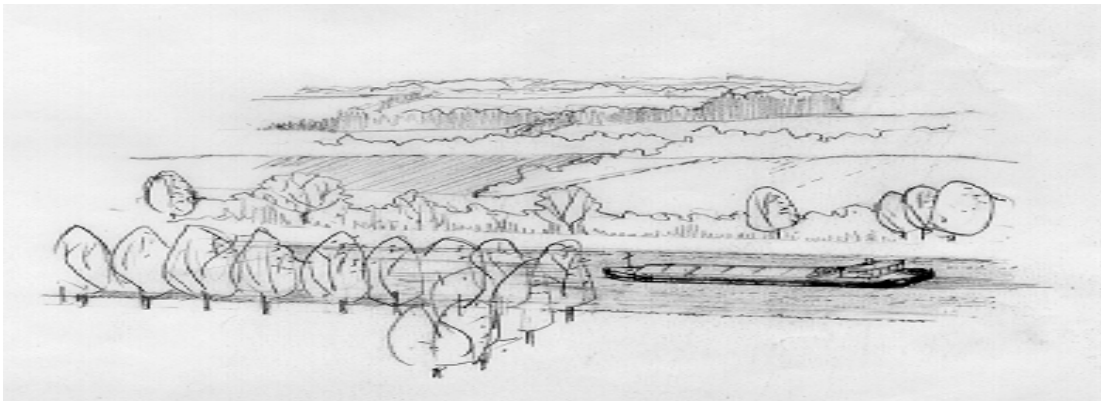
Legislation relating to land take associated with construction differs on a national basis. In some states compulsory purchase of land is restricted to that required directly for rail building with proposals for wider scale remedial planting being the responsibility of the municipality and the agreement of landowners therefore is less certain (Bakker 1997).

Waterways

The artificial structures associated with canals cut across the landscape with little relation to the natural scale (depending on the size of the channel). In lowland areas relatively small increases in height of an embankment are obvious over a wide area, and can form a regular skyline dam-type feature across the landscape.

In contrast, the natural origins of navigable rivers mean they are most closely linked with the landscape character. However, the visual effects of canalisation, dams, bank works and regularity of the flow for both navigation and flood prevention purposes should not be underestimated, for example the loss of seasonal changes associated with freezing, flooding, and low flow; irregular channels are associated with braiding, islands, and marsh land (Travers Morgan, 1987). Such regulation directly erodes the landscape diversity of river valleys. This is particularly important to understand on account of the relatively few remaining natural rivers.

Large bridges are often associated with navigations. These provide an opportunity for spectacular structures, which can unify a landscape or create an eye sore! As with roads and railways, bridges need to be appropriate to the landscape character and attention to detail is all important (Highways Agency 1996).



Mitigation should have its origins rooted in the character of the landscape which is affected. In this case the new planting reflecting the landscape structure and species

Problems and opportunities - Habitats/species

Direct land take causing loss of habitat and possibly fragmentation are common to all forms of linear transport infrastructure, but mostly the land take footprint of roads is larger. The direct land take effects depend on the diversity of the landscape. However, compared to railways and canals, the roads have the most flexible alignment, providing more opportunities to avoid valued habitats.

Barrier effects arise whereby animals are unable to easily cross the route as a result of fencing, structures, traffic flow and, in colder climates, walls of snow or steep banks in the case of waterways. The consequences can result in:

- a threat to the viability of affected populations as a result of genetic isolation and/or of isolation from a seasonal food source particularly for migrating species,
- a risk of accidents to road and rail users when larger animals attempt to cross the carriageway/line,

– negative affects to measures designed to rescue vulnerable populations (as an indirect consequence of a barrier).

To accommodate animal movements requires a knowledge of the behaviour and territories of affected /vulnerable populations. In the case of larger mammals like the moose (*Alces alces*) it can relate to an extensive area. The incorporation of crossing points is easiest if known about early in the design process. To channel their use, crossing facilities need to be accompanied by protective fencing and associated planting. Fencing requires a long-term maintenance commitment if it is to be effective. Subsequent monitoring can check the appropriateness of the particular design and result in fine adjustments taking place. Spatial planning in the wider area must protect ecological corridors connecting the crossing points. This may be the responsibility of a different authority to that concerned with transport related issues.

The physical construction of a transport route can block natural drainage patterns of water and of air. This can cause changes to the adjacent habitat, for example drying out of a valued wetland with resultant changes to the associated flora and fauna including loss of species. Other changes to wetland habitats can result from the diversion of numerous small streams into one side ditch. Early in the project design specialist skills are required to assess the ecological consequences of such changes, and the need for remedial measures as well as areas of opportunity. In an impoverished habitat this can be put to good effect through habitat creation.

In landscapes adversely affected by development or economic activities, opportunities should be taken for positive landscape enhancement to develop new landscape qualities and structures in association with the route, rather than the more limited screening or integration function. Such planning can be undertaken in conjunction with enhancement of biological diversity including as a contribution to specific targets in biological diversity action plans or strategies. To ensure implementation, wider scale works outside the boundary fence need to be related to land acquisition, or undertaken by agreement on a voluntary basis, and/or with fiscal incentives/ grants etc.

In areas of intensive agricultural production or degraded landscapes, the design of transport schemes can provide major opportunities for improving the wildlife value of the adjacent area; for example planting along the embankment/verge to provide a linkage between two woodlands important for butterflies but otherwise separated by arable production (Bickmore 1992). Verges can be designed as a linear nature reserve with possibilities for the Emerald Network. Small severed areas of adjacent land can likewise be developed and managed for wildlife benefit. Care needs to be exercised to ensure that such enhancement will not attract species that subsequently get killed by road or rail traffic.

Roads

The frequency of vehicles along roads creates the greatest risk for animal crossing movements with consequential danger to drivers and the species concerned. Crossing facilities for low-flying animals, e.g. lesser horseshoe bat (*Rhinolophus hipposideros*), barn owl (*Tyto alba*) can be problematic particularly for roads, although in some areas roadside verges can be important hunting grounds for these species.

In addition to negative changes arising from land take and fragmentation are those caused by effects on land beyond the road boundary such as lighting. For reasons of safety lighting is associated with roads in built up areas or around junctions and can be disruptive to the behaviour of certain species of bird, bat and night flying insects, a problem particularly near known populations of rare species. Similarly effects to adjacent land are associated with emissions arising from vehicles causing air and water contamination. Some studies have suggested that breeding birds are affected by the noise of traffic. Clearly knowledge of adjacent sensitive habitats and species is critical.

