



**Vägverket**

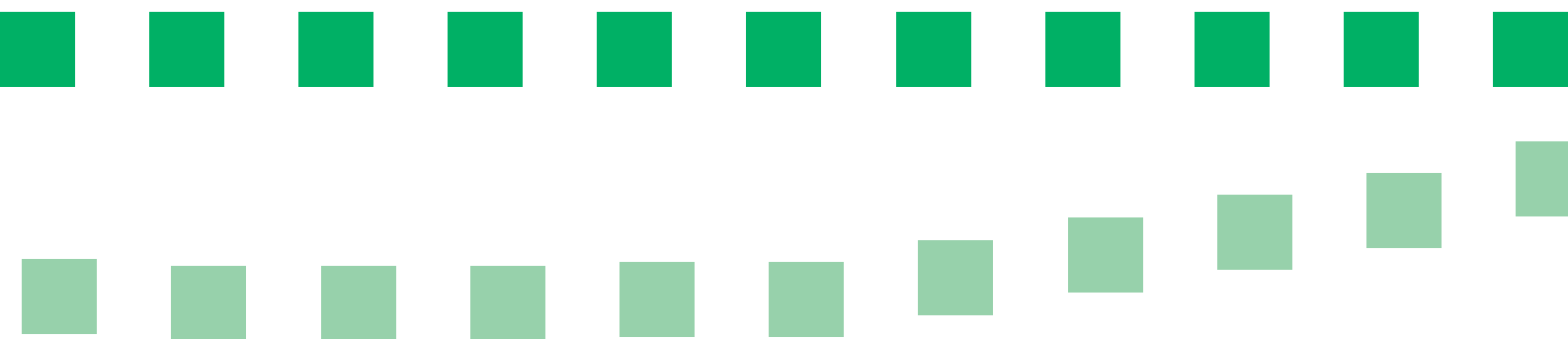
*Swedish National  
Road Administration*

Publication 2002:40E

*Handbook*

# Environmental-

**Impact Assessment  
within the Road Sector in Sweden**



**Summarising part**

**Other parts**

Part 1 Rules and Regulations

Part 2 Methodology

Part 3 Analysis and Assessment

**Title**

Environmental Impact Assessment within the Road Sector in Sweden, Summarising Part

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**Abstract**

This handbook is a tool for the application of Environmental Impact Assessment (EIA) within the road sector in Sweden. The aim is to safeguard the good quality of EIA documents and the integration of environmental consideration into planning and decision making.

The summarising part gives an introduction and an overview of important requirements and presentation of EIA documents. Part 1 focuses on comments and recommendations concerning those regulations which are connected to EIA for roads. Part 2 consists of recommendations with associated practical examples from completed EIAs, showing the methodology that should be considered in order to achieve good quality in work procedure and in EIA documents.

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## Foreword

The SNRA works for measures in the road transport system to contribute to sustainable development of society. Environmental Impact Assessment (EIA) is nowadays a self-evident part of the decision-making data for reviewing road measures in accordance with the Roads Act. Even in those cases where EIA is not mandatory, analyses should, when needed (which becomes evident in an initial study, for example), be documented in the form of EIA. Planning of measures should thus integrate analyses of environmental conditions, alternatives and impacts in a natural way, in order to secure consideration for the environment, minimise damage and, if possible, improve the environment. Good quality of EIA work, and usable reporting of EIA, are required in order for planning and decision-making processes to function and result in advantageous measures.

The SNRA's instructions regarding consultation and environmental impact assessment, etc., VVFS 2001:18, have been worked out in consultation with the Swedish Environmental Protection Agency, and with a broad referral process. The instructions supplement the Environmental Code's regulations on EIA, and in addition, deal with initial studies and feasibility studies. The Handbook *Environmental Impact Assessment within the Road Sector* is based on the regulations and gives recommendations as to how they can be applied. The Handbook does not go into detail as to how consultation can be carried out. This will be dealt with to a greater extent in new versions of the SNRA's Handbooks on initial studies, feasibility studies, etc. This Handbook links up with work on the Handbook on initial studies. This Handbook conforms to the general advice of the Swedish Environmental Protection Agency regarding EIA, NFS 2001:9.

The **summarising part** of this Handbook gives an introduction and a survey of important requirements concerning reporting EIA. It is, however, insufficient for anyone directly working with EIA. It is intended primarily to help road managers and users of EIA to get into the EIA procedure, to enable effective work with EIA of good quality to be promoted in day-to-day activities. **Part 1** contains comments and recommendations regarding rules and regulations concerning EIA, and **Part 2** is intended as a direct aid for anyone working specifically with Environmental Impact Assessment within the road sector.

The main part of the Handbook concerns feasibility studies which are construction of roads as defined in Section 15 of the Roads Act. As regards application of the Planning and Building Act's regulations on Impact Assessment and Environmental Impact Assessment, referral can be made to the publications of the National Swedish Board of Building, Planning and Housing.

The Handbook has been produced under the guidance of Inga-Maj Eriksson, Department for Environment and Natural Resources, Unit for Competence and Development, and was commissioned by of the Unit for Government Road Management. The work has been carried out in co-operation with the regional offices of the SNRA, and with reference to opinions obtained by referral from other authorities, county administrative boards, etc. J&W Samhällsbyggnad in Falun have contributed with examples, through Åsa Hermansson and Ove Staflin, and have been responsible for editing and layout.

The Handbook replaces the earlier Handbook "Miljökonsekvensbeskrivning inom vägar" [Environmental Impact Assessment for Roads], SNRA publication 1995:30.

Rolf Johansson  
Unit for Government Road Management

# 1. What is EIA?

Good quality in EIA work involves:

- that EIA work has been integrated into the planning process with confidential decisions,
- that EIA work has influenced the planning/design,
- that the EIA work has contributed to a good holistic solution,
- that opinions presented in consultation regarding the EIA are taken into account in a reasonable way.

Regarding legislation which guides work with EIA, see part 1 of the handbook.

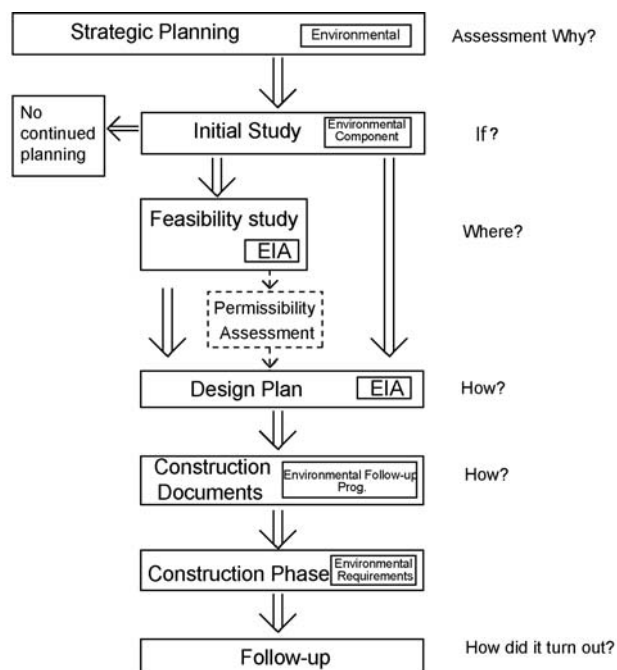
The purpose of Environmental Impact Assessments (EIA) is that they shall contribute to a good, all-round decision base, and by integrating the EIA work with planning, ensure environmental consideration and environmental adjustment of such things as a feasibility study. The work of Environmental Impact Assessments must be utilised in the planning and design of road and traffic solutions. It shall contribute to finding environmentally sound solutions and designs, in order to promote sustainable development.

Environmental Impact Assessments are an important support for the road manager being able to take responsibility for the structure not being the cause of unintended damage and in order to secure good environmental quality.

Work with Environmental Impact Assessments for a feasibility study:

- is therefore commenced in connection with the initial study for the project,
- contributes to identifying and comparing alternatives in a feasibility study,
- contributes to environmental adjustment of the solution, reducing negative environmental impacts and increasing positive environmental impacts,
- gives documentation which is taken into consideration in the decision and the construction documents and the construction, with such things as follow-ups of effects and impacts when so required.

The work is based with the general public and society. Interested parties that are affected are involved.



*Work with environmental questions within the road sector has various concentrations in different planning stages.*

## 2. EIA – Methodology

Below is given a description of a principal methodology for work with EIA or other impact assessments, after it has been established that impact assessments is required and work has begun.

### Collection of information

- Collect basic information, existing and new. (Includes collection of information through consultation.)

### Basic analysis – basis for analysis of change

- Analyse the present situation and trends (look back as well) – propose goals for the project!
- After dialogue, scope the content of the impact assessment, its extent and degree of detail (based both on professional knowledge and on views obtained from consultation with authorities and the general public).
- Analyse if and how function and traffic change in the road traffic system.
- Scope the network affected and which shall be included in location/design. Give do-nothing alternative/reference alternatives.
- Assess the size of the area of influence, what controls the extent of the environmental studies, etc.
- Analyse the appropriateness/sensitivity of the area under investigation for road location/road measures/traffic measures (give reasons for identification of alternative corridors/segments, etc.).

### Impact analysis

- Analyse and describe the situation with the do-nothing alternative regarding aspects relative to the project.
- Describe how/to what extent effects and impacts are taken into consideration in proposals for location/design. How have the impact analyses had an effect?
- Analyse direct and indirect effects and impacts of the proposal/proposals, including mitigation and similar measures, which are intended to be carried out. Drop those effects that do not have any impacts of importance. Relate to the goals (of the project) and general and quality norms.
- Describe effects and impacts so that comparison of alternatives/variants is made easier. Finish off by putting the alternatives in order of precedence, with respect to each type of effect.
- Analyse the additional damage prevention and quality-raising measures which could be made, with effects and costs estimated so that the reader/decision-maker can assess whether the measures that are already included are the most appropriate ones and are sufficient.

### Compilation, synthesis

- Compile a comparison of the alternatives.
- Assess the requirement for follow-up surveys, possible content of a follow-up programme and requirement that “base-line data” is secured in the “base-line situation”.
- Assess what is important to think about in continued planning or carrying out, in which previous impact analyses should be made use of.

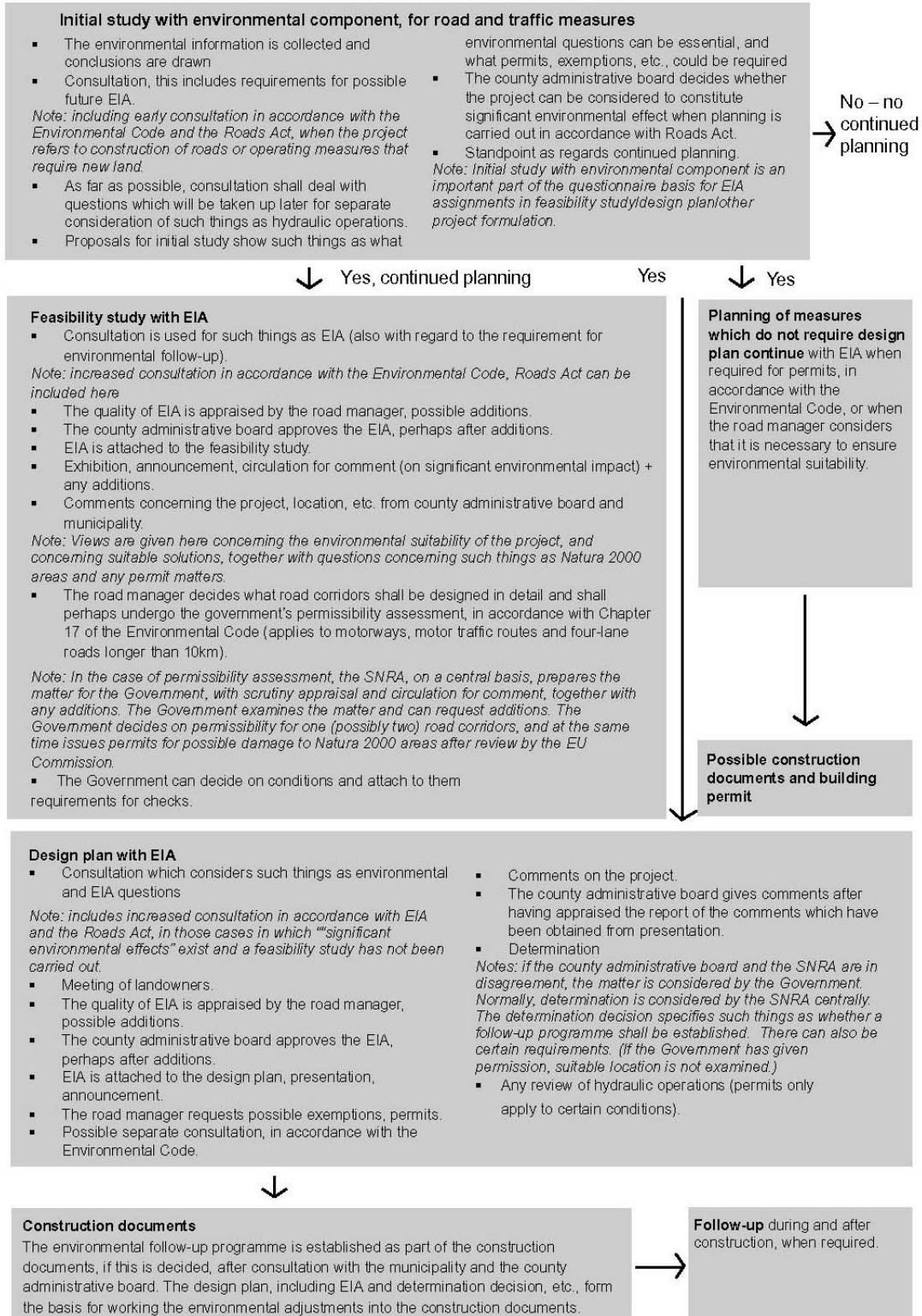
### Presentation

- Present the impact assessment in text and illustrations, verbally, in exhibitions, etc., easy to read and clear.

Principal methodology for EIA and other impact assessments.

## Integrate EIA

The figures below show how the EIA work is integrated in planning feasibility studies and traffic projects.



Regarding EIA work in the feasibility study, there are general rules in the SNRA's regulations, VVFS 2001:18. These regulations also deal with certain requirements concerning consultation, initial study, feasibility study, design plan and construction documents. *Regarding EIA methodology, see Part 2 of the Handbook.*

### **EIA for Minor Road Rebuilding Measures and Maintenance Measures**

For minor road rebuilding measures and maintenance measures involving encroachment on land, there are requirements in law for early consultation, initial study, EIA for design plan and acceptance of EIA.

In order that the formal handling should not take an unnecessarily long time and require too much in the way of resources for the authorities and others involved, the road manager should, especially when it is **not** a question of significant environmental effect, ensure that:

- EIA is adapted to the case in question and is not made unnecessarily far reaching,
- that the initial study, as with EIA of the design plan, is made jointly for several similar or connected measures where this is possible,
- that EIA for design plan can be based on an audit of the environmental component of the initial study,
- that the activities are kept together within the same period of time, and can be understood as meaningful by participating parties.

*(see also Page XX and Section 2, Pages XX and XX)*

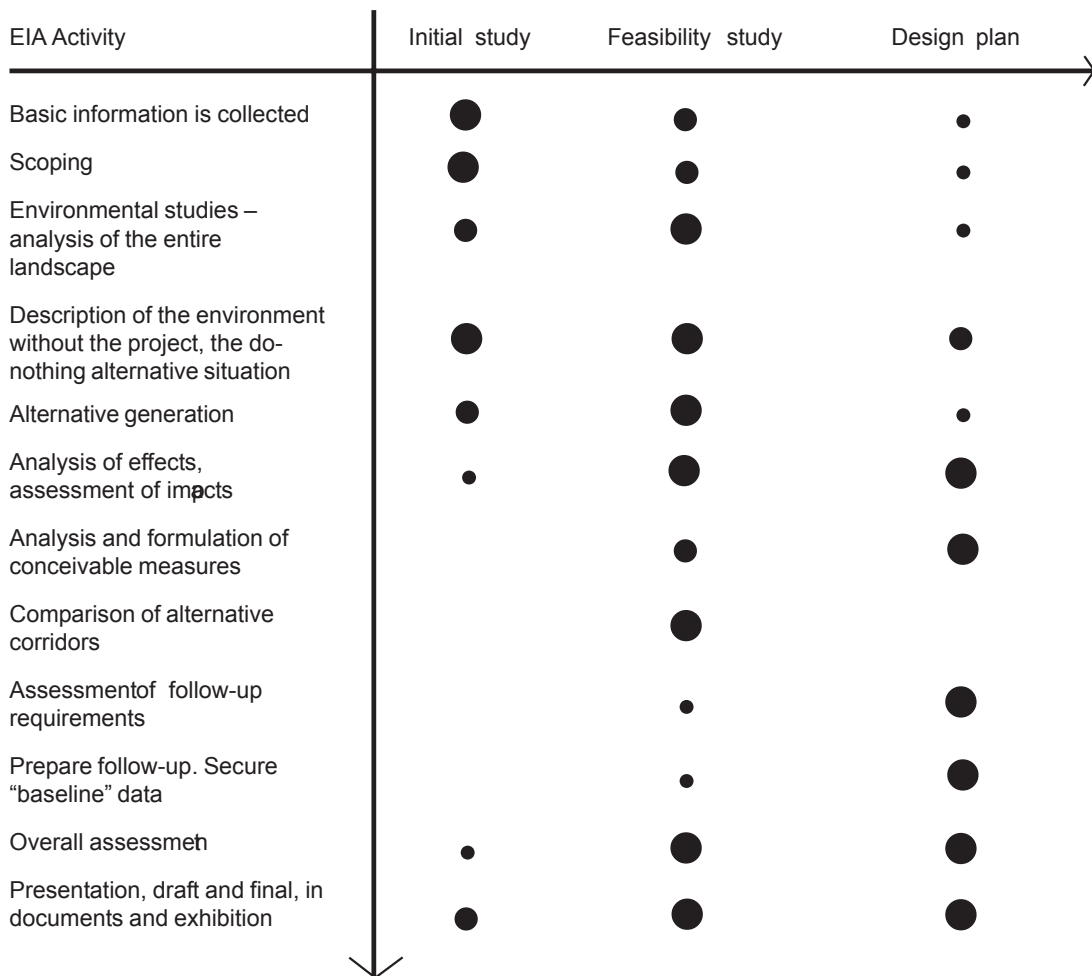
### **The Importance of the Planning Stage**

For best utilisation of EIA, the work must be started early and must focus on the right questions in the right planning stage. First of all, the impacts which can effect the current stage are given attention. See the outline diagram on the next page.