The large surface area of roads can result in a surge of surface water run-off into neighbouring watercourses. Water balancing/attenuation ponds are designed to minimise this effect. They can be adapted also to provide a beneficial wetland habitat; however, maintenance of the primary function of the ponds is crucial to their success. Water storage ponds may be required for fire control and can similarly be adapted. Such opportunities may provide positive benefits for wildlife at little extra cost and can help offset other negative effects. The application of best available technology has resulted in the use of porous tarmac, which can reduce surface water run off as well as have other benefits such as reduced spray and traffic noise.

Railways

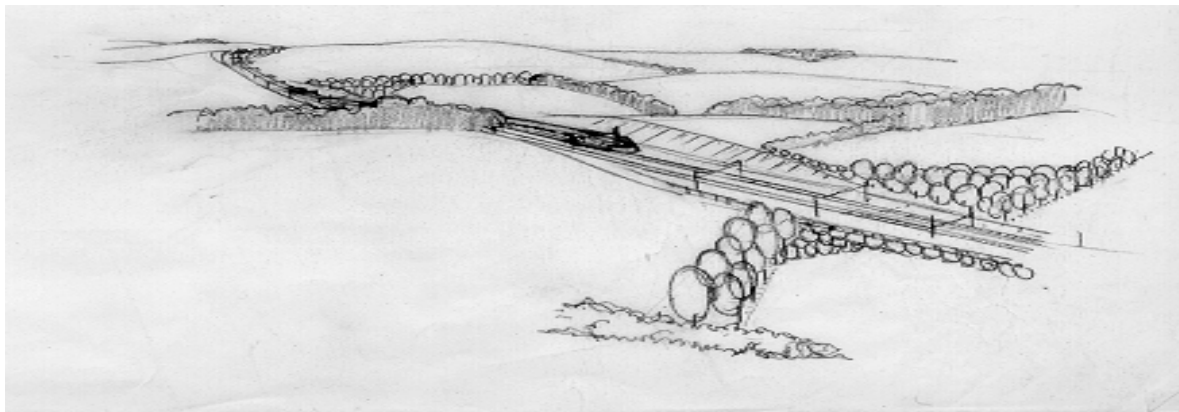
The effects of railway-induced fragmentation and associated habitat severance have not been extensively examined. Compared with roads the intermittent frequency of the trains provides certain wildlife with a greater opportunity to safely cross the track. (Tunnelling is discussed on the section on construction). Work to date suggests the ability to cross is quite variable between species. Migrating amphibians are known to have difficulties in crossing railway ballast (COST 341). One monitoring study confirmed that greater attention to fine detail would have increased use of the crossing facility by certain vertebrates, for instance the planting of cover near the entrances. More important was the relative location of the crossing to the particular species concerned (Rodriguez et. al. 1996). Fencing did not always prevent vertebrates gaining access onto the line.

In some locations railway embankments are associated with a relatively diverse specialist flora. The embankments provide some opportunities for the development of wildlife corridors but unlike roads these can be of limited length (compartments) on account of the restricted

distance between the ballast and the side wall of culvert bridges, on some bridges the track bed may include holes. Efforts to link areas of semi-natural habitat outside the fence line can be thwarted by the reliance on adjacent land occupiers (Bakker 1997).

Other measures are under study include adapting ballast size in selected places to facilitate the crossing of amphibians, reptiles and small mammals, the use of anti-perch devices, and extra large insulators to reduce the risk of electrocution, and winter feeding of certain species of wildlife to encourage them to stay away from railway lines (Berthoud 2001).

Railway embankments may be attractive to certain species that accept disturbances caused by the trains but this is not beneficial always. For example local rabbit populations have reached unacceptable levels, damaging adjoining crops.



The objective should be to break down the directionality in the landscape, eg. by planting away from the route and integrating with the pattern of the landscape including field boundaries

Waterways

Canals can cause wide-scale hydrological changes to the surrounding area including drying out of the flood plain with associated changes to sensitive wetland habitats and species. Changes to species can occur when waterways from different river catchments are connected with the risk of introducing aggressive species, or a modified biochemical composition (Kurstjens 2000).

Many long established canals have developed a diverse aquatic and bank side flora and fauna including species typical of lakesides. On this account a number of canals have been given legal protection, including as Special Areas of Conservation. This has implications if boat traffic increases.

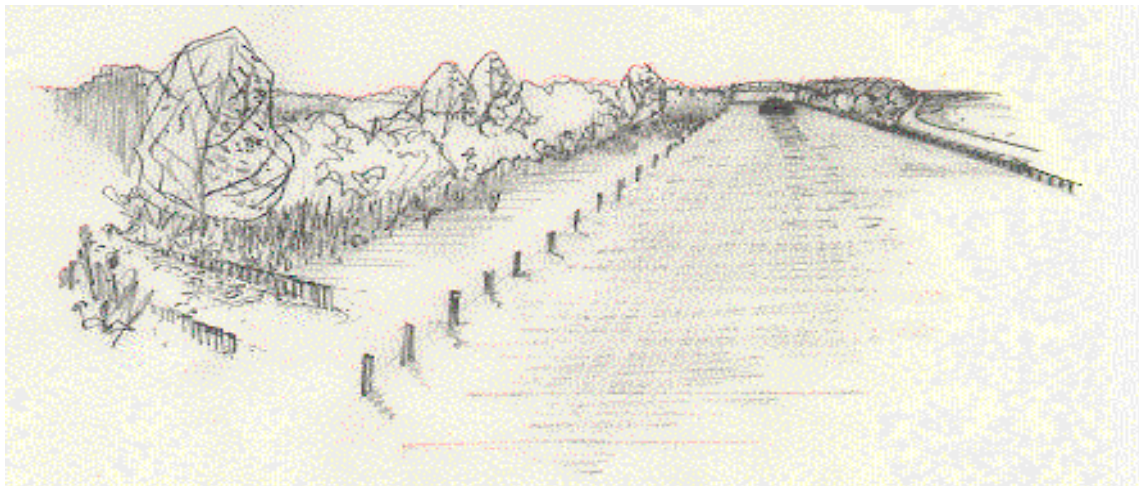
Regularisation of flow, canalisation and over widening/deepening required to meet navigation objectives of rivers have resulted in the loss of riverine forests, filter feeding macro

invertebrates, and natural herbivores and their associated predators. An alternative more sustainable approach is that the condition of the river dictates the type of vessel that can use it for navigation.