Often, several competencies need to be involved in EIA. The requirement for competence is controlled by the character of the project and the characteristics of the location. Different requirements for competence can also be required in different stages. An EIA co-ordinator or equivalent, with the body carrying it out, is responsible for the entity.

### **Focus and scope EIA Work**

EIA should only deal with things that are of importance in the project in question. A preliminary, rough scoping of EIA shall be given in the initial study, the content of which should be based with the consultative parties/interested parties. EIA for feasibility study should focus on that which is important as regards choice of location, choice of alternative. EIA for the design plan should focus on impacts of design within the selected corridor.



*In different stages of EIA work, the centre of gravity is on separate activities. The sizes of the circles are in proportion to the work input.*

Scoping of EIA should be explained at the beginning of the EIA document. Scoping should be based on such things as early consultation and any increased consultation. In assessing what are essential/significant effects and impacts, the following criteria are normally used.

- Type of impacts (geographic extent, duration, intensity, concentration, danger, possibility of stopping/preventing/repairing).
- That which can be subjected to permanent impacts (people, environmental values, natural resources).
- That which the general public are uneasy about and consider important.

Scoping should also state what environmental quality norms and environmental goals are relevant for inclusion.

### Physical environment

The concept of physical environment should include not only land, water areas, landscape, cultural environment, infrastructure, installations and buildings, but also ecosystems and their constituent components, such as plants, animals and other organisms, such as climate and experience of the physical environment, for example, in the form of silence and sound (in accordance with the general advice on EIA of the Swedish National Environmental Protection Agency, NFS 2001:09)

## Get to know the Environment

An introductory landscape analysis contributes to identifying environmental qualities in the initial stage, and thus forming a basis for the entire project. The landscape, including the activities of people, culture and structures, gives the physical, biological and cultural environmental prerequisites of the project. Traffic conditions in the transport system give prerequisites as regards environmental problems connected with traffic.

Existing conditions are analysed, and the most relevant of them are summarised later in the EIA report. What qualities and identified values are there in the area of influence? Which of them are of the greatest importance for the project and its impacts? For the goals of the project, possibilities, for alternative studies, for environmentally sound design?

These qualities and special values are those which should be in focus for continued analysis of the present situation, impacts of do-nothing alternative, prerequisites for road measures/new road corridors, effects and impacts.

In assessing impacts, development trends in the landscape which affect such things as use of land by people, must be taken into account. The content of the landscape can perhaps change with the do-nothing alternative as well.

A run-through of a checklist is useful in order not to forget any important property or environmental quality which should affect the project, or future assessment of environmental impacts.

▪ Land	Type of soil, soil, bedrock Geo-hydrology
▪ Landscape	Visual qualities Morphology, form Structure
▪ Water	Surface water, ground water divides/drainage areas Water courses, aquifers, inflow and outflow areas
▪ Air	Air quality, precipitation climate (local climate), winds, CO <sub>2</sub>
▪ Plants	Biotopes, species
▪ Animals	Ecosystems, migration routes, species
▪ People	Population, installations, outdoor activities, well-being Effects on health/disturbances, sensitive groups
▪ Cultural inheritance	Ancient remains, cultural landscape, building environments, installations
▪ Material assets	The physical environment, e.g., infrastructure, installations, buildings
▪ Interplay	The interplay in the landscape between environmental factors, use by people and existing effects
▪ Economic management	Materials, raw materials and energy
Present and planned changed use of land	
Development which is not planned but which is expected, etc.	

*Checklist – existing environmental conditions*

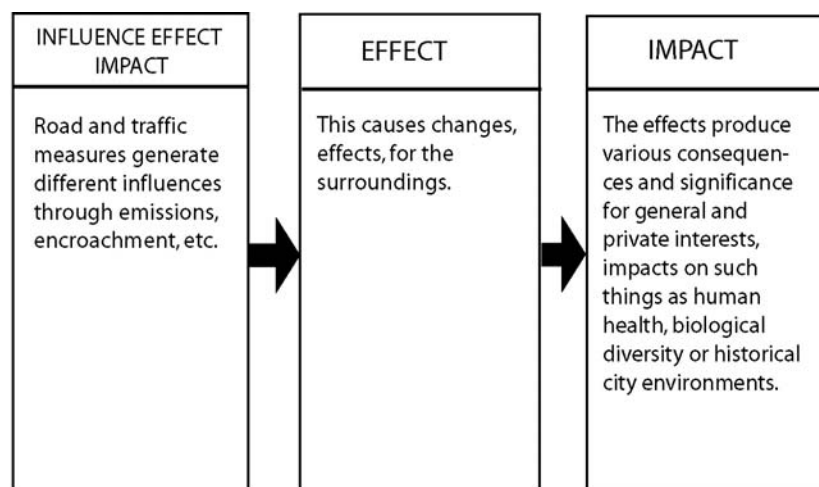
## The Environmental Goals of the Project

Analysis of the conditions within the area of influence gives the basis for formulating and proposing environmental goals for the project. In the formulation of the environmental goals, connections should be sought to national environmental goals and to any regional and local environmental goals.

*(see Mål och mått för natur och kulturvärden [Goals and Standards for Natural and Cultural Values] VV publ 2001:50.)*

## Analysis of Effects and Assessment of Impacts

Effects that can be expected are analysed using the knowledge of what disturbances and other effects can accompany the project. The significance of the most significant effects is then evaluated in assessment of the impacts.



*Influence – effects – impacts.*

*(see explanation of concepts, Part 2, Page X)*

Some bases for the analysis of effects and assessment of impacts are as follows:

- What happens during the course of building and on a more permanent basis through the structure itself, and through operational measures?
- What is influenced, how are environmental qualities changed?
- What importance do they have (for whom, for which interests and for what environmental goals)?
- Give an account only of those facts which are important, not the insignificant ones!
- Do not forget the possibilities of environmental improvements within the framework of the project!

The effects of alternative locations or design are expressed as a change compared with a **do-nothing alternative**, for example, as a change in the number of people who are subject to various levels of noise.



Aspects	Encroachment	Noise	Vibration	Light disturbance	Barrier effects	Air pollution	Visual effects	Pollution ground and water	Effect of development caused by the road
General Interests									
Nature resources and their use Water assets, agricultural land, forest land, energy, total emissions of air pollutants, materials (requirements, requirements for deposits, minerals, etc.)	x				x	x		x	x
Natural environments Flora, fauna, geology and landscape types, water and hydrological effects	x	(x)			x	(x)		x	x
Cultural environments Valuable settlements and structures, ancient remains, historical patterns and road structures	x	x	x		x	x	x	x	x
Recreation/outdoor activities Mobile outdoor activities, fixed installations, recreational buildings, hunting and fishing	x	x	x	x	x	x	x	x	x
Living environment including health and safety, adjacent recreation, etc.	x	x	x	x	x	x	x	x	x

*Many aspects affect many interests. This matrix shows an example. Which aspects are relevant for each respective interest must, however, be assessed from case to case. This type of matrix can be used as a checklist.*

A broad approach is necessary in the analysis so that no significant effects are missed. A basic rule is that all basic effects and impacts which can be of importance shall be assessed and presented. As necessary is subsequent sorting through the effects and impacts in order to see what is important. The division of positive and negative impacts should be shown in EIA and not rubbed out by pairing off.

### **Mitigation Measures and Environmental Improvement Measures**

Analysis shall be carried out in EIA work as regards what mitigation measures and environment improvement measures can be carried out to environmentally adapt a road action. In the first place, negative impacts shall be **prevented** as far as possible. Secondly, negative encroachment and other negative impacts should be **limited** by means of various measures. If damage cannot be prevented or mitigated, the road manager can create or contribute to a positive development of environmental quality by means of **compensatory measures** (see Part 2 of the Handbook, Page XX)

In EIA it should be stated what possible measures could be carried out to limit or prevent negative impacts. Not only selected measures should be presented, but also alternative measures and reasons as to why these have been omitted. It is also significant in EIA to separate what measures are presumed to be included in the impact assessments.

### 3. The EIA Document

Good quality in the **EIA document** involves:

- scientifically correct, sufficiently deep and broad descriptions,
- well based analyses, assessments constructed on professional experience and good practice,
- relevant and focused presentation of the most important questions,
- clear, easy to read and easy to grasp document, also for non-specialists.
- neutral document, i.e., not angled in construction or with embellished descriptions,
- being able to be related to other decision-making information, i.e., comparable so that it shall be possible to give a collected assessment of the effects of the project.

#### Good Presentation of EIA

The EIA document should be a separable part of the feasibility study or design plan. EIA should satisfy many different readers, from the general public, organisations and authorities to politicians and decision-makers.

Together with other planning documents, presentation shall give the examining authority the required guidance as regards:

- selection of environmentally sound solutions and contribution to environmental goals being fulfilled,
- what are significant conditions and environmental impacts,
- presentation and comparison of all relevant alternatives,
- how rules for consideration and environmental quality norms have been satisfied according to Chapters 2 and 5 of the Environmental Code,
- work with the EIA, and that it has been carried out in accordance with current regulations.

In VVFS 2001:18, and in the Environmental Code, there are certain requirements regarding content. (See next page.)

#### Adapted EIA, especially for Minor Road Rebuilding Measures and Operational Measures that require Land

**An initial study** shall be carried out jointly for several minor road rebuilding measures in different places. In this way, some co-ordination profit is gained as regards presentation, etc. In such an initial study, however, each specific measure shall be stated.

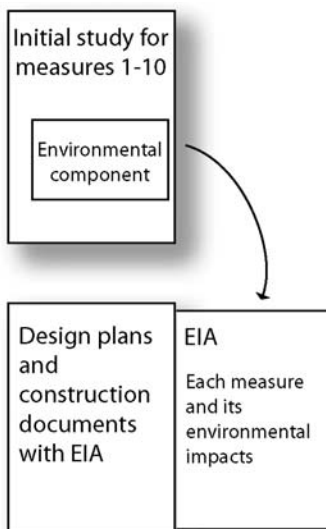
**EIA in the design plan** should also be made jointly for similar or connected minor road rebuilding. Each measure and its effects and environmental impacts shall be stated. In addition, especially when the environmental effects are not significant, the EIA document can be compiled by taking the environmental section (and other relevant parts) out from the initial study and adding further information to it. Any mitigation measures or environmental improvement measures, etc., are stated and justified.

EIA which is required only for consideration in accordance with the Environmental Code shall follow the presentational requirements in Chapter 6 of the Environmental Code.

As regards EIAs which are compiled in order that the road manager shall secure environmental adjustment for measures that do not require a design plan, for example, measures within existing road areas (central safety barrier, fence, etc.), there are no formal requirements. Use of and requirement for consultation are decided in each individual case. The general rules for consideration in the Environmental Code apply.

Total EIA for measures 1-10

Initial study and EIA can be combined for several measures



## Requirement for Statement, in accordance with the Roads Act

The following requirements for content in EIA are given in VVFS 2001:18, which contains references to the Environmental Code. (*see also Part 2, Chapters 4-15*)

BMP = with decision on "significant environmental impact".

(MB) = according to the Environmental Code

**Summary**, non-technical (MB)

**Feasibility study**, its purpose and connection with other projects, conformity with other land use planning and with environmental programmes or equivalent.

Description of operations or measures with information on location, design and extent (MB).

Information on how **alternative** solutions, road corridors and road design, and their environmental impacts have been taken into account in planning work and design work.

A presentation of alternative places, if this is possible, with alternative designs, together with reasons as to why a certain alternative has been selected (MB). Other comparable methods of attaining the same purpose (MB when required by county administrative board).

**Reasons for scoping** of content and degree of detail (including taking consultation into account).

**Existing environmental qualities, use of land and traffic conditions** within the area of influence, together with expected developments.

Description of **impacts of operations or measures not occurring** (MB). (This goes together with the description of the existing environment.)

**Expected direct and indirect environmental effects and environmental impacts** of the planned feasibility study being carried out, and how various interests are affected, including in accordance with stipulations in Chapters 3 and 4 of Environmental Code.

The information which is required to demonstrate and judge the main effects on **human health, environment and economic management of land and water**, together with other resources which the activity or measures can be assumed to entail (MB).

Effects of various alternative actions being related to the situation with the **do-nothing alternative**. Note that impacts and measures applying to existing roads also need to be assessed for cases in which a new road is built.

**Mitigation measures** (MB).

An assessment of the measures planned for harmful effects being avoided, mitigated or eliminated (MB).

The extent to which mitigation measures can be considered to be included in assessment of environmental effects and environmental impacts.

Comparative assessment of alternative mitigation measures – including during the construction stage – regarding effects and costs and a presentation of how relevant environmental goals, rules for consideration and environmental quality norms can be satisfied.

Which **methods and sources of information** are used together with uncertainty in analyses carried out and assessment (can also be presented in the form of references integrated into the statement).

What **environmental expertise** has participated in EIA work.

## Especially as regards EIA in feasibility study

The extent to which **environmental considerations** have affected identification of the road corridors which have been studied. (Is presented after existing environment if it is presented on its own, or earlier in the introduction).

A **comparative assessment** of alternative road corridors. (Decisive, alternative-separating environmental impacts shall be given prominence, but so also shall significant non-alternative separating impacts.) (An improvement of an existing road shall also be studied if special reasons do not dictate otherwise.

The extent to which it assessed **possible at a later stage** to solve any conflicts, prevent damage and improve the environment.

Significant prerequisites for **environmentally adapting** the road segment and its design in **continued planning**.

## Especially as regards EIA in the design plan

**How EIA work has influenced** the road design.

**Environmental impacts of the selected design** of the feasibility study and compensatory measures which can be especially justified.

**Requirement for follow-up** of the environmental impacts of the feasibility study, and **proposals for any follow-up programme** (which accompany the construction documents), which shall be justified in each section.

Special requirements regarding initial study, feasibility study and design plan, over and above the requirements in the Roads Act, are given in VVFS 2001:18, which is included in Part 1 of the Handbook.

## 4. EIA in Road Planning and Road Design

The right question at the right stage!

Do not go further into analyses and descriptions than can actually be made use of at the planning stage itself!

The four-stage principle involves the following types of measure being considered:

1. Measures which can affect the demand for transport and the choice of transport mode.
2. Measures which can give more efficient utilisation of an existing road network, for example, information, control and regulation.
3. Limited rebuilding measures on existing roads, for example, supplementing with central safety barrier, measures on side areas, rebuilding of junctions.
4. New building measures in the form of general rebuilding or new building in new terrain corridors.

As regards future work: impacts on road users are not normally included in EIA, but it can be necessary to comment on them with reference to other impact assessment(s).

### Environmental Assessment in Strategic Planning

An important basis for application of environmental assessments and other impact assessments is that all reasonable alternatives are studied.

Environmental assessment at strategic level is thus required for reasons including that it is not often possible to effect general environmental questions and action strategies at project level. Requirements for environmental assessments of plans and projects have increased after the EU Directive concerning this was issued during 2001.

Selection of action strategies or type of action in strategic planning is based on such things as application of the so-called four-stage principle.

Environmental assessment and other impact assessments are integrated and taken into account in the work. It shall be possible for environmental assessment to have an effect on the selection of what parts of the transport system shall be invested in, and in the choice of type of measure within a transport corridor.

### Environmental Component of the Initial Study

Environmental prerequisites and trends are roughly studied on the basis of existing information. It is important for the environmental component and the initial study in its entirety, that an assessment is made of the communication network, traffic data, travel/commuting, regional development plans, general plans, regional and municipal environmental programmes, etc. Authorities that apply the Environmental Code have a duty to provide planning information.

A general assessment is given of environmental conditions. Conclusions are drawn as to what can be important/significant environmental effects, and what environmental goals can be used. To establish environmental goals for the project can be important for environmental adjustment and facilitate future assessments of environmental impacts. Special requirements concerning environmental competence, Environmental Impact Assessments, separate consideration and permissibility are clarified as far as possible, in those cases in which work shall continue towards carrying out the project. Already at this stage, a preliminary scoping of what a future Environmental Impact Assessment should focus on is made. Take into account views that originate from consultation – make sure that those people who may have views concerning environmental questions are included among those consulted.