Both canals and navigable rivers can provide a barrier to movement on account of steep sided banks preventing animals from getting out of the water. Dams can prevent the movement of fish along the water course with wide reaching consequences for the rest of the river, for example in the case of migrating salmonids.

Along canals adjustments to the bank profile can assist crossing animals and thereby reduce the effects of severance. At the same time such adjustments can provide an area for the development of an emergent flora (Alberts 1991, and CUR 1999).

New dams and locks associated with waterways are of concern on account of the ecological consequences from regularisation of flow. Recent development of the use of screens to reduce erosion can lead to the loss of groins to give the river a more natural appearance. Other examples of measures to lessen the adverse effects caused by navigation include the construction of side channels to avoid the need for dams, to create a fish pass, or to re-establish the riverine flora and fauna.



A soft, bank with fauna exit ramp to a canal.

Implications of construction and improvement

Extensive earth moving is the main feature of most transport construction works (Table 5.3). This requires large machinery and land for temporary storage of topsoil, subsoil and dredgings in the case of waterways. Climatic conditions can cause short-term dust and/or run-off from the exposed surfaces with watercourses and sensitive habitats at risk from long-term damage. Large machinery emphasises the need to clearly protect/fence off the adjacent

sensitive habitats or features from “straying” vehicles. Environmental management systems should assist in identifying these and other such risks.

The construction of a railway is similar to a road but tunnelling or cut and cover may be more frequent. This can assist with long term visual and biological integration, provided adequate consideration is given to the disposal of large amounts of surplus material. Such effects should not be underestimated. With imagination surplus spoil may provide a positive opportunity. The long term benefits of cut and cover tunnels need to be assessed in terms of the destruction (loss) of the habitat during the construction phase. With high speed passenger trains, passenger pressure pulses cause discomfort and from this aspect tunnels are undesirable.

Upgrading the existing railway lines may be constrained to the present land ownership take resulting in the loss of valuable bank side habitat. Access for ecological surveys along railways can be restricted on account of Health and Safety and disruption to existing services (Railtrack 2000) with implications for the quality of EIA and management. Longer trains associated with upgrading may require the extension of station platforms. Upgrading may provide opportunities for adapting crossing points for use by certain species.

Construction of new canals is relatively infrequent. Construction works are of a similar nature to road and rail and relate to earthworks. Upgrading of rivers for navigation includes activities such as the construction of dams and dredging. Over deepening to accommodate larger sized vessels can be a specific problem. The disposal of the arising wet material requires large areas of land nearby.

Implications of use and management

Roads

User associated problems relate to user characteristics including the physical attributes and the frequency of the mode of transport, for example visual intrusion, noise and air pollution including dust, light and water pollution (Table 5.4). Management is a necessary requirement to maintain optimum functionality. This too has wider implications affecting the landscape and biological diversity. In particular, the management of the soft estate and the good repair of special installations for fauna.

The frequency and type of vehicle along roads is not always a function of the size of the road. For example, in parts of CEE large roads were constructed for strategic purposes and have low traffic flows, elsewhere, small roads may be over capacity with high traffic flows. The latter can be problematic on account of associated air and water pollution, and the lack of crossing facilities for wildlife. Thus, a gradual increase in use to over capacity may be associated with negative effects by default. Such effects may be less easy to control than with

the construction of a new road but this is a question of balance. On line widening schemes likewise are not automatically better than a new road – on line improvements can result in the destruction of verges associated with a diverse flora or significant feature trees.

The wider environmental effects of highway maintenance can be overlooked with implications for the realisation of the original design i.e. habitat creation and/ or protection of features of value. For example, maintenance depots on strategic routes require additional land take. Where possible these should be located with other services, e.g. service stations. Oil interceptor tanks and balancing ponds need clearing in order to function and assist in reducing water pollution.

In cold climates, salt is applied to the carriageway with consequential run-off into the adjacent watercourses. The maintenance of a snow free carriageway can cause a barrier (snow-wall) for wildlife wanting to cross. Also it can attract wildlife to the snow free carriageway causing a hazard to road users. With heavy snowfall wildlife underpasses and fences can become blocked diverting animals across the road and causing a traffic hazard also.

Routine verge maintenance is required to maintain sight lines for safety and the maintenance of firebreaks, and for access to telematics. This can be restricted to a narrow width with the remaining verge area managed to benefit identified/particular species of wildlife.

Railways

With railways regular maintenance is required to keep the track line clear for safe use. The passage of trains results in contamination of the track bed including herbicides, faecal matter, metal dust and lubricants. This can cause pollution of the ground water, streams and soil, the significance of which depends on the level of contamination and vulnerable species but little data is available on this aspect. Track ballast has to be replaced regularly and is difficult to recycle creating disposal problems.

Mostly a minimalist approach is taken to bank maintenance of railways to meet operational requirement only, for example clearance of scrub on a 5-10 year cycle. Also bank vegetation is subject to accidental or intentional burning. As with road and canal embankments, there may be opportunities to relate the management of the soft estate to landscape and wildlife objectives.

Waterways

As previously noted, waterways may serve several objectives in addition to transport and these affect use. Pollution and bank erosion from the wash of boats are some of the main

effects associated with navigation. Also, pollution includes problems relating to the importing of exotic species in ballast water or through the mixing of waters from other ecosystems. Exotics can thrive, for example an aggressive alien macrophytes can submerge the native flora in a relatively short space of time leading to a significant decline in habitat quality. Control can result in huge maintenance problems and be expensive (Newman J 2000). Greater awareness of problems associated with exotics could assist with their more timely removal.

Regular occurrence of water pollution from boats includes oil, antifouling paints and other chemicals as well as domestic waste causes problems. Maintenance dredging is an ongoing requirement of such navigations, with associated disposal problems.

Maintenance of canal bank sides may be important to retain their engineering integrity (dam function). As with roads and railways, embankments can provide a valuable habitat in their own right. Unlike road and rail, mostly this area is not subject to contaminants arising from transport users.