The county administrative board can be expected to have views concerning scoping of the content in EIA. Scoping should be justified. Work on the basis that the effects and impacts which are to be taken up are significant. If, for example, a noise situation is not considered to be influenced, and the noise level is clearly under the guideline values, there is no significant effect. If the noise value is exceeded equally much with and without the feasibility study, the noise must, nevertheless, be considered to be an important aspect. The known conditions of the place can involve important problems, which must be given attention in the initial study, such as known pollution from earlier operations, risk of substantial lowering of ground water, or large spoil surplus. (*see also Part 2, Page XX*)

Give prominence to the environmental impacts that are decisive, or separate the alternatives!

## EIA in Feasibility Study

In the feasibility study stage, further information needs to be produced on conditions and prerequisites over and above those which already exist as a result of work with the initial study. Things that are needed include environmental studies in the field.

More detailed studies of environmental conditions contribute to the information used for identifying alternative road corridors and for future analyses of effects and impacts. Improvement of existing roads shall always be included as an alternative, according to the Roads Act, if there are no special reasons for not doing this.

Environmental studies help to develop project goals which are needed in order that the project can be adapted to affected environmental values.

In EIA, it shall be stated how scoping of EIA has been carried out, with reference to consultations, etc. (Also point out how the structure and degree of detail differ from EIA in the design plan.)

Environmental impacts are presented collectively for each alternative. If possible, explain prioritisation/internal weight between different forms of environmental impact. In addition, there should be a comparison between alternatives for each significant environmental impact, with the alternatives in order of precedence.

Views from society in general, and from the general public, contribute to the evaluation which is made of impacts, i.e., the importance of the effects.

Together with other impact assessments, EIA shall facilitate a collective assessment and decision based on good information. The decision shall contribute to economic, social and environmental sustainable development! (See also Part 2, Page XX)

What consideration has been taken in respect of the environment?  
How can sufficient environmental adjustment be made, measures?  
Compensatory measures?  
Follow-up during and after building?

## EIA in the Design plan

For the design plan, EIA work is concentrated on the environment in and around the selected road corridor, and the environment around the existing road. What environmental effects and environmental impacts do the proposed road design and possible design alternatives have?

- Study the various possibilities available to prevent and mitigate disturbances or damage, using action, and fulfilling project-specific environmental goals and/or more general goals for the environment.

If a feasibility study or EIA has been carried out, it is important to connect with this and to explain how EIA for the design plan is different from, but nevertheless, is built on the earlier one. It can also be important to state how EIA shall be used, for one or more inquiries and permits. Scoping and “requirements” concerning EIA, possibly for several types of review, should have been discussed at earlier consultations, and taken into account in the initial study. Scoping of the content of EIA is discussed further at the beginning of the design plan stage (with increased consultation if appropriate).

- Describe how EIA work has affected the road design! State whether it is necessary to follow up environmental impacts and give proposals for the content of any follow-up programme, and give reasons!
- Study possible compensatory measures which can be justified in the case of certain damage to protected values, etc!

When separate consideration is required for hydrological operations, in accordance with Environmental Code, the questions concerning water in EIA should be presented in a separate section. EIA for the design plan should be sufficient in many cases for this assessment as well, together with descriptions of technical solutions, etc. (*See also Part 2, Page XX*)

## 5. Procurement of EIA

When EIA is to be compiled by a consultant, the procurement process, inquiry information and description of the assignment are, of course, important factors for the quality of EIA and the quality of the environmental adjustment of a feasibility study. The supply of qualified people to carry out the work is a prerequisite. EIA is often procured at the same time as the feasibility study or design plan. This should promote integrated work, but should not mean that the EIA component should not be given too brief a treatment. Separate requirements regarding competence should have been discussed at earlier consultation, during the initial study stage, and stated in the questionnaire. The consultant should state whether certain competence which is required in the questionnaire is lacking, and should specify sub-consultants. However, the consultant must have competence to recognise the unforeseen requirement for special expertise. The feasibility study or traffic project and its environmental prerequisites must be assessed as completely as possible, in order for the consultants to be able to rank the requirements of an EIA assignment, among other things. The ability to increase competence and assignment must be clarified. The road manager must also assess expected results of the assignment as explicitly as possible. Separate requirements concerning work in the form of certain methods, aids, calculation models, field survey, co-operation in consultation with separate illustrations, etc., and concerning, content, degree of detail and extent of statement.

It can also be necessary to give target groups. Do the general public and politicians show a great deal of interest? Will consideration by the Government be carried out in accordance with Chapter 17 of the Environmental Code? Such consideration, together with reconsideration of the design plan and Governmental consideration, in those cases in which the SNRA and the county administrative board have different opinions, consideration by the environmental court can involve extra stringent requirements as regards clarity and information for those who are not familiar with the case, and have no knowledge of the area in question. For EIA assignments that require several areas of competence, it is appropriate that those carrying it out have an EIA co-ordinator.

The transfer of information between consultants at different stages, and between consultant and principal, place great requirements concerning documentation. Information and work material which are not used in the statement are important for several reasons. It can also be valid in recording personal contacts and people who give information. This must be included in the description of the assignment. The material which the consultant receives (including information concerning earlier consultants/competence), and what consultant shall deliver, must be clarified. It can be necessary to have a meeting between consultants from the earlier stage and the consultant involved in the current stage.

As regards impacts that can be assumed to be difficult to assess, it is of value if the principal can state whether it is possible to establish choice of methods and principles for evaluation of impacts and assessments of possible damage, etc., on the basis of expertise from the county administrative board and possibly the municipality.

The inquiry concerning the EIA assignment should include information on such things as:

- how the EIA work is integrated in the planning process,



- target groups for the EIA document,
- what data is provided by the orderer,
- what contacts shall be made for collecting facts,
- co-operation with consultation, number of consultative meetings,
- how feedback of information is made from earlier stages,
- determined geographical scoping,
- determined scoping of the assignment, for example, regarding the number of alternatives to be studied,
- what environmental qualities, interests and problems are of especial importance and can require special expertise,
- what type of surveys and field studies shall be carried out,
- whether supplementary investigations are to be carried out, and what type of expertise shall carry them out,
- how EIA shall be presented, and what documentation shall be delivered at what points of time, maximisation of extent,
- time-control factors, for example, important deadlines and how the project is getting on in planning.

## 6. After EIA

### **EIA – a Basis for the Construction Documents and Requirements concerning Contractors during the Building Stage**

VVFS 2001:18, Section 41 states: “The road management authority responsible for the stipulated mitigation measures and other environmental considerations being worked into the project’s construction documents”.

Assessments and maps of protected landmarks, etc., are taken from EIA. EIA is also the basis for working out any follow-up programme of the road manager, and for environmental requirements placed on contractors during the building stage.

As regards requirements on contractors, “Miljökrva under byggtiden” [Environmental Requirements during the Building Period], VV publ 2001:15, is a starting point.

### **Follow-up**

The road manager is responsible for important follow-up studies being carried out, both during the building stage and during the operational stage. EIA states the follow-up requirements. The requirement to secure certain information concerning the baseline situation must be observed at an early stage.

Any environmental follow-up programme constitutes an appendix to the construction documents, and is worked out in consultation with the municipality and the county administrative board.

The SNRA develops the methods of making follow-up programmes and follow-up results more accessible, for external interests as well. (*See “Miljöuppföljning av vägprojekt” [Environmental Follow-up of Road Projects], VV publ 1999:159*)

### **Quality Assurance**

The road manager’s project managers are responsible for internal controls of the quality in the Environmental Impact Assessments. Whether quality controls have been carried out, and who carried them out, shall be stated in a filled-in checklist, for example. The following two pages present a template for quality appraisal of EIA (referring both to EIA work and the EIA document), together with a reminder list of the requirements concerning the actual EIA statement stipulated in VVFS 2001:18 and the Environmental Code.

VVFS 2001:18, Section 15 stipulates the following as regards quality assurance of EIA: “Before EIA is delivered for approval to the county administrative board involved, the road managing authority shall check that the quality is good. Using controls it is ensured that the EIA, together with other project documents, gives the examining authority the required guidance as regards

1. choice of environmentally sound solutions and contribution to environmental goals being fulfilled,
2. what the important circumstances and environmental impacts are,
3. presentation and comparison of all relevant alternatives,

4. how rules for consideration and environmental quality norms have been satisfied, in accordance with Chapters 2 and 5 of the Environmental Code,
5. Work with EIA, and that it has been carried out in accordance with regulations in force.”

Statement as regards environmental questions is required for the feasibility study and for the design plan, in addition to EIA! See VVFS 2001:18. General criteria regarding EIA quality are given in the boxes on Pages X and XX.

Note that different people with the road manager can inspect and sign different items on the list, for example, the project manager, EIA expert, etc.

With respect to statement, see the reminder list of requirements in accordance with VVFS and MB on the next page.

<b>Quality Assurance of EIA by the Road manager, in accordance with VVFS 2001:18</b>	
By means of controls it shall be ensured that EIA, together with other project documents, give the reviewing authority the required guidance.	
<p><b>Questions</b></p> <p>1. Does EIA give guidance as regards choice of environmentally adapted solutions, and contribute to the environmental goals being fulfilled?</p> <p>Comments:</p> <p>2. Does EIA give guidance as regards understanding what the significant environmental conditions are, and the significant environmental impacts are?</p> <p>Comments:</p> <p>3. Does EIA give guidance as regards presentation and comparison of all relevant alternatives?</p> <p>Comments:</p> <p>4. Does EIA give guidance as regards how the rules for consideration and environmental quality norms have been satisfied, in accordance with Chapters 2 and 5 of the Environmental Code?</p> <p>Comments:</p> <p>Rules for consideration:            Burden of proof of the road manager            The required knowledge            The principle of caution            The location principle            Economic management and cycle principles            The principle of selection of products            Responsibility to rectify damage            The stop rule in the case of damage or inconvenience of essential importance</p> <p>Environmental quality norms:            NO<sub>x</sub>, SO<sub>2</sub>, lead, particulates (PM10)</p> <p>Limit values:            Guide values</p> <p>5. Work with EIA, and that it has been carried out in accordance with current regulations, work processes</p> <p>Comments:</p>	<p><b>Signature, Inspector</b></p>

## Reminder list for quality appraisal of EIA statement

Comment on each respective item below (statement requirements in accordance with FFVS 2001:18 and MB).

### **Non-technical summary**

#### **The Road Project**

- Purpose, requirement, connection with other projects and conformity with .....
- Where, how, when? What – activity/measure?
- How have alternative solutions to the problems been handled? Reasons for alternatives. What does the do-nothing alternative involve?

#### **Reasons for scoping**

- Is it evident what is expected as regards being substantial effects/impacts?

**Existing environmental qualities**, use of land and traffic conditions. (Can be dealt with together with assessment of impacts).

- What happens, impacts if the project does not materialise?

#### **Expected direct and indirect environmental effects and environmental impacts**

- How various interests are affected by such things as the requirements in Chapters 3 and 4 of the Environmental Code.
- Main effects on human health, the environment and economic management of land and water and other resources which the activities or measures can be expected to involve, also as regards the building stage.
- Also include existing roads in those cases in which there is new road building.
- Improvement alternatives shall be included unless there are special reasons for not including such alternatives.

#### **Mitigation measures**

- Assumptions on measures that will be included in impact assessment.
- Comparative assessment of alternative or supplementary measures, effect-cost.

#### **Methods, uncertainties, sources of information**

##### **Contributing expertise**

**Have EIA questions been dealt with in earlier consultations?**

**Can EIA (part of) be used for review of hydraulic operations** if they are supplemented with more detailed technical descriptions of detailed planning?

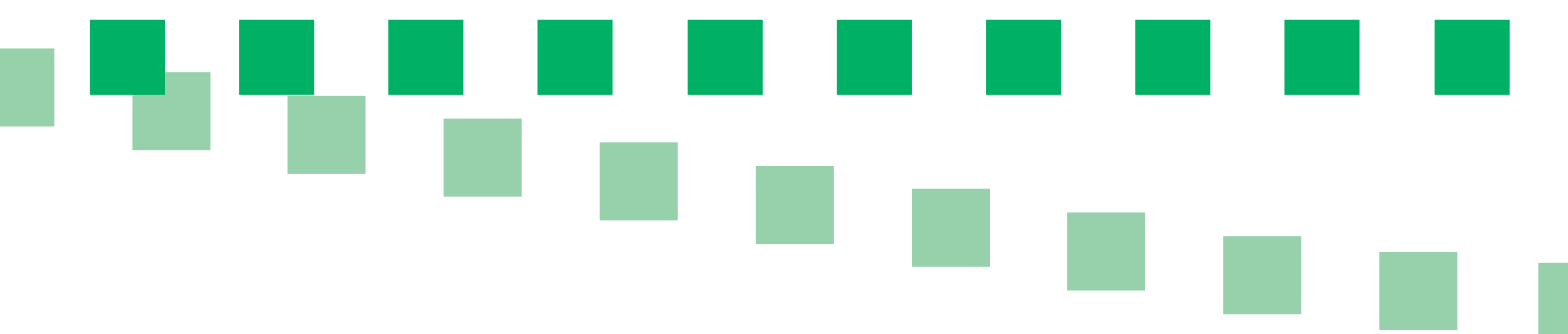
#### **Especially for EIA in feasibility study**

- environmental considerations in the identification of road corridors
- comparative assessment of alternative road corridors
- possibilities of solving any conflicts, preventing damage, improving the environment at a later stage
- important prerequisites for environmental adjustment of the extent and form of the road in continued design

#### **Especially for EIA in design plan**

- how the EIA work has affected the road design
- environmental impacts of the selected design and supplementary measures which can be especially motivated
- requirement for follow-up, proposals for any follow-up programme





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*Handbook*

# Environmental-

**Impact Assessment  
within the Road Sector in Sweden**



**Part 2  
Methodology**

**Other parts**

Summarising part

Part 1 Rules and Regulations

Part 3 Analysis and Assessment



**Title**

Environmental Impact Assessment within the Road Sector in Sweden, Part 2  
Methodology.

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Environmental impact assessment, EIA, road planning, road design, effects.

**Abstract**

This handbook is a tool for the application of Environmental Impact Assessment (EIA) within the road sector in Sweden. The aim is to safeguard the good quality of EIA documents and the integration of environmental consideration into planning and decision making.

The summarising part gives an introduction and an overview of important requirements and presentation of EIA documents. Part 1 focuses on comments and recommendations concerning those regulations which are connected to EIA for roads. Part 2 consists of recommendations with associated practical examples from completed EIAs, showing the methodology that should be considered in order to achieve good quality in work procedure and in EIA documents.

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## Foreword

The SNRA works for measures in the road transport system to contribute to sustainable development of society. Environmental Impact Assessment (EIA) is nowadays a self-evident part of the decision-making data for reviewing road measures in accordance with the Roads Act. Even in those cases where EIA is not mandatory, analyses should, when needed (which becomes evident in an initial study, for example), be documented in the form of EIA. Planning of measures should thus integrate analyses of environmental conditions, alternatives and impacts in a natural way, in order to secure consideration for the environment, minimise damage and, if possible, improve the environment. Good quality of EIA work, and usable reporting of EIA, are required in order for planning and decision-making processes to function and result in advantageous measures.

The SNRA's instructions regarding consultation and environmental impact assessment, etc., VVFS 2001:18, have been worked out in consultation with the Swedish Environmental Protection Agency, and with a broad referral process. The instructions supplement the Environmental Code's regulations on EIA, and in addition, deal with initial studies and feasibility studies. The Handbook *Environmental Impact Assessment within the Road Sector* is based on the regulations and gives recommendations as to how they can be applied. The Handbook does not go into detail as to how consultation can be carried out. This will be dealt with to a greater extent in new versions of the SNRA's Handbooks on initial studies, feasibility studies, etc. This Handbook links up with work on the Handbook on initial studies. This Handbook conforms to the general advice of the Swedish Environmental Protection Agency regarding EIA, NFS 2001:9.

**Part 2** of the Handbook is intended primarily for those who work with EIA within the road sector. The content is also expected to be useful for commissioning bodies and environmental authorities. Examples often elucidate adaptations to individual cases of road and traffic project, both large and small. Examples which are based on actual cases are intended to show that variations in the structuring of an Environmental Impact Assessment can be carried out in different ways, and that the way which works best in an individual case shall be chosen together while fulfilling statement requirements. Part 2 also deals with methods of working with EIA when it is not mandatory. **Part 1** contains comments and recommendations regarding rules and regulations affecting EIA, including permits, etc., according to the Environmental Code. The **summarising part** of the Handbook gives an introduction and a survey of important requirements and the reporting of EIA.

The main part of the Handbook concerns road projects which are constructions of roads as defined in Section 15 of the Roads Act. As regards application of the Planning and Building Act's regulations on Impact Assessment and Environmental Impact Assessment, referral can be made to the publications of the National Swedish Board of Building, Planning and Housing.

The Handbook has been produced under the guidance of Inga-Maj Eriksson, Department for Environment and Natural Resources, Unit for Competence and Development, on the assignment of the Unit for Government Road Management. The work has been carried out in co-operation with the regional offices of the SNRA, and with reference to opinions obtained by referral from other authorities, county administrative boards, etc. J&W Samhällsbyggnad in Falun have contributed with examples, through Åsa Hermansson and Ove Stafin, and have been responsible for editing and layout.

The Handbook replaces the earlier Handbook "Miljökonsekvensbeskrivning inom vägar" [Environmental Impact Assessment for Roads], SNRA publication 1995:30.

Rolf Johansson  
Unit for Government Road Management

## Concepts used in the Handbook

Collective assessment	A weighting (internal evaluation of factors) in which EIA, together with other decision data, shall make it possible for the decision-making authority to make a collective assessment of the effects of the project/plan, not item by item or impact by impact, but as an overall picture of the project plans' effects.
Construction of road	Construction of new road, re-routing of road in a new segment, and reconstruction of road.
Cumulative impacts	A resulting effect of several changes, either independent or interacting.
Do-nothing alternative	Existing road/road network without measures apart from operation and maintenance.
Early consultation	The term which is used in the Environmental Code, Chapter 6, Section 4, for consultation with the county administrative board, general public, etc., the intentions of which include affecting the direction and competence of EIA work.
Environmental effect	Changed environmental quality in different respects, caused by such things as a road or traffic project. Environmental effect is expressed neutrally.
Environmental impact	Result of certain environmental effects with regard to an interest. Environmental impact is expressed as an appraising assessment.
Environmental Impact Assessment (EIA)	A document especially intended to constitute a basis of data and the content of which is based on a process in which the practitioner collects, develops, mediates and utilises knowledge concerning how the activity or measures affect human health and the environment in the sense the concept is used in Chapter 1, Section 1 of the Environmental Code.
Environmental quality	Quality of land, water, air, landscape, etc.
Global effects	Effects that affect the climate, land and water, over very large areas.
Increased consultation	The term which is used in the Environmental Code, Chapter 6, Sections 5 to 6, for the consultation with those Government authorities, municipalities, general public and organisations which are expected to be affected. The consultation is applied in those cases where the county administrative board decides that the project is presumed to entail significant environmental impact.
Indirect effects	Effects and impacts which are not a direct result of the intrusion of the road project or its disturbances. Secondary and tertiary effects are also normally counted as indirect effects.
Minor road reconstruction	Reconstruction, for example, widening of road, adjustment in plan and section, construction of pedestrian and cycle path next to existing road.
National interest	General interest in a geographical area (in accordance with the Environmental Code), which is of such strength that it can be considered to be important from a national or international perspective.
Natura 2000	Natura 2000 is a network of valuable natural areas which is being assembled within the EU. The purpose is to safeguard types of nature and ecosystems for species which the EU countries have agreed to conserve.
Operational measure in accordance with Section 28 of the Roads Act	When land outside the road area is required for removal of trees, rocks, etc., noise protection, fences for wild animals, side structures (bus stops, control areas, etc.) and certain other improvement measures.
Physical Environment	Land, areas of water, landscapes, cultural environments, infrastructure, structures, buildings, ecosystems, climate and experience of the physical environment.
Public Interest	Interest represented or promoted by society, public interests, as opposed to private interests.

# 1. Introduction

Now and again we need to remind ourselves as to what an Environmental Impact Assessment is and what its benefits are. Sometimes it can also be necessary to mention this in consultative meetings, etc.

Work with EIAs is integrated with, and may affect, other work involving road planning and road design, or planning of other measures within the road transport system. The EIA document belongs to the collective basis for decision-making, but must be presented so that it can be easily found and lifted out.

## EIA Work

Work with an Environmental Impact Assessment - EIA – comprises analysis and assessment of the effects of a planned structure, operation or measure on health, the environment and economic management of land, water and other resources. Work with EIA should be integrated into the remaining planning process. By doing this, conflicts between various interests can be identified early on, and the possibilities of finding environmentally sound solutions increased. Consultation, in accordance with various pieces of legislation, is co-ordinated in the different planning stages, so that environmental questions are integrated with other questions. Through co-operation from the general public, local knowledge and ideas can be taken up. Many parties can exert influence while work is in progress, and more will be satisfied with the knowledge put into the planning through the EIA work, and with the environmental adjustment of the project made in this way.

## The EIA Document

As a basis for decision-making, EIA should make increased environmental consideration possible when adopting standpoints on the location of roads, road standards and detailed design, and for the weighing up between different interests made when reviewing in accordance with the Roads Act or the Environmental Code. The EIA shall be a clearly separable part of the entire decision-making basis, which facilitates review by the general public, etc., and as regards approval by the county administrative board.

The statement should also reflect the environmental considerations of different kinds that have been taken, and the adjustment to the environment which has occurred through location and design. In the best case, one can show that anticipated negative impacts can be turned into positive impacts, and that the possibilities of environmental improvement have been made use of.

EIA is often of great interest to the general public, and gives opportunities for creating unanimity on facts and forecast effects. A very important task, therefore, is to formulate the presentation of EIA in a clear and easily accessible way, so that the general public, decision makers, and others., can understand and take positions on projects and solving their problems.

That EIA shall be objective and credible is also important for the road manager. Estimated assessments must be included, but should be described openly as such, and should preferably be rooted with environmental authorities that represent the values of society at large.

In addition, the assessments should be made so that appraisal is facilitated together with other impacts, and with regard to objectives and aspirations for long-term sustainable development (ecological, social and economic).

### **The Benefits of EIA**

By analysing conditions and impacts, damage can be prevented or mitigated. Many road projects involve both positive and negative environmental impacts. By means of EIA, existing environmental qualities can be promoted and improved, and sometimes, new environmental qualities can also be provided. To neglect environmental factors, or take them into account too late, can involve considerable increases in cost for environmental adjustment at a late stage, or costs of environmental damage. EIA should therefore lead to better projects, better information and contributions from various players, often of intrinsic value.

Of course, benefits should balance costs. For this reason, one should question how each part of the work and of the statement is to be used.

### **Responsibility and Costs**

In Sweden, as in other countries, it is the developer/road manager who is responsible for EIA and pays for the work.

The road manager is responsible for the content of the EIA document being correct. Responsibility for faulty assessments however, rests not only with the road manager but also with any consultant/expert. For this reason, among others, it is therefore important to present methods and uncertainties in analyses and assessments together with the baseline data.

It is appropriate to mention scoped expert investigations, and to use them in the final EIA, but presenting them separately or having them available separately. It should be clear that the expert himself/herself is responsible for the content.

If the EIA requirements for all appropriate reviews are taken into account from the start, and the EIA work is integrated into the planning and design work, EIA should not lead to any prolongation of the planning period.

As regards minor road construction and maintenance measures requiring land, formal EIA requirements and consultations are often experienced as requiring a disproportionate amount of time and resources compared with the environmental benefit they give. The SNRA's handbooks, together with VVFS 2001:18 indicate possibilities of simplifying things.

### **More Impact Assessments**

With a road project, all relevant effects and impacts of importance shall be analysed and assessed, especially with regard to accessibility, transport quality, traffic safety, environment and regional development. They should lead to measures and decisions bases that promote sustainable development with regard both to environmental aspects and social and economic aspects, for future generations in a long-term perspective. Important impacts are generally to do with traffic - road users, surroundings - use of land and regional economics. It may be

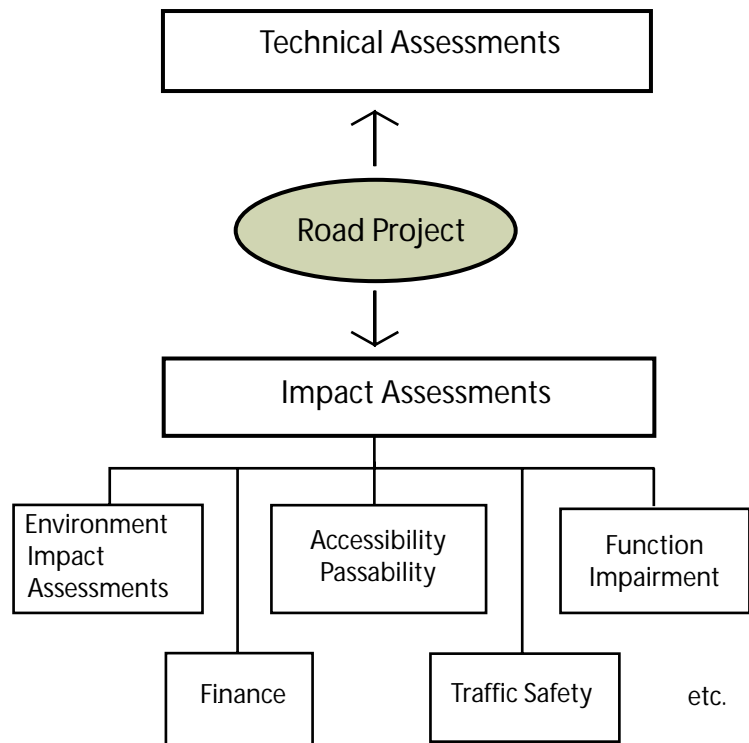
Environmental Code, Chapter 6, Section 10

“An Environmental Impact Assessment, together with the procedure of an environmental impact statement shall be paid for by the applicant referred to in Section 1, or is otherwise liable to draw up an Environmental Impact Assessment”

The SNRA's instructions concerning consultation and Environmental Impact Assessments, etc., in initial studies, road enquiries and design plans (VVFS 2001:18)

especially necessary to emphasise children, old people and the functionally disabled or other perspectives of fairness, etc.

Irrespective of which impact assessments are made in each individual case, the Environmental Impact Assessment shall be clearly separable. If there are several impact assessments, they should be adjusted one to another to facilitate collective evaluation. As regards fixing boundaries, see Chapter 10, Page XX of this handbook.



*Environmental Impact Assessment in relation to other impact assessments.*



## 2. Procedures

In this Chapter, a principal methodology for working with impact assessments is described. In addition, appropriate methods of working are presented as regards EIA for less extensive measures.

### General Basic Methodology for Impact Assessment

The fact that similar methodology is used for EIAs as for other impact assessments makes interplay and collective assessment easier. Impact assessments shall note road construction and traffic/traffic monitoring, the construction phase and operational phase, and can be applied to different planning phases. First clarify the **requirement** for impact assessments, including Environmental Impact Assessment (in those cases in which there is not a statutory requirement). How will the analysis work and assessments be used?

#### Collection of Information

- Collect basic information, both existing and new. (Includes collection of information through consultation).

#### Analysis of Requirements – Basis for Analysis of Change

- Analyse the present situation and trends (also look back in time) – propose goals for the project!
- After dialogue, scope the content of the impact assessment, its extent and degree of detail (based both on professional knowledge and on points of view from consultation with authorities and with the general public).
- Analyse if and how function and traffic are changed in the road traffic system.
- Scope the network which is affected and shall be included in location/design. Give a do-nothing/reference alternative.
- Assess the size of the area of influence that controls the extent of the environmental studies, etc.
- Analyse the appropriateness/sensitivity of the area of investigation as regards road location/road measures/traffic measures (give reasons for the identification of alternative corridors/segments, etc.).

#### Impact Assessment Process

- Analyse and describe the situation in the do-nothing alternative with regard to aspects relevant to the project.
- Describe how/to what extent effects and impacts are taken into account in proposals for location/design. How have the impact assessment processes had an effect?
- Analyse direct and indirect effects and impacts of the proposal/proposals, including the mitigation measures and similar, intended to be put into effect. Discard those effects which do not have impacts of importance. Relate to goals (of the project and overall) and quality norms.
- Describe the effects and impacts so that comparison of alternative/variants is made easier. Finish by placing the alternatives in order of precedence, with respect to each type of effect.
- Analyse the external mitigation and quality improvement measures which could be achieved with the effects and costs estimated, so that the reader/decision maker can assess whether the measures which are already included are the most appropriate ones and are sufficient.

### **The compilation synthesis**

- Compile a comparison of the alternatives.
- Assess the requirement for follow-up surveys, any content of the follow-up programme and requirement for securing “baseline data” in the “baseline situation”.
- Assess what is important to think about in continued planning or implementation, and when previous impact analyses should be taken into account.

### **Presentation**

- Present the impact assessment in text and illustrations, verbally, in the form of an exhibition, etc., easy to read and explicit.

*Principal methodology for EIA and other impact assessments*

## **Adjustment of the EIA to the Actual Case**

According to the Roads Act, the EIA document can be small and simple.

The majority of design plans and EIAs produced in accordance with the requirements of the Roads Act are to do with smaller road reconstruction and operational measures which require land outside the road area. What look like simple measures can, however damage environmental values, such as ancient remains or migratory routes in watercourses for fish, etc. Therefore, there is a compulsory requirement for EIA in design plans, in accordance with the Roads Act. This requirement applies, irrespective of the degree of environmental effect. For this reason, the initial study of the environmental part plays an important role in collecting information that indicates the requirement for environmental considerations, so that early consultation can contribute to appropriate scoping of content and extent in future EIAs. As regards EIA where there is no question of there being environmental impacts of importance, it is especially important to use information concerning environmental circumstances at the place in question, to explain why no environmental impacts, or only a few of them, are discussed apart from such things as certain precautionary measures.

Simplification of working methods is sometimes possible and should be aimed at.

- For an initial study or an EIA respectively, a design plan can be made collectively for several similar or adjoining road reconstructions or operating measures which require land. Each specific measure, and its effects and environmental impacts shall then be studied. (According to VVFS 2001:18)
- The environmental part of the initial study is used for continued work, and after supplementation it forms an EIA.

Formal handling can also sometimes be co-ordinated, to avoid unnecessary work and delay in the planning process. With good baseline data, it can be possible for several factors to be completed in connection with earlier consultation.

Other road and traffic projects, which do not consist of road construction and are not operational measures that require new land.

In order to ensure satisfactory measures and necessary environmental considerations, the SNRA recommends a working method using initial study documents be applied in general to all road and traffic measures, see VV Publication 2002:46, Handbook – Initial Study. Traffic safety measures, and also formation measures or noise protection measures, etc., normally need to be adapted to circumstances on different types of location in order not to cause unnecessary negative effects. In this context, the initial study document is thus **not** connected with any statutory consultation, **or** requirement for consultation with the county administrative board.

The method of working with the initial study gives the road manager a basis for assessing whether it can be a case of significant impacts on the environment, and whether environmental considerations shall be established in the documentation in the form of EIA for the purpose of mitigating damage and using improvement possibilities.

The general rules for consideration in the Environmental Code shall be applied in all cases!

The initial study collects relevant environmental information, such as on known ancient remains or the SNRA's survey of valuable roadsides (biologically and culturally), valuable tree-lined roads and migratory hindrances of fish in the form of incorrectly placed culverts. The EIA affects the formulation of measures and documents values, or the EIA highlights damage which affects tree-lined roads and contributes by giving proposals as to how a new tree-lined road or compensation can be solved. For measures where the law does not require EIA, but where the road manager considers that one is required, one and the same document can contain the initial study and the Environmental Impact Assessment. In this context therefore, the county administrative board shall **not** approve the EIA.

Formal requirements regarding consultation and EIAs exist for measures that require permits, in accordance with Environmental Code, even when the Roads Act does not require them.

### 3. EIA is adjusted to the Planning Stage

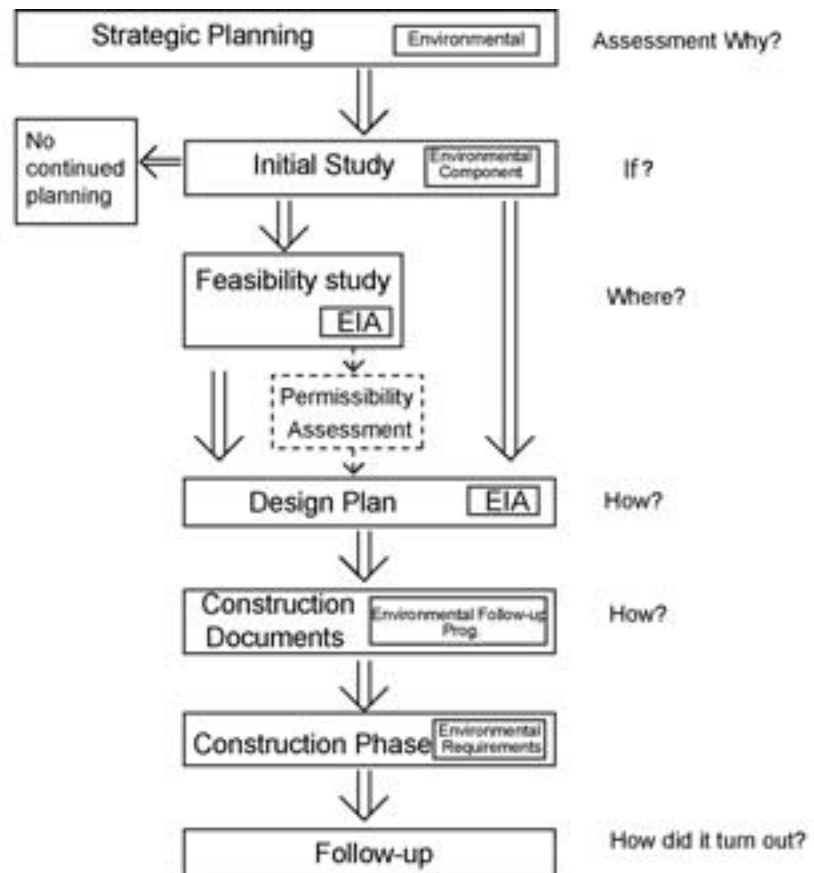
In this chapter, the role, direction and degree of detail of EIA are described for various planning stages. The relationships between the planning stages are given special attention.

#### The Importance of the Planning Stage

For the best use of EIA, work must be started early, and must focus on the correct questions at the correct planning stage. In the first place, attention shall be given to the impacts which can affect the stage in question.