Table 5.1 Comparison of main physical and user characteristics of strategic linear transport systems : structural aspects

Aspect	Roads	Railways	Waterways
Hierarchy type of network	Extensive network related to size and user figures	Truncated network	Ruderal network
Harmonisation of freight standards influences the scale of the scheme including the need for larger structures/clearances and speed	Larger class of freight vehicle Growth in user numbers	Development of high speed rail links Internodal railway links	Larger class of river/sea ships
Linear feature	May conflict with scale of natural land form and pattern of features	May conflict with scale of natural land form and pattern of features	May conflict with scale of natural land form and pattern of features. Cross watersheds and floodplains
Track type	Constructed: pavement – engineered surface tarmac and concrete; broad and flat	Constructed: load bearing flat track, ballast bed, metal rails and sleepers	Water- natural element but regulated. Canals have vertical edges and access tracks along the banks for maintenance
Earth works influenced by topography affecting land take including valued habitats/species	Most responsive to changes in topography	Highly responsive to changes in topography	Least responsive to changes in topography Tend to increase with boat size
Head room requirements influence scale of earthworks/crossing structures	Tend to increase with traffic and vehicle size	Generally larger than for roads Tend to increase with speed.	Generally larger than roads Tend to increase with boat size

Aspect	Roads	Railways	Waterways
Ancillary structures	Signs, Lighting, Barriers, Fencing Communication network in verge Drainage structures	Electric traction requires overhead cabling and gantries Fencing Communication network alongside track Drainage structures Occasional need for maintenance track	Dams and locks Bunding Reinforced banks Maintenance track
Embankment slopes	Angle of slope affects land take, habitat loss and fragmentation. Opportunity for creating wildlife habitats/corridors in keeping with local habitat and soils Maintenance required for sight lines	Angle of slope affects land take and habitat loss/fragmentation. Opportunity for creating wildlife habitats/corridors between structures in keeping with local habitats and soils Maintenance of woody vegetation to protect overhead cables, includes slope clearance every 5-10 years Regular maintenance of trackside vegetation to keep track clear	Angle of slope affects land take and habitat loss/fragmentation. Opportunity for creating wildlife habitats/corridors in keeping with local habitats and soils Bank erosion from boat traffic affects marginal aquatic vegetation
Pattern of traffic movement	Continuous and/or peaked Fast with noise and light	Intermittent, fast and noisy	Intermittent

Table 5.2 Examples of the physical and user effects on landscape and biological diversity

Effect	Roads	Railways	Waterways
Microclimate	Embankments may dam or channel air movements Increased heat from road surface Build up of cold air in winter Air turbulence generated by traffic	Embankments may dam or channel air movements Increased heat from track surface Heat accumulation in ballast Irregular but large displacements of air (the woosh effect) dependent on speed of train	Embankments may dam or channel air movements Increased air humidity
Hydrology	Canalisation/straightening of adjacent water courses including deepening to assist drainage Changes to natural groundwater regimes Increased flooding of water through surface water collection Drying out and damming of natural drainage Opportunities for habitat enhancement	Canalisation/straightening of adjacent water courses including deepening to assist drainage Changes to natural groundwater regimes Changes to surface water run-off patterns Opportunities for habitat enhancement	Regulation of river flows Possible risk of drying out of floodplains/marshlands Changes to natural groundwater regimes Mixing of water quality across catchments
Introduction of exotic species	Conduit for seed dispersal from wheels Development of salt loving species in verge	Conduit for seed dispersal from carriages and freight transport	Conduit for fauna/flora dispersal from ballast water, and interconnecting watersheds
Barrier effects	Embankments and ancillary structures disrupt views Fencing, width of structure and intensity of traffic flow prevent crossing movements Habitat fragmentation affecting population viability Deviation of animals seeking to circumvent obstacle.	Embankments and ancillary structures disrupt views Fencing, track surface inhibit crossing movements Habitat fragmentation affecting population viability Deviation of animals seeking to circumvent obstacle	Embankments and ancillary structures disrupt views Bank profile inhibits crossing movements Habitat fragmentation affecting population viability Deviation of animals seeking to circumvent obstacle

Wildlife mortality	Risk of animal mortality from attempts to cross and also because wildlife is attracted to embankments	Risk of animal mortality from attempts to cross and also because wildlife is attracted to embankments	Zero risk by collision but very high risk of drowning
Water pollution and accidental spillages	Surface water run-off/spray includes hydrocarbons, tyre residues, suspended solids and de-icing salts with implications for soil pollution Increased risk of accidental spillage associated with increased volumes of traffic	Contaminated track bed run-off including herbicides, faecal matter, metal dust and lubricants is fed into adjacent drains/groundwater Increased risk of accidental spillage associated with transport of hazardous substances	Domestic waste, oil from users Increased risk of accidental spillage associated with increased volumes of traffic
Lighting	Attracts insects and bats, and can create barrier Permanent light at night even in remote rural areas Continuous lighting of road by vehicle headlights General disturbance of wildlife activities	Non-continuous light Little effect on wildlife	Little or no light except at some marinas etc No effect on wildlife
Noise	Can be continuous disturbs wildlife and tranquil areas	Intermittent short "whoosh" effect	Variable in duration and levels
Outmoded or abandoned network	Ancient roads/track ways may form a cultural landscape feature Less frequently abandoned upgrading more likely	Early structures may form cultural landscape feature especially viaducts Colonised by variety of species and can provide green links in urban areas or degraded landscapes Alternative uses for recreation may have negative consequences for biological diversity. Occasionally reinstated for commercial use.	Early structures may form cultural landscape feature especially aqueducts Colonised by variety of species and can provide green links in urban areas or degraded landscapes Alternative uses for recreation or water transfer may have negative consequences for biological diversity

Table 5.3 Examples of typical solutions to problems affecting landscape and biological diversity arising during the design and construction period of roads, railways and waterways