For a feasibility study, EIA shall therefore, primarily, be concerned with environmental effects which are of importance as regards the public interest. In road design (design plans and construction documents), the impacts of private interests can receive greater attention, at the same time as consideration and adjustment to benefit the public interest should be attended to.

Assessment of the effects of CO<sub>2</sub> emissions, and the possibilities of contributing to “long-lasting sustainable development”, are more relevant in planning transport at system level for a larger urban area or a region than for a single road project. A large road project or several small road projects can, however, increase total traffic movement and emissions, and also influence the distribution of traffic in a larger road system.

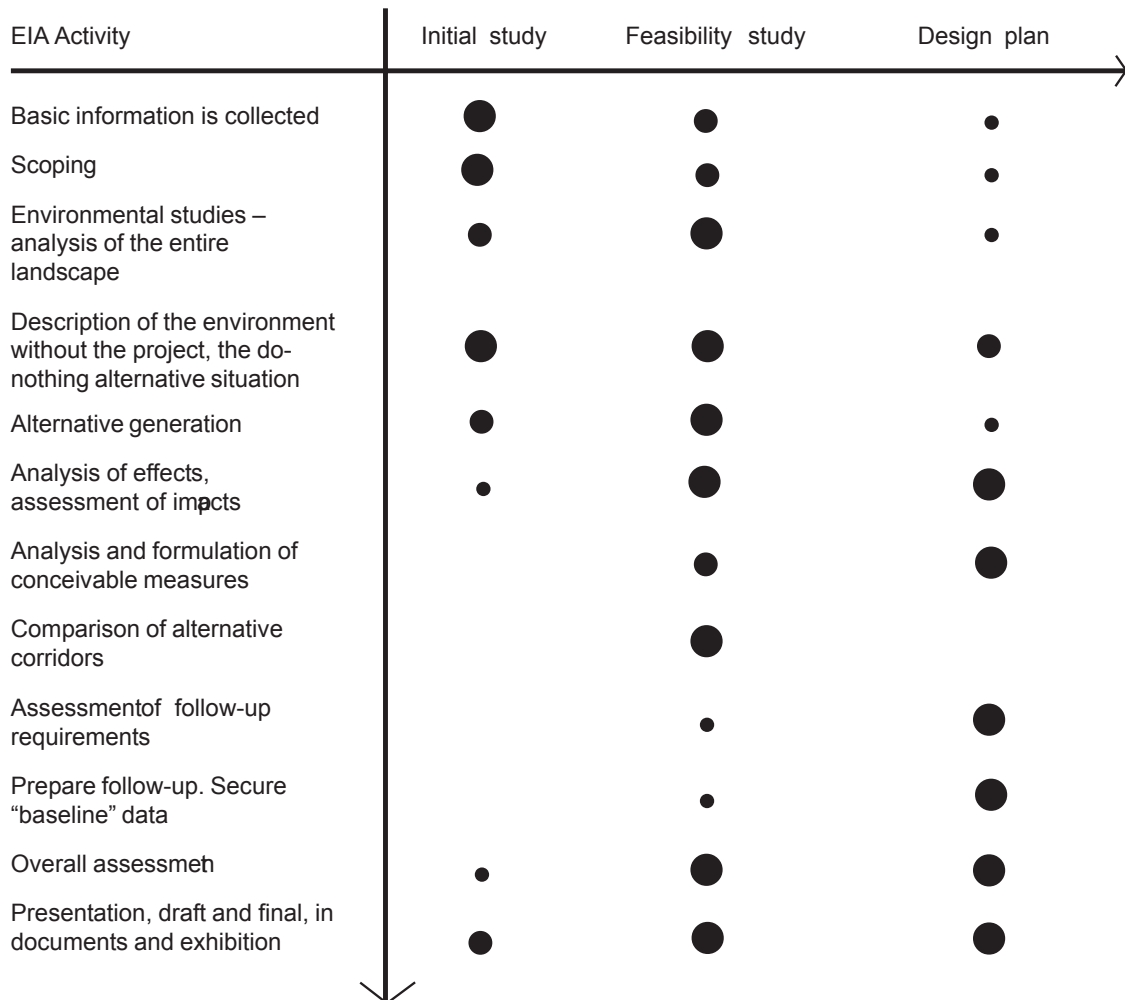


*Work with environmental questions within the road sector varies at different planning stages.*

The differences between alternative segments of road in a single road project are often small as regards contribution to global effects. Because the sum total of the effects of several projects can be considerable, and the direction of development is interesting, changes in traffic and consequent changes in emissions of climate gases and similar effects are nevertheless dealt with in EIA at project level. (For more minor measures, this can be satisfied with a commentary on possible contributions to general environmental goals). These so-called cumulative impacts can also involve other aspects than vehicle exhaust gases.

Do not go deeper into the analysis and assessment than that which can be made use of in the planning stage itself!

It is important to note whether several road and traffic projects, and other development projects, will produce impacts which affect the same people or the same environments. A common situation is that a follow-up project, "the next stage", is implied and involves serious impacts on the same environment or on other environments. If this is not given attention at strategic level, EIA for the one road project must also highlight the impacts of the other project where a joint study cannot be arranged.



*In different stages of EIA work, the emphasis is on different activities. The size of each circle is in proportion to the work input.*

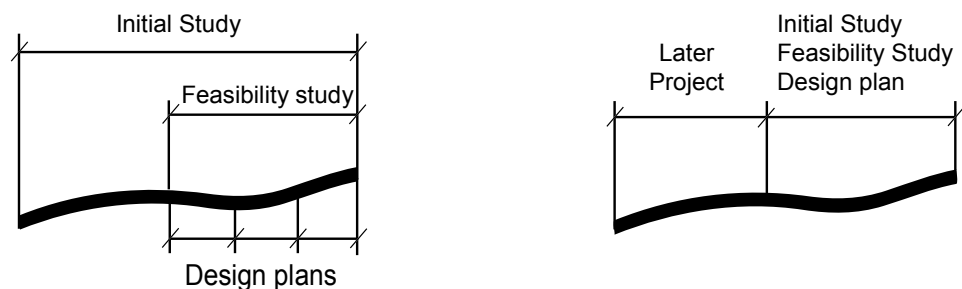
## Strategic Planning

The choice of action strategies or action types is determined by the general transport-policy goals, problem analyses and by a broad set of conceivable measures. This choice is based on such things as the so-called four-stage model, which means involves following four types of action being considered and examined:

1. Measures which can affect the demand for transport and the choice of transport mode.
2. Measures which give more efficient utilisation of an existing road network, for example, information, control, regulation.
3. Limited rebuilding measures on an existing road, for example, supplementation with a central safety barrier, action in adjacent areas, reconstruction of crossings.
4. New construction measures in the form of general reconstruction or new construction in new terrain corridor.

Environmental assessment in strategic planning within the transport sector is required in order to obtain an environmental adjustment at system level. This should, preferably, be integrated with other impact assessments for a total view of sustainable development. Strategic studies with environmental assessments can embrace a transport network or a transport corridor with several types of transport, and can also include policy type measures. One form of strategic plan, which can be important for the transport infrastructure, is the regional plan, survey plan or in-depth survey plan, in accordance with the Planning and Building Act (PBL).

Environmental assessment in strategic planning facilitates EIA at project level, by dealing with general environmental questions and possibly alternative types of transport, which are often difficult to manage at project level. At strategic level, environmental impacts should preferably not be dealt with if they are more appropriate to be dealt with in EIA at project level, as regards suitable location or design. However, encroachment impacts do not need to be included if they can be decisive for the choice of system design. See the EU Directive on assessment of certain plans and programmes, 2001/42/EU, and separate guidance produced jointly for traffic work, the environmental assessment guide, 2001.



*The initial study can cover more than a project covers. The figures show two principal examples for managing a large transport corridor, which is studied in strategic planning. The initial study which follows can cover the entire transport corridor, subsequently divided up into shorter segments in the feasibility study and design plan (example on the left-hand side). Alternatively, the project can already be limited in the initial study, to cover only part of the transport corridor (example on the right-hand side)*

The environmental component of the initial study is looked at here in relative detail, as it is not included subsequently under any special heading in this handbook. The environmental component of the initial study is important:

- for deciding whether the project involves significant environmental effects that guide continued procedure,
- in order to show whether EIA is required in cases that do not have a compulsory EIA,
- for the direction of future EIA,
- for environmental standpoints in general.

Minor road measures, traffic safety measures, etc., can also cause environmental damage or make possible environmental gains!



*The initial study is the first step in the road planning process. The SNRA's recommendations concerning content, etc., are given in VV Publ 2002:46 Handbook – Initial Study*

## Initial study

### The Role of the Initial study

In the initial study, problems, prerequisites and possible measures are described, together with their effects. Project goals can be formulated for qualities to be achieved as regards accessibility, environment, road safety, etc. Proposals for the initial study are the basis of early consultation and the position taken by the county administrative board as to whether the project can be presumed to entail significant environmental impacts. The initial study leads adoption of a standpoint as regards possible continued work with the road project, and/or design plan for road measures, or planning and design of traffic measures, etc.

### Connection EIA –Initial study

The proposal for an initial study (i.e., a first version, in which the proposal for continued work and standpoint are not included) forms the basis of **early consultation** and the standpoint taken by the county administrative board as to whether the project can be presumed to entail **significant environmental effects**. The latter guides the requirement for increased consultation and a wider circle of consultees, and to a certain extent, the requirements concerning the content of EIA.

When the law does not require an initial study, including one can nevertheless be important in order to indicate environmental problems, and requirement for EIA, however, without requirement for legal formalities.

Even when the formal decision on significant environmental effects is made by the county administrative board, the road manager should have sufficient knowledge at its disposal to anticipate the expected decision in advance. The environmental component of the initial study, and consultation on environmental questions, are also important as regards any subsequent review, under the Environmental Code.

The initial study does not contain any actual analyses of effects or assessments of impacts. Surveying the environmental circumstances has the character of collecting existing information together, and the conclusions regarding effects and impacts are preliminary. For this reason, an initial study is, in principle, not sufficient to form the basis of an evaluation of alternative locations or choice of road standards. If the work is given increased depth, it is no longer an initial study.

An initial study should be carried out collectively, for several smaller measures in different places. In this way, some benefit of co-ordination can be attained as regards presentation, etc. However, in such an initial study, each specific measure should be stated.

### Connection to Previous Stages

The initial study should show if and how environmental impacts have been treated at system level. If a project is updated without being based on analyses at system level, equivalent analyses should be ensured in some way, using such things as the four-stage principle. (*See Handbook –Initial study VV publ 2002:46*)

The initial study can also be broken off if work shows that system studies, land use planning or similar are required before a particular measure can be planned.

What characterises the environment and landscape? Examples of problems.

- Is it, for example, a population centre, with town environment qualities and recreation areas close to the population centre?
- Is it a region with intensive land use, intensively developed? Then perhaps it is more important to see what environmental qualities can be created than those which may be claimed, provided land of low quality is utilised. Removing roads sections that are no longer needed can be important.
- If it is an area of high quality, such measures should be chosen if they can be compatible with these qualities.

See checklists in the Swedish National Environmental Protection Agency's Environmental Impact Assessments, NFS 2001:9, the EIA ordinance and the EU checklist for screening and scoping.

Reference with abstract is made to the previous problem analyses, in order to select an action strategy. If previous problem analysis is insufficient, it may be necessary to carry out a further analysis and assessment in the initial study, as a basis for assessing whether other or further alternative measures are required in the EIA work. The basic criterion for an interesting alternative is that it should solve the problem or fulfil a certain purpose. EIA should contribute to ensuring that all satisfactory alternatives are included.

## Environmental questions in an initial study

The compiled information on environmental conditions, environmental interests and land use is interpreted and conclusions are drawn on sensitive environments and on which qualities and functions of the landscape are important to retain or develop. This is an important basis for establishing environmental goals for the project. Consideration should be given as to whether urban areas, intensively developed areas, protected areas or everyday countryside are involved. The reader should be given a general picture of the environmental conditions.

Probable effects and impacts follow on from the type of operations and conditions at the site. These three components are fundamental for assessment as to whether EIA is needed, and requirements concerning the content of possible EIA. For example, factors that characterise the environment and landscape can be ascertained.

## Important

- Environmental conditions and trends should be studied broadly on the basis of existing information.
- Conclusions should be drawn as to what can become significant, important effects and impacts, and on relevant environmental goals. Environmental goals for the region and the project can guide the content of future EIA.
- Special requirements concerning environmental competence, Environmental Impact Assessment, special review and permits shall be clarified in those cases in which work is to continue with road planning and road design. At this stage, what a future EIA should focus on can already be established on a preliminary basis.
- Known conditions at the site can involve important problems, which must be given attention now, such as risks of excessive lowering of the ground water level or a large surplus of spoil.
- Requirements for co-ordinating such things as land use planning must be given attention and initiated at this stage.
- The initial study should provide an explanatory statement as to why the problem can be solved with the measures indicated. Some of the measures required can be due to environmental problems.
- Plan early consultation so that all conceivable environmental questions can be dealt with, and local knowledge collected.



## EIAs in Feasibility studies

### The role of the feasibility study

The road project shall constitute a basis for the selection of road corridors and road engineering standards. Detailed study of the environmental conditions in the road project's EIA forms the basis for identification of such things as alternative road corridors for new construction.

A road enquiry with EIA forms the basis for consideration by the Government of whether permission shall be granted for a motorway, motor traffic connection, or four-lane road more than 10 kilometres in length.

As EIA is part of the basis for decision-making, not a decision-making document, important requirements concerning the road project are given in VVFS 2001:18. This is an important link from EIA to the decision, and shows that EIA is taken into account, as required in the Environmental Code.

### Connection to Earlier Stages

The initial study is important to use and append to procurement of a road project with EIA. The content can be the basis of requirements for certain competence, and shows what has been done already, information that is already available.

An initial study shall be referred to and shall be available when proposals for a road project are described.



*The feasibility study leads to adoption of a standpoint regarding choice of technical standards and choice of corridor, if this is appropriate. The recommendations of the SNRA concerning content, etc., are given in VV publ 1994:71, Redovisning av vägutredning. Handbok [Presentation of feasibility study. Handbook], (in revision)*

### Important

- In projects where increased consultation is to be carried out, the initial study and a first draft of the most important questions in the feasibility study (including the EIA questions) are used as a basis for this consultation.
- Environmental studies give a basis for monitoring project goals and possible goal conflicts.
- Improvement of an existing road shall normally be presented as an alternative. Measures for an existing road often need to be included in alternatives which involve new segments of road. Alternative road standards shall also be elucidated from the environmental point of view. An important difference can apply to the requirements for local roads and their impacts.
- It can be necessary to secure baseline data on the environment with respect to future follow-up requirements.
- In EIA of the road project, assessment is also made as to whether it is possible to prevent or mitigate crucial environmental impacts (for example, damage) with measures which shall be studied in detail later, in connection with the design plan or construction documents.
- Connection to the next planning stage. State how the direction of EIA and degree of detail differ from future EIA in the design plan.

## The EIA in a Road Design Plan

### The role of the design plan

After a permissibility review, the choice of road corridor is not subject to a review when the design plan is established

Any review of hydraulic operations which can be included in the project is a conditional review, i.e., it only applies to conditions for hydraulic operations. Determination of the design plan is a review in which the project can, in itself, be rejected.

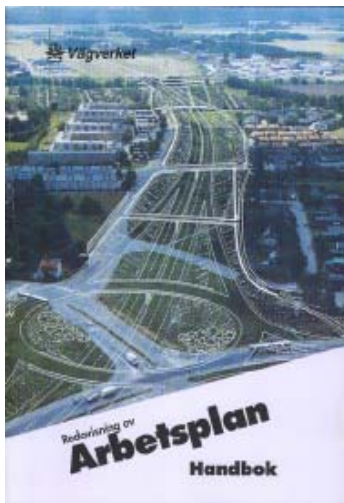
Compiling a design plan is put on an equal footing with permit review. EIA is carried out for the design plan, irrespective of whether it is to be confirmed or whether access to land is to be made by means of agreements with each separate landowner. Here, EIA is a support in assessing whether sufficient consideration has been given to the environment, that environmental quality norms have been taken care of and that goals and ambitions regarding the environment will be fulfilled. In the case of a determining review, the final consideration is about weighing up between different interest, including private interests, and also in those cases in which a government permissibility review has been carried out

The determining decision can give terms and requirements regarding follow-up programmes, management programmes for roadside areas, etc.

In order that important standpoints concerning the environment and environmental measures in the road project shall have legal effect, there are separate requirements regarding statement of a design plan in VVFS 2001:18.

### Connection with earlier stages

A summary should be made of the initial study and any road project in the EIA. These documents shall be accessible. It is important that the recommendations from earlier stages are included in the design plan stage, concerning which environmental questions need to be investigated further or taken into consideration in other ways in the design plan.



*The design plan gives the design of the road, the land which is required, etc. The requirements of the SNRA concerning content, etc., are given in VV publ 1994:72, Redovisning av arbetsplan. Handbok [Statement of Design plan. Handbook] (revision planned)*

### Important

- In projects with considerable environmental effect, increased consultation is required. If a road project is not made, this consultation should be carried out at the start of the design plan stage. The initial study and first draft of the design plan and EIA (with the most important problems) are used as a basis for this consultation.
- Clarify that the EIA concerns environmental impacts of the road design with possible design alternatives, and also impacts concerning existing roads and how environmental adjustment can increase with mitigation measures, etc.
- Explain which reviews/permits the EIA is to be used for.
- Describe how the EIA work affects road design proposals.
- Requirements for following up environmental impacts? Suggest a follow-up programme. Give reasons for each part.
- Illustrate possible compensation measures that can be especially motivated in the case of specific damage to protected values, etc.
- Ensure that important environmental adjustments and considerations are transferred on into the construction documents, etc.
- EIA for the design plan should also be used in the case of any review for a permit application for hydrologic operations. In order that the EIA can also be usable for future hydrologic operation inquiries, the questions concerning hydrology should be described in a separate section.