Typical problem	Roads	Railways	Waterways
Land take	Redesign embankments/cuttings to reduce land take in sensitive areas, and amount of surplus material	Redesign embankments/cuttings to reduce land take in sensitive areas, and amount of surplus material	Redesign embankments to reduce land take in sensitive areas, and amount of surplus material
Integration into landscape	Design profile to provide natural appearance and wildlife benefit	Design profile to provide natural appearance and wildlife benefit	Design profile to provide natural appearance and wildlife benefit
Habitat loss/damage	Avoid, mitigate and compensate for habitat/species Before start of construction works erect protective fencing around features to be retained or re located eg trees	Avoid, mitigate and compensate for habitat/species Before start of construction works erect protective fencing around features to be retained or re located eg trees	Avoid, mitigate and compensate for habitat/species Before start of construction works erect protective fencing around features to be retained or re located eg trees
Habitat severance	Design crossings for wildlife Maintain temporary crossing facilities for animals for duration of works.	Design crossings for wildlife Maintain temporary crossing facilities for animals for duration of works	Design crossings for wildlife Maintain temporary crossing facilities for animals for duration of works
Water pollution	Porous tarmac can reduce spray and run off Provide areas to retain and treat surface water and spillages Protect soil stores to reduce erosion	Waterproof plain and collect surface water in risk areas Provide areas to retain and treat surface water and spillages Protect soil stores to reduce erosion	Supervise earthmoving sites and equipment Protect soil stores to reduce erosion
Air pollution	Wash down surfaces to reduce dust including wheel wipe	Wash down surfaces to reduce dust including wheel wipe	Wash down surfaces to reduce dust including wheel wipe

Table 5.4 Examples of typical solutions to problems arising from the use of roads, railways and waterways

Typical problem	Roads	Railways	Waterways
Traffic movement in the landscape	Vertical adjustment, artificial mounding in character with local landscape e.g. field boundaries Tree and shrub planting in character with local landscape vegetation type.	Vertical adjustment, artificial mounding character with local landscape e.g. field boundaries Tree/shrub planting in character with local landscape and vegetation type	Reduce speed of boat traffic to reduce bank erosion. Tree and shrub planting in character with local landscape and vegetation type Relate size of vessel to depth and width of water/channel
Animal movement (ref COST 341)	Adaptation of existing structures e.g. underpasses/culverts, green bridges, ledges in relation to wildlife movement patterns and habitats Fence to suit certain types of species Consider providing tunnels (note additional cost and excavated material) Verges provide linkages across degraded habitats	Adaptation of existing structures e.g. underpasses/culverts, green bridges, ledges in relation to wildlife movement patterns and habitats Overhead train power lines may reduce opportunities for bridges/overpasses Fence to suit certain species Consider provision of tunnels (note associated economic penalties and excavated material) Verges provide linkages across degraded habitats	Less opportunity for crossing structures Include fauna stepping out structures and species protection measured on banks Fish passes and side channels enable free migration of aquatic organisms round dams
Noise	Adjustment of alignment and addition of bunds and noise barriers – check landscape and ecological consequences Review type of surface material	Adjustment of alignment and addition of bunds and noise barriers – check landscape and ecological consequences	

Typical problem	Roads	Railways	Waterways
Water pollution and accidental spillages	<p>Interceptor drains with regular maintenance required linked to areas to retain and treat surface water and spillages</p> <p>Engineering and vegetative system to store, ameliorate and treat run off</p> <p>Use of porous tarmac reduces spray</p> <p>Develop emergency contingency plan</p>	<p>Interceptor drains with regular maintenance required linked to areas to retain and treat surface water and spillages</p> <p>Engineering and vegetative system to store, ameliorate and treat run off</p> <p>Develop emergency contingency plan</p>	<p>Install free collection points for waste from users</p> <p>Develop emergency contingency plan</p>
Air pollution	<p>Dependent on type of fuel, traffic flow free and microclimate-vegetation can provide a natural filter</p> <p>Use of porous tarmac reduces spray</p>	<p>Vegetation can provide a natural filter</p>	
Lighting	<p>Adopt best available technology and in rural areas restrict to essential locations</p> <p>Use methods which minimize spillage of light and where possible avoid lighting on link sections</p>	<p>Adopt best available technology and in rural areas restrict to essential locations</p>	<p>Adopt best available technology and in rural areas restrict to essential locations</p> <p>eg marinas</p>
Maintenance	<p>Adapt verges and access ways to enhance wildlife value</p> <p>Assess the implications of changes for maintenance and improvement work to enhance wildlife value of verges and drainage facilities</p> <p>Assess the wildlife implications of maintenance for adverse weather conditions</p>	<p>Adapt to enhance wildlife value of verges and drainage facilities</p> <p>Assess the implications of changes for maintenance and improvement work to enhance wildlife value of verges and drainage facilities</p> <p>Assess the wildlife implications of maintenance for adverse weather conditions</p>	<p>Adapt to enhance wildlife value of verges and drainage facilities</p> <p>Organise dredging outside fish reproduction period</p> <p>Select dredging access and disposal points in relation to zones of activity and types of riparian habitat</p>

ASSESSMENT, REVIEW AND RESEARCH

Code of Practice Pointers

- *Co-ordinate and encourage a Pan-European-wide exchange of Design Manuals and Method Statements. Relate these to landscape and habitat types, and encompass languages.*
- *Encourage an exchange of approach between those involved with the design of roads, railways and waterways.*
- *Monitor and evaluate the effectiveness of environmental measures and disseminate information relating to new or improved techniques.*
- *Encourage the application of scientific research to the development of practical procedures and methods.*
- *Promote further research into the special ecological and landscape implications associated with railways and waterways*

Introduction

The production of this Code has brought to light the need for further applied research to assist with the process of planning, designing and implementing transport schemes. Monitoring forms an essential part of this with feedback used to assess the effectiveness of measures. In addition monitoring is valuable to evaluate new and improved techniques particularly relating to mitigation measures.

Technical manuals and exchange of experience

A relatively recent development in highway planning is the inclusion of landscape and wildlife issues within the assessment, in particular, for strategic routes. A number of states have published technical manuals (Box 6.1), but to be of wider value greater dissemination and exchange is required between practitioners and countries. The COST 341 programme could be one such outlet.

Such dissemination should consider the accessibility of information with respect to language, with a focus relating to broad landscape and habitat types. With significant differences in landscape ecology across Europe the application of a landscape character approach to transport planning is useful. For example, the Norwegian technical manual considers roads around lakes, across agricultural land, etc (Norwegian Public Rods Administration).

Manuals focus mostly on the planning and design stages of major roads with few considering minor roads, or the practicalities of construction and maintenance, and this needs to be addressed. Method statements as to how to undertake construction work are a recent

development of procurement/contractual arrangements and part of environmental management. There would be benefits if these were co-ordinated and appraised i.e. what techniques are effective and why.

Monitoring and feedback

Monitoring is a legal requirement in relatively few states e.g. Rosette 1998, SETRA 1993, but is essential if mistakes are to be corrected and lessons learnt. Success stories may make good headlines but investigation of failures and the application of lessons learnt, can lead to future success stories. Such monitoring is essential to check the function of a scheme, for example the integrity of protective fencing, or the appropriateness of special crossings for fauna.

Also, monitoring is required to assess the technical value and appropriateness of innovative techniques, for example translocated areas, or measures to reduce severance of low flying bat.

There is a relatively large body of scientific research which has examined the effects of highways on particular species. Much of this needs to be put in a user-friendly format to assist practitioners, i.e. to consider the significance of the findings and their wider practical application.

Research

Relatively few publications relate to the effects of railways. This may be a consequence of the historical development of the network and the administrative structure. COST 341 should provide further research relating to aspects of fragmentation.

While much road-related research may be applicable to railways, significant structural and user differences merit more specific work. In view of the proposals to upgrade and/or extend the network for high-speed trains and freight, such research is required urgently.

Over the last 20 years or so, concern about the degrading landscape of river valleys and associated wetlands from drainage and related engineering works has led to a number of publications e.g. Ward *et al* (1994), and initiatives involved with the restoration of rivers. Such work is applicable to navigable waterways and there would be benefits in a greater exchange of this information.

Technical guidance for capital and maintenance works along waterways need to encompass other uses in addition to those of transport, as well as rehabilitating of abandoned waterways. Evidence to date suggests there are few monitoring studies which have examined the significance of the barrier effects of canals on the movement of animals and needs to be examined further.

Box 6.1 Example from Technical Manual

Principles for Road Planning from Norwegian Public Roads Administration (1996)

“The principles applied in road planning aim to conserve the biodiversity and natural and cultural environments, the scenery and opportunities for outdoor recreation when road building affects the countryside.

Seven principles for environmental-friendly road planning

1. The developer has the principal responsibility for taking environmental concerns into account. Concern for natural assets must be evaluated on an equal footing with technical and financial aspects.
2. Planning should be based on a good knowledge of nature and the environment. Mapping protected areas and protected objects is not sufficient. Experts should evaluate the scientific consequences of the various alternatives. Co-operation with specialist authorities early in the process is a prerequisite for a good environmental result.
3. Analyse and evaluate the entire area affected by the road. Road works affect the natural and cultural environments, the scenery and outdoor recreation over larger areas than the road itself covers. Evaluate the consequences for longer stretches and larger areas than the actual road works will directly involve.
4. Avoid disturbing or cutting through valuable areas of countryside.

Division and fragmentation can lead to loss of assets for the natural and cultural environments, the landscape and outdoor pursuits. The remaining areas must have a form and size which make them functional for the natural environment.

5. Protect animal migration routes, opportunities for fish to swim freely and links between areas of open countryside. Ecological interplay which has evolved over a long period and which is perfectly adapted to the location and the surroundings can never be fully restored.
6. Accommodate the road to the natural and cultural environments, the scenery and opportunities for outdoor recreation. Choose alignment, standard, materials and details which safeguard the assets of the countryside.
7. Use alleviatory measures if undesirable encroachment is unavoidable. Revise plans which do not take the environmental viewpoint into account.”

CONCLUSIONS

Landscape and biological diversity is one of Europe's greatest assets. However the extent and the value of this asset has been significantly diminished by the activities of man. To maintain the asset for the future generations a reverse in the decline must take place. Responsibility for the reversal includes those involved with linear transport.

At a strategic level across Europe a framework is in place to incorporate environmental considerations into transport infrastructure so to influence the processes which affect landscape and biological diversity. However, there is a gulf between Declarations, legislation and subsequent implementation.

Effective use of environmental assessment and other procedures need to permeate all levels of decision-making in the process of planning, designing, constructing and managing transport infrastructure. This will assist with anticipating problems and opportunities, and design solutions. Attention to detail is important.

This Code of Practice has highlighted and presented examples of best practice in taking forward linear transport infrastructure within the context of landscape and biological diversity. It should assist the conservation and enhancement of the diversity of landscape and biological features and contribute towards more sustainable transportation systems.

This Code of Practice is recommended to all those individuals in linear transport systems within the pan-European Region.

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APPENDIX: SUPPORTING TECHNICAL PAPERS - SUMMARIES

I. Résumés rédigés par les auteurs des études préliminaires / Summaries written by the authors of the preliminary studies

Legal aspects of procedures for assessing the effects of transport projects and their impact on biological and landscape diversity

by Mr Nicolas de Sadeleer, Director of the Centre d'étude du droit de l'environnement, Belgium

This legal study is a survey of recent regulatory and case-law developments in international and Community law concerning procedures for assessing the effects of transport projects and their impact on biodiversity.

The scope and limits of the legal instruments currently in force at national and international level are highlighted with respect to the impact of transport networks on flora and fauna and their habitats.

The author uses this descriptive study as a starting point for suggesting a procedural structure that could be used as a basis for new legislation in this field at national and international level.

Consideration of biological and landscape diversity in the development of road transport

by Mr Jean-Marc Fauconnier, Conseil en Environnement, France

Whether directly or indirectly, roads and motorways have an adverse influence on diversity, both by the fact of their existence and as a consequence of their use by traffic and their maintenance, causing negative (and occasionally positive) effects on land areas (biotopes and landscapes) and ecosystems (biocenoses and plant and animal species).

The impact of road transport on biological and landscape diversity

1. The impact on land areas

This impact directly concerns the areas crossed in terms of landscape (human environment) and biotopes (supporting biocenoses) and falls into the following main categories:

- **Replacement effect:** The road infrastructure replaces an area (elimination of the original environment in the area occupied) and transforms the surrounding land (replacement of the original environment by a new environment) within boundaries which vary but considerably exceed the actual road surface (agricultural consolidation; industrial estates consequent upon construction of road infrastructure). This effect usually increases human influence, resulting in standardised and uniform landscapes.