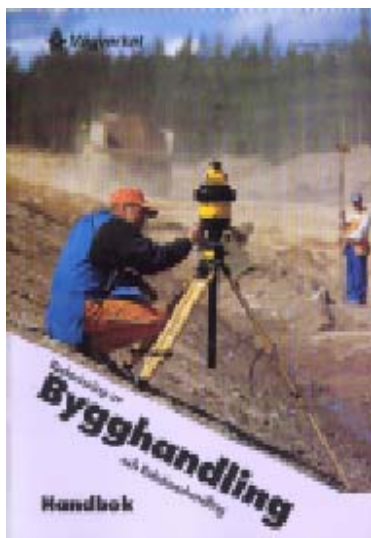
See also:

VV publ 2001:105, Miljökrav vid upphandling av projekteringsuppdrag och entreprenader [Environmental Requirements in Procurement of Project Planning Assignments and Contracts].

VV publ 2001:15, Miljökrav under byggtiden [Environmental Requirements during the Construction Phase].

VV publ 2000:104, Vägverkets regler för kvalitetssäkring av planerings-/projekteringsuppdrag och entreprenader [The SNRA's Rules for Quality Assurance of Planning/Project Planning Assignments and Contracts].

VV publ 1999:159, Miljöuppföljning av vägprojekt [Environmental Follow-up of Road Projects].



*The SNRA's recommendations concerning the content of the construction documents, etc., are given in VV publ 1994:73*

## Environment in the Construction Documents

### EIA is used

The construction documents constitute the basis of the construction process. The environmental impacts of the construction process can be considerable, and should have been analysed and assessed in earlier EIA. Environmental considerations in decisions and other ambitions regarding environmental adjustment shall be implemented in the construction documents and the construction process.

The construction documents and requirements concerning the contractor shall ensure that the environmental ambitions of the design plan or the decision-maker are followed, and are based on EIA and the rules of consideration of the Environmental Code and the Roads Act. The environmental follow-up and management programmes are worked out at the same time as the construction documents, when this is justified.

### Connection to earlier stages

The design plan with EIA is a basis for construction documents, for any follow-up programme for the road manager and requirements concerning the contractor at the construction stage. Prescribed mitigation measures and other environmental considerations are worked into the construction documents.

### Important to think about with the construction documents

- Make sure that environmental questions are included in the design. Requirements concerning inclusion in the construction documents are given in VVFS 2001:18, Section 41.
- Use opportunities to add further environmental adjustment to the project, for example, in detailed design of the road area.
- Descriptions and maps of protected landmarks, etc., are taken from the EIA and used when necessary in follow-up programmes, requirements concerning the contractor or in training.
- During the construction period, a follow-up can be made of anticipated negative environmental impacts, effect of measures already taken, etc. The follow-up programme is worked out in consultation with the county administrative board and municipality and can cover both the construction stage and the operational stage.
- A management programme can be required for environmental measures which have been carried out, for example, surface water purification installations, noise protection fences or new tree-lined roads.

## 4. Statement of EIA in accordance with the Roads Act

The Roads Act's requirements concerning statement of EIA, which includes the requirements of the Environmental Code, are given in this chapter. Commentaries to the requirements are given in Part 1 of the Handbook. The chapter centres on the statement requirements of VVFS 2001:18.

### Statement of the Environmental Impact Assessment for the Road Project

Before statement of the EIA is worked out – discuss once again what the presentation is intended for; for the general public, complainants, decision-makers including referral bodies. It is assumed that the county administrative board, during consultations and prior to approval, will work towards making the EIA usable and easy to read. Remember that sometimes EIA is to function for several different reviews, permits, etc.

The following requirements concerning content of EIA are given in VVFS 2001:18, which contains references to the Environmental Code. BMP = in cases with decisions on “significant environmental effects”. (MB) = in accordance with the Environmental Code.

**Summary**, non-technical, (MB)

**Road project**, its purpose and relationship with other projects, conformity with other land use planning and with environment programmes or equivalent.

Description of activity or measures with information concerning location, planning and extent (MB).

Information on how **alternative** solutions, road corridors and road design and their environmental impacts have been taken into account in the planning and project work.

A statement of alternative locations, if such are possible, and alternative designs, together with reasons as to why a certain alternative has been selected (MB). Other comparable methods of attaining the same purpose (MB, with requirements from the county administration board).

**Reasons for scoping** of content and degree of detail (after taking into consideration consultation, etc.).

**Existing environment qualities, land use and traffic conditions** within the area of influence and expected development.

Description of **impacts of the activity or measures not being realised** (MB). (This is closely connected with the description of existing environment.)

**Expected direct and indirect environmental effects and environmental impacts** of the planned road project being carried out, and how various interests are affected, including in accordance with the requirements of Chapters 3 and 4 of the Environment Code.

The information which is required to demonstrate and assess the main effects on human **health, the environment and management of land and water**, and other resources which the activity or measure can be expected to bring about (MB).

The effects of various alternative actions are related to the **do-nothing alternative**. Note that impacts and measures concerning an existing road also need to be assessed in cases where new a roads is to be built.

### **Mitigation measures (MB)**

A description of planned measures so that damaging effects can be avoided, reduced or rectified (MB).

The extent to which mitigation measures are assumed to be included in the assessment of environmental effects and environmental impacts.

Comparative assessments of alternative mitigation measures – including during the construction phase – regarding effects and costs, with a statement of how relevant environmental goals, consideration rules and environmental quality norms can be satisfied.

Which **methods and sources of information** have been used, together with uncertainty in analyses and assessments that have been carried out (can also be presented as references integrated into the report).

What **environmental expertise** has contributed to the EIA work.

### Especially for EIA in a feasibility study

The extent to which **environmental considerations** have affected identification of the road corridors which have been studied (described with existing environment if presented separately, or put in the introduction.)

A **comparative assessment** of alternative road corridors. (Decisive, alternative, separated environmental impacts can be emphasised, but important impacts which are not alternatives can also be emphasised) (An improvement of the existing road shall also be studied if special reasons do not determine otherwise.)

The extent to which it is assessed **possible** to solve possible conflicts, mitigate and improve the environment **at a later stage**.

Important conditions for environmental adjustment of the direction and design of the road in **continued planning**.

### Especially as regards EIA in the design plan

**How EIA work has affected** the road design.

**The environmental impacts of the selected design** of the road project and compensatory measures which can be especially justified.

**Requirement for follow-up** of the environmental impacts of the road project and **proposals for possible follow-up programme** (added to the construction documents), explained in each section.

## Relationship to other Project Documents

Statement of EIA interacts with other important statements. The EIA can refer to other parts of the feasibility study and design plan, for example, as regards traffic data and impact descriptions regarding road safety. EIA and other impact assessments should also be carried out so that collective assessment can be formulated in an appropriate way.

Statement of EIA, together with other project documents, shall give the examining authority the required guidance, in accordance with FFVS 2001:18, as regards:

- choice of environmentally suited solutions and contributions to environmental goals being fulfilled,
- important conditions and environmental impacts,
- presentation and comparison of all relevant alternatives,
- how rules for consideration and environmental quality norms have been satisfied, in accordance with Chapters 2 and 5 of the Environmental Code,
- work with the EIA and that it has been carried out in accordance with current regulations.

## Feasibility study

According to VVFS 2001:18, a road project should give a report from the road management authority, in which it is made clear how points of view which have been put forward have been taken into consideration in the final proposal, or reasons why this has not been done. The report shall also state how the requirements of Chapters 2 to 5 of the Environmental Code have been satisfied.

## Design plan

According to VVFS 2001:18, a design plan shall state:

- which of the mitigation measures and other environmental adjustments, and compensation measures included in the EIA are intended to be carried out, and the reasons why these are considered to be sufficient,
- which measures are to be investigated further in the construction document stage or the construction stage, to satisfy expected requirements concerning the environmental adjustment of the project,
- how the Environmental Code's rules for consideration and regulations concerning environmental quality norms shall be satisfied,
- whether the environmental impacts of the project are to be followed up, and what environmental aspects are to be included in the follow-up.

Points of view which have come in after the presentation shall be summarised and commented upon in a formal report.

The first, second and third items here can be advantageously expressed in connection with project goals or environmental ambitions expressed in some other way.

## **Construction Documents**

The road management authority is responsible for prescribing mitigation measures and other environmental considerations in the project's construction documents.

## **Consultation**

EIA covers the consultation that has been carried out, but the actual consultation statement is only presented in one place in the road project or design plan, not in the EIA. Relevant points of view shall, of course, have the capacity of affecting the EIA, and should therefore be mentioned in the EIA.



## 5. Summary of EIA

This chapter describes what is meant by the Environment Code's requirement that EIA shall contain a non-technical summary. Examples are given of how this can be done. This chapter is based on the statement requirements of VVFS 2001:18

A non-technical summary is presented first in the EIA document, or as an adjacent part of a joint summary for the road project or design plan. It can be replaced with or supplemented with a separate folder that summarises the project, with a separate page or spread on the EIA. An example of such supplementary information material is shown below.



E4-alternativens miljöpåverkan längs befintligt vägnät										Antalet ☉ är ett mått på hur stor förbättringen bedöms bli för respektive intresse. (☉) motsvarar en halv ☉.
Bas	JV	ÄV	JVM	ÄVM	JVÖ	ÄVÖ	JÖM	JÖ		
Naturvård	☉	☉	☉	☉	☉	☉	☉	☉	☉	
Kultur	☉	☉☉	☉☉	☉☉	☉☉	☉☉	☉☉	☉☉	☉☉	
Friluftsliv	☉	☉☉	☉☉	☉☉	☉☉	☉☉	☉☉	☉☉	☉☉	
Naturresurser	☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	
Boende	☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	☉☉☉	

E4-alternativens konflikter längs föreslagna E4-sträckningar										Antalet ☹ är ett mått på konflikternas storlek med respektive intresse, måttlig, stor respektive mycket stor.
Bas	JV	ÄV	JVM	ÄVM	JVÖ	ÄVÖ	JÖM	JÖ		
Naturvård	☉	☹☹	☹	☹☹☹	☹☹	☹☹	☹☹	☹☹☹	☹☹☹	
Kultur	☉	☹(☹)	☹☹	☹☹(☹)	☹☹☹	☹☹	☹☹(☹)	☹☹	☹	
Friluftsliv	☉	☹☹	☹	☹☹☹	☹☹	☹☹	☹☹	☹☹☹	☹☹☹	
Naturresurser	☉	☹☹	☹☹	☹☹(☹)	☹☹	☹☹(☹)	☹☹	☹	☹	
Boende	☉	☹	☹	☹	☹	☹	☹	☹	☹	

Sammanfattning av miljöeffekter längs föreslagna leder					Sammanfattning av miljöeffekter vid befintligt vägnät inom Uppsala				
	Bärbyled III	Svinstalänken	Bärbyled Nord	Bärbyled Syd		Bärbyled III	Svinstalänken	Bärbyled Nord	Bärbyled Syd
Natur	☉	☹☹	☉	☉	Natur	☉	☉	☉	☉
Kultur	☹☹☹	☹☹	(☹)	(☹)	Kultur	☉	☉	☉	☉
Friluftsliv	☉	☹☹	☉	☉	Friluftsliv	☉	☉	☉	☉
Naturresurser	☉	☹☹☹	☉	☉	Naturresurser	☉	☹	☹	☹
Boende	☹(☹)	(☹)	☹	☹(☹)	Boende	☉☉	☉	☉☉☉	☉☉

Extract from summarising brochure for a large road project. The front and back of the cover (shown above) have been used for a general map, in which the extent of the project, the alternatives studied, etc., are shown: (Source: Feasibility study E4 Section Uppsala-Mehedeby.)



Note: The summary in the example shown here consists of four sections.

- Why is a new E4 required?
- Alternative road corridors.
- Environmental impacts.
- Collected evaluation.

Only an extract of the last section is given here.

### **EXAMPLE: FROM SUMMARY EIA IN ROAD PROJECT**

#### COLLECTED ASSESSMENT OF THE VARIOUS ALTERNATIVES

All alternatives mainly result in positive effects for human health and for safety:

- road safety is improved and the barrier effects are reduced,
- noise disturbance is reduced,
- risks of serious impacts from accidents with dangerous goods are reduced.

All alternatives mainly result in negative effects for nature and the cultural environment:

- infringement is made into valuable cultural environments,
- natural values are affected negatively,
- large areas which are at present not subjected to noise will be affected by noise, which is negative for outdoor activities.

The alternatives studied are, in the main, of equal value with regard to positive effects for **human health and safety**. Alternatives F and F2 do, however, require noise protection measures to give an improvement in the noise situation in Måsta-Björka. All alternatives involve considerable improvements along existing roads, and small impairments along the new road.

The summary must give a picture of the extent to which certain impacts can be decisive for the project, even if they do not separate out alternatives.

All alternatives involve negative impacts for the **natural environment, the cultural environment and outdoor activities**. On the section Enånger-Ölsundsvägen, alternative D involves the least amount of impact of all three aspects. Alternative B can involve encroachment on many sensitive, natural environments (shore zones and bogs) and goes right through the interesting long valley at Mekrossla. Alternative C involves considerable encroachment in Ygelberget with its key biotopes and divides the villages of Nordmyra and Mörtsjö. The alternatives B and C both also involve considerable encroachment in the long valley towards Bergtjärn and cut off an important link for outdoor activities in the area. Alternative D is thus best from the environmental point of view. In a final choice between the alternatives, however, other aspects must also be taken into account, such as construction costs and road user costs.

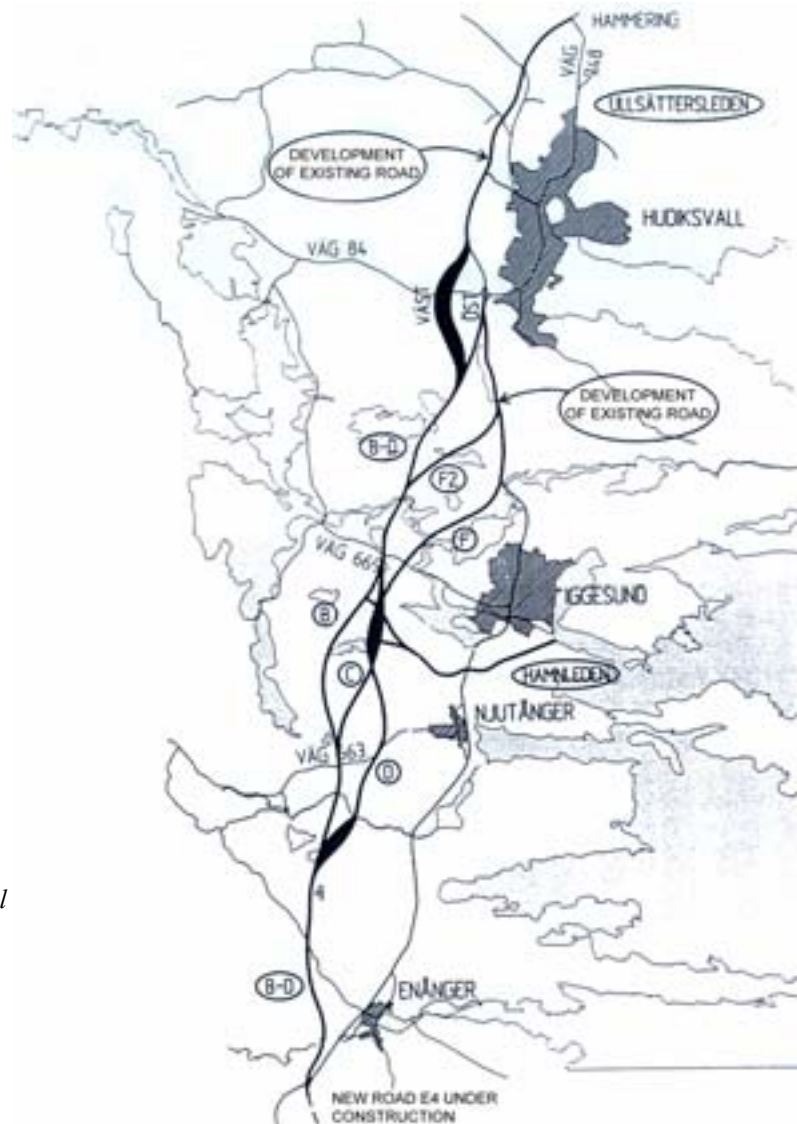
On the section Ölsundsvägen – Hudiksvall, alternative B-D West involves serious fragmentation of the forest area around Yarna. The alternative follows existing borders in the landscape, and avoids areas which have a density of ancient remains. It gives considerable noise dissemination in an area, which until now, is quiet, which means that the attractiveness of the area will diminish.