- **Dissection and fragmentation effect:** Dissection takes the form of a barrier whose permeability varies according to the scale and characteristics of the infrastructure (road or motorway, total land requirement and geometric characteristics), leading to landscape and habitat fragmentation. This effect acts on landscape structure and affects both animal and plant diversity. Biologically, population interchange may be jeopardised (risk that non-viable populations could be isolated) and habitat sizes may be reduced below the necessary threshold (depending on the species concerned). The fragmentation effect is the main obstacle to conservation of fauna diversity in industrialised countries.
- **Edge effect:** This is the effect which the road (or motorway) has on nearby environments, mainly on flora (and indirectly on fauna), owing to the local environmental changes which it causes (microclimate parameters, illumination, alterations affecting ground, drainage, etc).

2. The impact of construction sites

Construction work may disturb habitats, affect the species which they harbour and adversely influence biodiversity in areas varying in distance from the construction zone. The causes are, in particular, site clearing and earthworks, activity and noise, uncontrolled liquid wastes, as well as borrow pits and storage areas for materials.

3. The impact of toxic emissions

Directly related to traffic, these emissions have an adverse effect on air, water and soil quality, and consequently on biotopes and ecosystems, mainly in the areas along both sides of the road (local influence over 50 to 100 metres), but they may also affect more distant areas (depending on methods of transfer, in particular through the air).

4. The direct impact on fauna

For the habitats which it crosses, which are occupied by animal species of varying mobility, the road represents a hostile zone (fragmentation effect) that animals may try to cross in response to their biological needs (access to traditional feeding or breeding grounds, or migration routes). This being so, the risk of animal mortality due to collisions will depend on infrastructure characteristics, traffic density and habitat type.

5. The indirect impact

Indirect effects (away from the actual road area) which may be created by spatial changes and the redistribution of human activities in the area concerned (industrial estates at intersections and agricultural consolidation) often account for a not inconsiderable part of the impact on biological and landscape diversity.

Necessary policies and practices

1. The need for a common approach in the various policies pursued

- A determination to use spatial planning and integration.
- Consideration of environmental criteria in spatial planning.
- The idea of ecological networks (just as there exist transport networks).

2. Better implementation of the principle of continuous assessment

Although the principle of continuous environmental assessment is generally accepted, in practice environmental experts work consecutively on separate studies without any real continuity. This leads to a damaging loss of information between the various project stages. A sole co-ordinator responsible for interdisciplinary dialogue and the temporal continuity of environmental assessments would prove more effective.

3. Development of operational methodologies and tools

Ecology and landscape experts often lack reference material and tools for analysing, assessing and planning. This dearth contrasts with proven practices in road engineering and means that ecological and landscape factors are given inadequate consideration in the choices made and measures taken.

4. Guidelines for biodiversity-oriented professional practices

- When deciding whether a new road is justified, account must be taken of alternative modes of transport and serious consideration given to the zero option.
- Environmental impact studies must offer choices in terms of spatial planning.
- The study area must be large enough to include all effects and allow a functional approach to landscapes and ecosystems.
- Crucial issues, key species and sensitive areas must be defined according to scientific criteria alone, disregarding pressure groups.
- When choosing a new route, account must be taken of biological and landscape diversity, and the areas of least impact first ascertained.
- The importance of ecological and landscape criteria must be sufficient to balance that of economic and technical requirements.
- Ecological and landscape requirements for preserving biodiversity must be taken into consideration at all stages of the project (from initial design studies to the actual opening of the road).

Consideration of biological and landscape diversity in the development of navigable waterways

by Mr Gijs Kurstjens, Wissel Consultancy, The Netherlands

In this study the effects of navigable waterways on landscape and biodiversity are presented. Two types of navigable waterways are distinguished: canals and regulated rivers.

Negative and positive effects of both types of waterways

The construction of canals (mainly in the past) has caused great loss of natural biotopes and a big barrier problem in the area being traversed. The problems are very similar to the ones caused by motorways and high speed trains. Besides this canals can have severe hydrologic effects (drying up of natural floodplains and marshlands) and negative effects on native species (by connecting separated catchments and giving opportunities for exotic species to invade new areas).

Normally canals have little variation in biotopes but in some sections new, sometimes exceptional nature values have developed. In regulated rivers a large variation of biotopes and populations can occur depending on the degree of regulation. The measures for normalization and canalization can cause severe negative effects on the natural morphology and hydrology of river ecosystems as well as on natural biotopes for the typical flora and fauna of floodplains. The worst effects are caused by dams changing rivers into nearly standstill canals and a chain of oblonged lakes hardly passable for aquatic organisms.

Measures to solve the negative effects

Regulated rivers can be restored with the natural river in mind. Morphologic and hydrologic processes play an important role in natural rivers as well as biotic processes. For instance flooding and the occurrence of alluvial forest are typical for rivers. In dammed rivers streaming side channels can be constructed around dams as fish passage and biotope for rheophile species. In normalized rivers without dams old side channels can become alive by stimulating morphological processes or active digging out by man. In many places stony bank protection can be replaced by natural spontaneously grown alluvial forest with exception of locations where navigable problems can occur (in river bends) and bottle-necks in the river bed where savity problems can occur during floods.

Proposals of measures to ensure protection of biological and landscape diversity in future

In the case of canals possibilities to compensate for negative barrier effects of canals which fragmentate core areas of the Pan-European Ecological Network should be investigated. On the other hand management authorities for waterways should introduce 'natural management' along canals to gain a lot of ecological benefit and landscape improvement. In case authorities are planning to build a new canal it should be compulsory to carry out an impact assessment study as is the case with new motorways and railways. This legislation does not exist sufficiently in many countries outside the EU.

Impact assessment studies for large-scale regulation works (dams and locks) in rivers should be made obliged by national law in all member states of the Council of Europe. Attention should be paid to conflicting laws existing in some countries. The legislation should be adjusted in order that both the barrier effect and the loss of (flowing) aquatic habitats due to dam construction should be compensated.

Governments should put more efforts on the large-scale restoration of regulated river systems and emphasize measures based on the natural reference of particular rivers. For instance it is preferred to construct natural side channels in stead of fish passages to compensate for the barrier effect caused by dams. Financial means for restoration and nature development can be generated to combine measures for navigation with measures for safety, extraction of drinking water and tourism.

Introduction of Biological and Landscape diversity considerations in the development and management of rail transport networks in Europe

by Guy Berthoud, ECONAT, Switzerland

Our study is based on information compiled in their national reports by the countries taking part in the COST 341 project, "Habitat fragmentation due to transportation infrastructure", interviews with national officials and the results of questionnaire surveys conducted among them, our own data on railway routing in Switzerland gathered in the course of environmental impact studies, and a summary analysis of a few lines chosen as being representative of the European rail network.