*Example of a summary of EIA for road project. Continues on the next page. (Source: Road project, Road E4 Enånger-Hudiksvall.)*

**EXAMPLE: FROM SUMMARY EIA IN ROAD PROJECT, continued**

The alternatives B-D East are equivalent as regards the natural environment and outdoor activities, but in addition, involve considerable impacts on the cultural environment, because of the new segment over the long valley south of Hudiksvall, and encroachment on ancient remains and building environment around Måsta-Björka. Alternative F can involve a greater risk of muddying the Delånger River during the construction period, but apart from that is lenient, as it follows the existing E4 for a long segment. The alternative gives the least noise effect in the quiet areas. The alternative F2 involves a somewhat greater encroachment in the area around Yarna and greater dissemination of noise than alternative F, at the same time as the risk of disturbing the Delånger River is less. Alternatives F and F2 involve no new encroachment into the cultural environment of the long valley south of Hudiksvall. The alternatives F and F2 are thus best from an environmental point of view. In a final choice of alternatives, other aspect must be taken into account, however, such as construction costs and road user costs.

The effect on **natural resources** is small for all alternatives. However, alternative F has a considerable impact on Iggesund's water resources, by limiting utilisation, and is therefore inferior to the other alternatives in this respect.



*Example of summary for feasibility study. A general map is included in the summary. (Source: Feasibility study Road E4 Enånger-Hudiksvall.)*



## **EXAMPLE: SUMMARY EIA IN DESIGN PLAN – PUBLIC FOOTPATH AND CYCLE PATH**

### SUMMARY

The SNRA plans to construct a public footpath and cycle track (public footpath and cycle path) along Road 293 on the section Smedsbo-Stråtenbo. The public footpath and cycle path will follow the northern side of Road 293, apart from two sub-segments, furthest to the west and to the east respectively, where it will be on the southern side. The purpose of the project is to create a new pedestrian and cycle connection alongside the narrow road, which at times is heavily congested. Parallel to this project, and co-ordinated with it, a design plan is being drawn up for the public footpath and cycle path along the Ångesgårdarna-Vallmoravägen segment as well.

The positive impacts of the project are obvious. They consist primarily of increased security and safety for unprotected road users, which will be the result of the rebuilding, and which will improve the living environment. The public footpath and cycle path also increases accessibility in the area, and is positive for mobile outdoor activities. Despite the fact that the public footpath and cycle path does not bring about any change in the noise situation in the area, measures will be taken regarding the buildings which have noise levels in excess of applied national values, irrespective of this development.

The negative environmental impacts of the project are judged to be greatest with regard to the cultural environment. In Stråtenbo, the public footpath and cycle path affects the built-up environment and its interaction with the ancient remains environment and the road. Between Stråtenbo and Smedsbo, the public footpath and cycle path involves encroachment into the cultural landscape, due to the road area being widened.

The effects on the cultural environment cannot be fully assessed until a planned archaeological survey has been carried out. The SNRA is prepared to reconsider the final location and design of the public footpath and cycle path on the basis of the results of the survey.

The project also involves certain encroachment on housing property.

The impacts for the natural environment are assessed to be small, provided that care is taken in the location of culverts in sensitive waterways.

*Example of a summary of EIA in design plan for a public footpath and cycle path project. (Source: Design plan Road 293 Public footpath and cycle path Smedsbo-Stråtenbo.)*

## **EXAMPLE: SUMMARY EIA IN DESIGN PLAN – WIDENING OF ROAD TO FOUR-LANE ROAD**

### **THE PROJECT**

Road E65 between Malmö and Ystad is expected to be of increasing importance for transport. The section between Börringe and Skurup is not of an acceptable technical standard. The analysis of accidents shows that the risk of injury is greater than average for this type of road. With an expected considerable increase in traffic, the situation can only get worse.

When the initial study was being carried out between Malmö and Ystad, a requirement came from the head office of the SNRA for suitable segments of road within the country for developing a new type of road safer for traffic. This section was proposed by the SNRA region Skåne.

The proposed new road type is 15.75 metres wide, with two lanes in each direction, separated by a central safety barrier. Crossings shall be over or under the road. The side areas are planned with level slopes and shallow road ditches. There shall be no changes in the geometrical standard of the existing road.

### **NATIONAL INTEREST**

The project will affect four national interests. The national interest of natural values protects the distinctive character of the hilly landscape and its conditions for biological life. The two national interests regarding cultural environmental protection protect both a long-term continuity of settlement, strongholds and a castle landscape. The fourth national interest, according to the Environmental Code, Chapter 4, Section 2, is protection of mobile outdoor activities. The impacts on the national interests are considered to be moderate. Damage can be prevented.

### **ENVIRONMENTAL IMPACTS**

#### **Environment**

The landscape will be affected by a wider road, seen from the surroundings. At Börringe kyrkby, Stjärneberg and at the road traffic junction at Skurup, especially, the impacts will be great. As regards other locations, the impacts will be moderate. The natural environment will be affected, but to a small extent, as the road is only being widened. Additional access roads affect the natural environment and agriculture more. The impacts are assessed to be moderate. As regards recreation and cultural environments, the impacts are assessed to be small. Documented ancient remains will be affected.

#### **Health**

The barrier effect of the road will be considerable. In order to get over to the other side of the carriageway from some properties, it will be necessary to travel in the “wrong direction” to get into the right direction on the road. Exits to the carriageway on the same side can be made direct. Noise abatement measures will improve the quality of life in residential property along the road. New opportunities will be created for pedestrians and cyclists to travel to Skurup, as a separate path from Stjärneberg is proposed.

#### **Management of natural resources**

Agricultural land will be required, and access roads to fields will be removed. Replacement roads will be planned in consultation with agriculture. The impacts are assessed to be moderate. Management of ground water will be improved compared with the do-nothing alternative, with a delay reservoir.

It is calculated that the superstructure will require a total of 75,000<sup>3</sup> of gravel.

#### **Miscellaneous**

The risk of accidents with dangerous goods assessed to be reduced on account of the road being safer for traffic.

*Example of a summary of EIA in design plan for a TS project – an existing road is widened and provided with a central safety barrier, the adjacent area is revised with level slopes and shallow ditches. (Source: from design plan Road E65 Börringe-Skurup.)*

## 6. The Purpose of the Project, its connection with other Projects, Land Use Planning, etc.

In this chapter, a description is given of what is meant by the requirement of VVFS 2001:18 that EIA shall contain a description of the purpose of the project, its connection with other projects, and conformity to other land use planning and environment programme or equivalent. The Chapter is based on the statement requirements of VVFS2001:18.

Questions to ask yourself include the following.

- Who/what has a need for the project to be carried out? Forestry? Commuters?
- Is the purpose of the project increased road safety, regional development (the business community or work-related travel), accessibility for pedestrians and cyclists, children, functionally disabled, etc?
- Is the project intended to reduce exhaust emission content in a built-up area? Several types of measure can be conceivable for attaining the same objective.

Also connect up with the transport-policy objectives! They constitute an important basis as regards the purpose of, and requirements for, the project.

### Purpose

The purpose and requirement of the project should be described in the EIA, as it is crucial for the EIA that no interesting alternative shall be excluded, that all relevant alternatives shall be studied. The reader should be able to assess this as well. A first criterion for an alternative being conceivable is that it satisfies the requirement and purpose of the project proposal. Purpose, requirement and conceivable principal alternatives are looked at in the initial study, and it should be possible to continue the formulation of the initial study at a later stage and possibly develop it further. The environmental component of the initial study should therefore, if necessary, contribute with proposals for scoping of areas under investigation and future investigation areas.

### Connection with other projects

Connection with other projects does not need to be assessed in EIA for the reader to be able to form an opinion, both on the role of the project in its broader context, and on such aspects as valuable areas being affected by several projects.

A joint EIA can be made for several measures which are similar or are within a certain geographical area, irrespective of the connection between the measures. This applies to minor road construction measures and operational measures that require land, for example, a combination of noise prevention measures along a segment of road, and widening of the road at an adjacent segment, or the improvement of several bus stops along a longer segment.

### Conformity with other land use planning, etc.

EIA should contain an outline statement of current land use for the area in question, for example based on municipal plans. An assessment of the project's conformity or conflict with these plans or programmes shall be presented.

## 7. Scoping of EIA

This chapter describes how to arrive at scoping of the content of EIA, and its extent and degree of detail with regard to the character of the project in question, its size and the sensitivity of the environment. Examples are given showing how this can be done. The chapter is based on the reporting requirements of VVFS 2001:18.

### Why scope?

EIA shall focus on that which is of importance in the project in question, important environmental impacts. A preliminary rough scoping shall be established in the initial study, the content of which shall be worked out with consultees/interested parties. EIA for a road project shall emphasise that which is important with regard to choice of location, choices of alternatives. This does not mean, however, that only impacts which separate out alternatives should be considered. It can be that certain important environmental impacts are connected equally to all alternatives, for example, the impacts of construction in a watercourse. EIA for the design plan can highlight alternative environmental adjustment and alternative protective measures, but must clearly show which environmental questions are “big” and perhaps decisive for execution of the project.

There is no reason to include things that are only affected to an insignificant extent. It has been common to give headings for things that will not be affected, where only “no effect” is given. In order to avoid this, reasons for scoping shall be explained at the beginning of the document. In giving reasons why certain aspects are not dealt with, it should be stated that data is available and analyses have been made that show why a certain type of commonly occurring effect cannot be of importance.

Scoping of EIA shall be based on such things as early consultation and possible increased consultation. Reasons for suitable scoping should be talked through and have a basis. Agreements on scoping reached through consultation, should be documented.

### How to scope?

In assessing what are significant effects on the environment, the following criteria are used.

- Type of effect: geographical extent, durability, intensity, concentration, danger, possibility of stopping, preventing or repairing.
- Things that are subjected to permanent effect: people, environment, natural resources
- Things that the general public are uneasy about and consider important.

For work with EIA, more scoping can be carried out than is subsequently described, in order not to miss anything important. But for the statement, the principle applies that given in the Environmental Code, and in other places, that it is the **main** effect that shall be described. There are thus no requirements for completeness. On the other hand, EIA shall contribute to a good decision-making basis and environmental adjustment of the project during the work.

When the direction and extent of the EIA document is established, remember that the headings in EIA should reflect impacts of importance. If the impacts are only insignificant regarding , for example, the natural environment, it shall not be given a separate heading.

If there is uncertainty, a study can be carried out of, for example, the hydrology. The result can conceivably be that anticipated risks connected with effects on the ground water are not probable. In that case, the conclusion of the analysis can be given at the beginning of the EIA, when the scoping has been justified, and it is not necessary to have a separate heading about the effects on ground water.

The road manager is responsible for sufficient information and knowledge being available as the basis of scoping. Each indication or risk of effect must be taken seriously, i.e., must be checked.

Checklists used in discussions on scoping are often based on the EIA ordinance. the general advice of the Swedish National Environmental Protection Agency and the EU Commission’s recommended lists.

**Important Environmental Aspects 09-11-1999**

- Noise
- Barrier effects
- Crossing of Prästbäcken
- Crossing of Storån
- Crossing of Lillån
- Crossing by Degermyren
- Tunnel
- Crossing of Storälven
- Effect on ground water
- Separate water catchments
- Ecological barriers
- Handling of spoil: permanent disposal of durable substances
- Side roads, parallel roads

**Important Environmental Aspects 07-03-2003**

- Noise
- Barrier effects
- Crossing of Prästbäcken
- Crossing of Lillån
- Crossing by Norrsjön
- Crossing by Degermyren
- Tunnel
- Crossing of Storälven
- Effect of ground water
- Separate water catchments
- Ecological barriers
- Handling of spoil: permanent disposal of durable substances
- Side roads, parallel roads
- Construction Period:
- Handling of spoil: transport
- Handling of spoil: disposal of spoil
- Rock blasting

*Examples of scoping, in which “important environmental aspects” are defined in the project. The list stays with the project and is continually updated afterwards, as knowledge and points of view are added.*



## Scoping for Initial study

In an initial study for a road or traffic project, requirements specific to the project are given in EIA. It may already be evident that the EIA is to be used in a review of hydrologic operations. Discussion of conceivable environment effects in the initial study can be connected with requirements also being made regarding special competence needed to participate in the EIA surveys. Description of conceivable effects gives guidance for more exact scoping of the content in the EIA, which occurs in the introduction to the next stage. The rough assessment of effects in the initial study is, however, an important basis for enquiries to those carrying out the road project or EIA design plan.

It should be possible to demonstrate that all conceivable environmental factors have been looked into. Start by using a checklist of environmental factors. See Chapter 9 of this Handbook. A list can also be appended to a single EIA. It might then be evident that there are no impacts of importance on the environment. And that can be given in the reasons for scoping.

### **EXAMPLE: SCOPING OF EIA IN FEASIBILITY STUDY**

EIA in road project primarily deals with general interests, with the emphasis mainly on separable alternative impacts.

In scoping made during the work, the focus has been on the most important questions for the investigation work. This meant that the EIA work has been concentrated on living environment, cultural environment, landscape, outdoor activities and natural environment, and also the water catchment in Gäddvik. Questions which are not judged to be separable alternatives or decisive for continued planning are considered in a more general way. The scopings have been made for reasons which include being based on statements which have come in during the widened consultation.

Regarding geographical scoping, see the general maps.

Only impact-limiting measures that can affect the assessment of an alternative to an important extent are included at this stage. Measures which do not affect assessment of alternative impacts and/or are common for all alternatives, are dealt with in future EIA in design plan for a selected alternative.

Environmental impacts are assessed on the basis of present use of land. Assessment of the long-term impacts of the road alternative can, however, change as a result of changed use of land. Other establishments in the road positions studied, or close to them, can mean that the encroachment and disturbance that the road is expected to produce can also occur, even if another location for the road is selected. Examples of such changes in land use can, for example, consist of subsequent establishment on account of increased activities at an air freight location, an extension of the Norrbotnia railway, and a general increase in population according to the Luleå Vision 2010.

*Example of formulation of scoping.  
(Source: Feasibility study Alternative  
Road Connections between the E4  
and Kallax Airport/Bergnäset.)*

## Scoping in Feasibility study and Design plan

The examples below and on the next page show how scoping can be formulated in text at the road project stage and the design plan stage respectively.

### **EXAMPLE: SCOPING IN EIA FOR DESIGN PLAN – NEW ROAD WITH TUNNEL**

#### **Scopings**

According to the Environmental Code, Chapter 6, Section 7, the EIA shall present information required to assess the project's *primary effects* on human health, the environment and economic management of land and water, and of other resources. This means that certain impacts of little importance can be dealt with in general, or left out.

#### **Alternative corridors**

Impact assessments of alternative road corridors are not made at the design plan stage. The alternative corridors studied in the road project are, however, described in general form in Chapter 1.

#### **Geographical scoping**

This EIA deals with that section of road 00 which is intended to be replaced by a new road on the segment at Storstad-Lillby.

Assessments of the do-nothing alternative impacts apply to the existing road on the segment Storstad-Lillby.

#### **Environmental aspects**

The work is focused on the most important environmental aspects, which are assessed to be:

- Impacts on water supply, nature, agriculture and forestry resulting from changes in ground water levels and ground water quality which arise if the tunnel is completed, both during the construction stage and the operational stage,
- other impacts during the construction stage, resulting from such things as uses of chemicals, handling of spoil and transport.

No work will be carried out from the ground surface along the main segment of tunnel. No physical impact on the cultural environment or installations for outdoor activities will occur there. These environmental aspects are therefore dealt with mainly on the basis of possible resulting changes in vegetation, which can affect the character of the landscape.

In the impact assessment, for the Tunnel Alternative, consideration has only been given to cessation of traffic on the existing road, and the road being demolished, not to alternative land use.

Alternatives or variants of the location of a road can, if necessary, be included in the design plan and EIA, for example, as regards the question of whether a new bridge should be located upstream or downstream from an existing bridge.

*Example of the formulation of scoping. (Source: fictitious example.)*

**EXAMPLE: SCOPING OF EIA FOR A MINOR RECONSTRUCTION PROJECT WITH CONSIDERABLE ENVIRONMENTAL IMPACTS**

Traffic calming measures on the thoroughfare through Xtown involve minor reconstruction, selective measures and the planting of trees to strengthen the character of streets. This involves limited environmental impacts. According to results of consultation, and the decision of the county administrative board that the project is presumed to entail considerable environmental impacts, EIA is concentrated entirely on the impact on the sensitive cultural environment and the historically valuable town centre, which is protected. It includes an analysis of visual effects. In addition, the degree of reduced barrier experience is analysed.

As an introduction, it is important to elucidate the town environment in its totality.

The changes regarding environmental aspects involving traffic will, however, be small, according to traffic calculations and connection with impacts. The roads and streets are not recommended for dangerous goods, and the amount of such transport is small.

Other environmental interests are not relevant in this case, involving an urban area.

**EXAMPLE: SCOPING OF EIA FOR OPERATIONAL MEASURES WITH REQUIREMENT FOR LAND, WITHOUT SIGNIFICANT ENVIRONMENTAL IMPACTS**

EIA FOR INSTALLATION OF FOUR BUS STOPS ALONG ROAD XXX.

**Scoping**

The bus stops each require an area of 1-2 metres of land next to the existing road area, for a segment of about 10 metres per stop. This, in itself, indicates little or no environmental impact. Attention has, however, been drawn to certain sensitive environmental qualities, which must be safeguarded. The EIA therefore concentrates on a species-rich road edge and encroachment into agricultural land, and also deals with compensation measures.

Other aspects are not important, as explained by the following.

The bus stop construction is planned on the basis of a design programme adopted by the municipality, and involves no visual disturbance or other conflict with the character of the buildings.

Questions concerning pedestrians and cyclists and road safety are dealt with in a separate section. Traffic with dangerous goods is of small extent, and the risks will not increase, for which reason this subject is not elucidated further.