After a period of rapid development, from the 1950s to the 1970s European rail networks suffered a decline and low profit lines were closed as the first motorways were built and road freight traffic developed. The construction of high-speed lines has given rail transport a new boost, but there are still a few countries where rail is losing out to road, particularly in the passenger sector. These countries are now trying to make public transport more attractive.

Railway infrastructure affects the environment in several ways during both the construction phase and once lines are in operation. In an attempt to limit the impact on the environment, most countries have enacted laws and introduced guidelines and/or procedures that are designed to protect the environment and natural landscapes, principally on the basis of environmental impact assessments and strategic environmental assessments.

The main problems encountered during the construction phase are loss of landscape and loss of biotopes, as a result of the large areas of land needed to build railway lines, technical constraints that make it difficult for lines to blend into the landscape, and the use and storing of materials, notably ballast and tunnel-building materials. Ballast is also a problem once a line is in service, as it has to be regularly replaced and is difficult to recycle, creating a need for more dumps.

Railway operations bring more problems, including the risk of collisions, in particular involving large mammals, the barrier effect, noise, animal movements along the track, and electrocution. Other problems encountered are colonisation of the track by numerous plant species, and the presence of vegetation that can hamper operations as well as representing an attractive food source for animals, bringing a risk of collisions. Such vegetation is often kept at bay by the use of herbicides, but these, along with faecal lavatory waste, metal dust and lubricants from passing trains, can be a source of pollution, particularly for the groundwater and soil.

A number of measures have been taken to combat these harmful effects. They include the construction of special wildlife crossings (under- and overpasses), track fencing, covered cuttings, moderate and reasonable use of chemical herbicides, machine mowing at times likely to cause least disturbance to wildlife, and landscaping of embankments.

Other measures are still under study. They include adapting ballast size in selected places to facilitate the crossing of amphibians, reptiles and small mammals, the use of anti-perch devices, and extra large insulators to reduce the risk of electrocution, and winter feeding of certain species of wildlife to encourage them to stay away from railway lines.

Landscape aspects

by Mr Roger J. Cooper, United Kingdom

The landscape we see is an expression of the participation of mankind in the shaping of his environment. One instrument for landscape change is the power of socio-economic forces. Transport is an agent for such change by permitting the equalisation of socio-economic systems and with it the homogenisation of landscapes.

The Pan-European Biological and Landscape Diversity Strategy (1996) notes that one of Europe's greatest riches lies in its biological and landscape diversity, but also notes that this diversity is under threat. Its vision is to reduce that threat, partly by seeking to strengthen biological and landscape considerations in all socio-economic sectors, including transport. More recently, the European Landscape Convention (2000) acknowledges that European landscapes represent a common resource. It is important therefore to co-operation towards its protection, management and planning. This applies to all landscapes: natural, rural, urban, peri-urban and transfrontier. Specifically, Article 5 lays down the general measures necessary to implement the Convention. Actions include the systematic accommodation of landscape consideration into various policy sectors, which may either directly or indirectly impact upon it, including transport.

Such recognition in the framing and implementation of socio-economic policies is of vital importance. History has shown us that transport is a key factor in changing the relationship between town and country, such that local responses are exposed to and potentially overwhelmed by external influences.

The overall transport corridor consists of the on-line element viz the vehicle; the track; the accommodation works (ie. all those required to engineer the route into the landscape) and the ancillary structures; and the off line element – that is the zone around the route which is impacted by it. The characteristics of the on-line elements, and consequently some of the potential for impact on its surrounds, will vary from mode to mode. All modes, however, share certain characteristics which impact upon the landscape, namely: movement; linearity;

geometry; disturbance; externality. Each mode, however, will have a characteristic signature. Modal choice can thus influence impact.

Movement in the landscape will always attract the eye. The movement of transport is highly directional and concerted. It penetrates rather than permeates the landscape, although perhaps less so for water borne traffic. The linearity of transport systems can exhibit great continuity through the landscape which tends to be divisive. It challenges the coherence of a landscape and has fragmentary effects. Transport also brings disturbance to the landscape as a source of noise, movement and light, thus compromising tranquillity and the natural order of systems through which it passes. Externality is a marked characteristic of modern transport systems. Indeed the inter-urban transport corridor, by its very *raison d'être*, is inherently alien to the countryside through which it passes.

It is often the very remoteness, either actual or relative inaccessibility, of Europe's wildscapes that has helped to preserve them as such. The same is true of distinctive, traditional landscapes. At strategic level, therefore, it is important that where policies or programmes either directly or indirectly extend or improve the transport linkages of such sensitive areas, so making them more permeable to external influences, that the potentially destabilising effects on their landscape equilibrium is recognised.

Where implemented, the transport route imposes its own aesthetic on the immediate landscape. A multi-disciplinary approach to mitigation at all scales and stages of the development process is necessary therefore if integration with the landscape is to be successful. The guiding principle should be that although the mitigation is targeted at off setting the characteristics of the transport corridor, its method of delivery should have its origins in the character of the landscape that is affected. Moreover, mitigation should not simply just figure as applied treatments, but rather be fully integrated with scheme engineering. Design and operating standards need to be flexible. Harmonisation of standards across Europe in the interest of operational efficiency must be matched in areas of recognised threat to landscape diversity by the ability to design infrastructure in recognition of the capacity of the affected landscape to absorb it.

In respect of the characteristics of the transport corridor, the impact of movement can really only be mitigated by screening. For linearity, the objective should be to break down the directionality and continuity through the corridor. Recognition of the local characteristics, rather than standardised solutions, is important to reducing externality. Moreover, it is usually better to harness or channel the natural processes of the area in pursuit of scheme design objectives so as the sooner to achieve an equilibrium and a seamless blend into its surroundings. Finally the successful mitigation of a scheme's principal landscape impacts should not be undermined by lack of attention to its ancillary elements.

Integration of the landscape considerations and objectives into the frameworks, policies, standards, and actions involved in the development and management of transport infrastructure in Europe would be an important contribution towards preserving landscape diversity and reducing the risk of the continent's landscapes becoming uniform and

monotonous. Respect for, and understanding of, the influence of transport projects is a fundamental requirement that underpins the future of European landscapes as a continuing source of natural and economic productivity – as well as pleasure – wonderment and inspiration.