As regards the disturbance which is associated with vehicle traffic, the fact that bus traffic will increase should be compensated for somewhat by reduced car traffic. The bus stops have been located in accordance with views expressed by residents.

No watercourses are affected by the work.

*Example of formulation of scoping for small projects, one with and one without significant environmental effects. (Source: fictitious examples.)*

## 8. Existing Environment – Baseline data

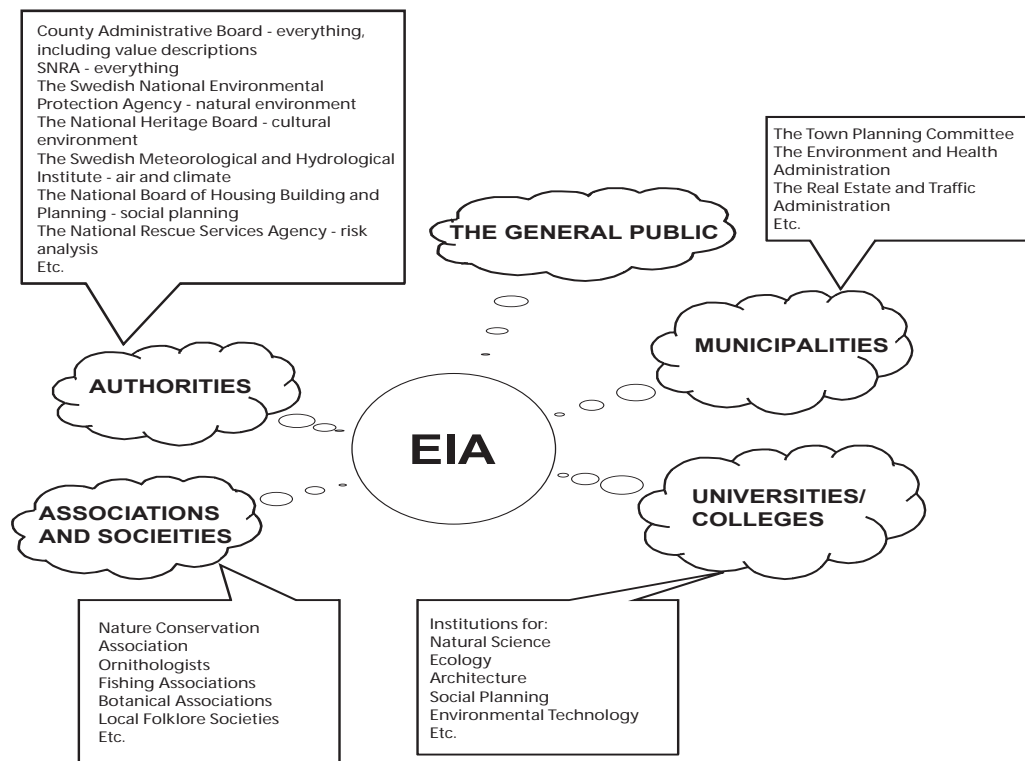
This Chapter deals with mapping of existing environment and its development in the geographical area that can be affected by a road project. The basis consists of existing environmental qualities and those people who may be affected by altered environmental qualities. Information on the use of land and expected volumes of traffic, with and without the project, are important components. The Chapter is based on the statement requirements of VVFS 2001:18.

### Basis of Analysis and Assessment

Knowledge concerning conditions, characteristics concerning use of land constitute the bases of analyses concerning how the entire landscape or cityscape with people functions as regards environmental factors.

Knowledge is obtained from

- existing information: maps and documents, municipal survey plans, etc.,
- surveys and programmes for environmental protection and cultural environment conservation reported earlier for other developments, etc.,
- site visit,
- verbal information from the local population, schools, etc.,
- verbal information from local population, schools, etc.,
- interpretation of aerial photos, satellite photos,
- consultation with experts, field surveys, surveys of ground water, etc.,
- literature.



*Information is collected from many sources.*

Mapping can give an indication the extent of the area of impact is to be taken into account. Geographical scoping of EIA depends on the extent of the impacts. Therefore, a geographical scoping of the studies must be made on a preliminary basis initially.

Mapping of environmental conditions, interests, use of land and population begins in the initial study, in which existing information is collected together. This forms the starting point for EIA in the road project or design plan, but it can be necessary to check how urgent things are.

Collection of basic information is, in many cases, a time-consuming part of the EIA work, and also difficult to predict. Therefore, it is very important to clarify what is there, what is available digitally, what requirements there are for further additional knowledge. This is already done, as far as possible, in the task description for the EIA. The information to be collected cannot wait for scoping of the EIA, but must begin early, and contribute to a position being taken as to what is important and what is lacking. Existing information collected during the initial study is augmented later, to varying extents, with surveys, investigations, interpretation of aerial photographs and various types of field study, general or detailed. Looking for information on impacts which occurred or were prevented in similar cases can also be valuable.

An important task of the county administrative board and municipalities is, to provide information and knowledge. Universities and colleges, interest group organisations and private persons can have detailed knowledge which can be used in EIA work.

**A statement** of the prerequisites in the existing environment can be made in summary, together with describing each group of environmental effects and impacts. Deeper analyses of prerequisites can be referred to, but do not need to be included in a unitary EIA. If a statement of such deeper analyses is necessary, in order to understand the environmental impacts, it should be present in the form of appendices.

**Environment in Initial Study:**

Only existing information

- Occurrence of red-data species
- Survey of meadows and enclosed pastures
- Valuable road edges (SNRA survey)
- Fish-water information
- Areas which have been pointed out as of interest for protection regarding the natural environment.

Presentation scales vary according to the character of the project and location

**EIA in feasibility study**

Information from the initial study and such things as general field surveys, and interpretation of aerial photographs (IR also vegetation maps, etc.)

- Classification of biotopes
- Functions of the fauna in the landscape
- Information collected from the Game Act on the movements of wild animals.

Normal presentation scale about 1:20,000 – 1:50,000

**EIA in design plan**

Information from earlier stages and detailed field inventories, with some scoping,

- Flora and fauna, occurrence of species, populations, extent
- Investigations of the movements of certain species of animal, basis for location of crossings.

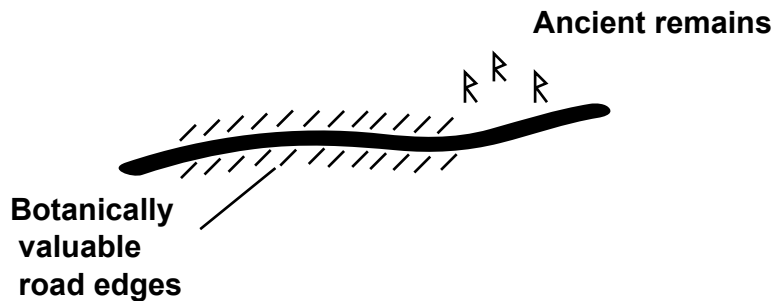
Normal presentation scale about 1:2,000 – 1:10,000

*Collection of information at various stages. The example applies to information on the natural environment.*

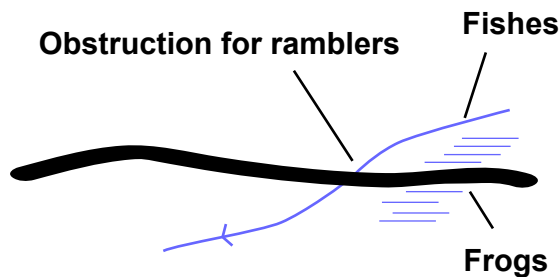
## Basic Information for Small Projects

For **minor road rebuilding measures and operational measures requiring land** it is often not a question of significant effect on the environment. EIA is required anyway, according to the Roads Act. It should therefore be sufficient, just to make small additions to the information which was collected for the initial study.

On the basis of visits to the site and dialogue with residents and other consultations, it should be clarified whether further information is required to facilitate environmental adjustment and for assessment of effects which were, perhaps, dealt with earlier with uncertainty. A description, with a few lines of text connected to a map, should be able to contain a unitary description of the environment and environmental qualities, and their importance for people.



*Road safety measures with clearing of fixed obstructions in the areas adjacent to the road. The initial study shows that environmental considerations are required. The documentation is made in a single EIA, prior to being carried out.*



*Strengthening of road, which involves changing road culverts. Basis for EIA needs to be supplemented. Local information shows that environmental considerations are required.*



## Map Information, etc.

Use of geographic information, i.e., maps, is essential for the EIA to be easy to understand. Which material is chosen for use is up to each person, but the developments within this area are making rapid progress, for which reason it is worth spending some time in researching what there is to use.

Municipalities often have detailed maps, primarily of areas with buildings. They are, however, not always available in digital form.

County administrative boards have, to an increasing extent, digitised their so-called RUM material (RUM = regionalt underlagsmaterial [Regional Basis Material]). However, the digital material needs to be gone through in order to clarify any gaps.



In utilising general map material, permission is required from the National Land Survey and from the Geological Survey of Sweden, SGU (for geological maps). The SNRA has entered into an agreement with the National Land Survey on rights to use certain types of map. In order to publish aerial photographs and oblique photographs, it is necessary to have these approved for distribution.

## Digitally

Additional map information and other geographically tied information, including such things as environmental conditions, are produced to an increasing extent in digital form. If the basic information is collected in a geographical information system (GIS) various types of analyses and presentations are made easier.



Input data files for GIS tools are scattered throughout various authorities and organisations, but can be found collected together in each respective county administrative board. For projects for the SNRA, this type of information can be accessed via the regional offices of the SNRA.

In selecting map material for presentation, it is important to put oneself in the position and experience of the reader as regards map reading. The GIS tools give great possibilities regarding analyses and presentation of maps, but in certain cases the information can be difficult to understand, especially if the background map contains too little information or is absent. The general public usually read only driving maps, touring maps, the “green map” and the “yellow map”. These are thus maps that can be recognised, and should be considered for the presentation, being types of map that the reader is familiar with.

*Example of paper maps and two versions of digital map respectively, of the same area. GIS material often needs to be re-worked as regards colour, line typology, thickness of lines, etc., in order to increase clarity. It is especially important for legibility that the background map has contour lines which give a picture of the terrain.*

## 9. Existing Environment – Analyses

This Chapter describes how basic material regarding the existing environment is used for analyses of environmental prerequisites in a project. The view of EIA work as a single unit facilitates adhering to the scoping of important aspects which are described in Chapter 7. The Chapter is based on the statement requirements of VVFS 2001:18.

### Environmental Studies – analyses of the entire landscape

A broad landscape analysis should be started before supplementary studies and surveys in the field are carried out. Analysis which has been started gives guidance as to what it is necessary to collect in the field.

Existing circumstances are analysed, and the most relevant ones are summarised later in the report.

An introductory landscape analysis contributes to identifying environmental qualities at the start, and thus forms a basis for the entire project. The landscape, including human operations, culture and structures, gives physical, biological and cultural environmental prerequisites. The traffic situation in the transport system gives conditions as regards environmental problems connected with traffic, and on the presence of disturbances or freedom from disturbances.

Existing assessments of the landscape in its entirety can be useful. In this assessment, which is presented in the EIA, it is, however, important to give an understanding as to why the landscape functions, and not to give a great mass of names and irrelevant details. The relevant things are those characteristics which are connected with potentially important effects and impacts.

Ask yourself what type of landscape you are in. Nature and the economic-geographic region? What are the implications? Are considerable requirements placed on adjustment and avoidance, or is the environmental quality so low that road measures can contribute to raising the quality of the environment in heavily developed areas and in urban areas.

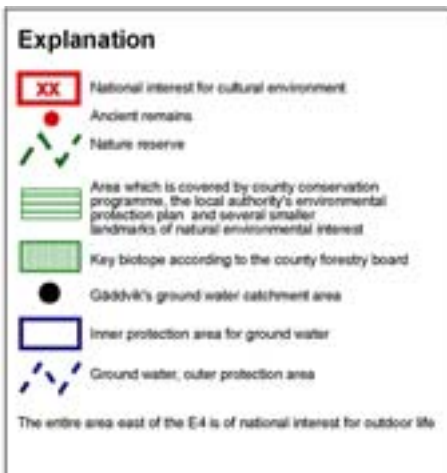
Normally, the landscape is more-or-less characterised by culture. It is often a combination of natural and cultural circumstances in the landscape which give special values and such things as favourable conditions for outdoor activities. For this reason, the landscape should be studied generally in its entirety to start with, with all its components and important characteristics, character as a total unit and the relationship of people to it, or their utilisation of it. The landscape can also be a city landscape.

#### EXAMPLE: SUMMARY LANDSCAPE DESCRIPTION

Högbyn is an extensive raised plateau. The geological material and plateau formation mean that ground water formation and the level of the ground water are high. The fertility of the soil is also high, as the soil is not waterlogged, and it contains lime. This has, in turn, given rise to wet areas, rich flora and fauna and a rather heavily populated agricultural settlement with a long cultural history. The area is relatively undisturbed as regards traffic and industry, which contributes to its attraction for outdoor activities from the neighbouring centres of population.

*An example of an general assessment of the present situation and development trends at the initial study stage. On the basis of this assessment, general conclusions can be drawn as to what impacts a new surface road or road through a tunnel, respectively, can cause. (Source: fictitious example.)*





A dynamic approach should be applied, in time and space. The past is taken into account, as is probable development in the future. Dynamics and interplay are about the dynamics of the landscape, with flows of water and air, movements of animals, ecology, people and culture.

The EIA work contributes to a mutual identification for the project of alternative road corridors or variants of segments and designs. An introductory landscape analysis is a basis of assessing both prerequisites and effects and impacts. For this analysis it is not sufficient to be aware of the borders of conservation areas that are pointed out, etc. A total picture must be created, which explains why these values and other values are dependent on various factors in the landscape.



Example of collection of information regarding existing environmental interests and environmental qualities at the initial study stage. (Source: fictitious example based on Road project, Alternative Road Connection between E4 and Kallax Airport/Bergnäset.)

## Analysis and Presentation Scale

It is important that all information from the EIA work is transferred to the next planning stage. But all information does not need to be presented. Analyses and raw results obviously cannot be used in a statement. Generalisation of map information and compilation of information from several maps often needs to be done. The presentation scale is controlled by baseline data, analyses and by what the decision refers to.

## The Environmental Goals of the Project

Analysis of conditions within the area of influence gives the basis for formulating the environmental goals for the project. The qualities that can be the basis of the project goals should be established with experts, for example at the county administrative board. In formulating these environmental goals, connections should be sought to national environmental goals, of which the following apply especially to the transport sector

- Reduced emissions of carbon dioxide, nitric oxide, sulphur and volatile organic substances.
- Percentages of carbon dioxide, nitric oxide, sulphur dioxide, soot and particulates in urban areas should be within the limits and norms. Emissions of carcinogenic substances should be halved.
- No resident should be subjected to road noise in excess of 65dBA equivalent level out-of-doors by the year 2007, (2005 for state-owned roads). If this is not possible, the indoor noise should not exceed 30dBA.
- No environmentally dangerous material in the infrastructure. Minimise use of non-renewable material. Material shall be re-used.
- New transport installations shall be located so that they function in harmony with their environment, and shall be planned with consideration taken to local natural and cultural values.

The planning of the road transport system shall contribute to national environmental quality goals being achieved. Connections can also be sought to any regional and local goals. (See: *Mål och mått för natur och kulturvärden [Goals and Levels for Natural and Cultural Values]*, VV publ 2001:.)

### EXAMPLE, PROJECT GOALS

The review of planning requirements for this project has been directed at attempting to fulfil the following goals:

- A good connection shall be created between the Road E4 and the airport on the basis of both existing and future transport demand
- The environment in Södra Gäddvik shall be improved with consideration given to the value of the old cultural settlement
- Road safety on the 616 road through Södra Gäddvik shall be improved
- The traffic-related environmental disturbances, primarily referring to air pollution, noise and encroachment in Luleå Centre, shall be reduced.

*Example of presentation of project goals in initial study. In these, the project's environmental goals are included. (Source: Initial study Road 616 Alternative Road Connections between the E4 and Kallax airport/Bergnäset.)*

## Area of Analysis – Area of Influence

The area of influence of a project, i.e., the area affected directly and indirectly, can be larger than the search area for road corridors.

The size of the area of influence is determined by, among other things, an area's characteristic properties, sensitivity, qualities, restrictions and possibilities. In a project in which questions of hydrology are of great importance, an outflow area can determine the size of the area of impact.

## Time Perspective

The assessment of effects and impacts shall refer to conditions during the **forecast year**, i.e., a number of years subsequent to the completion of the structure. The impacts which are assessed to be important on a longer perspective must, however, also be given attention. Studies of the present situation, do-nothing alternatives and trends in environmental conditions should also have a comparable time perspective regarding how changes occur over time, irrespective of the project.

To predict future conditions in the forecast year for the natural environment, cultural environment, natural resources and outdoor activities is not always easy. The municipality's survey plan can support assessments of whether existing land use can be assumed to persist. For example, possible development areas can be given as examples. The overall plan can also give support for assessments as to how an area will be valued in the future. In an urban area which is assumed to grow, such things as outdoor activities can become valued more highly, and encroachment seen as more serious than at present.

### EXAMPLE: PROJECT GOAL

#### Project Goal

Retain and improve the character of the road as an old village road located directly next to surrounding countryside with small and winding carriageway, edged by small ditches.

Retain the diversity and density of cultural landmarks on and next to the road.

Retain the diversity of culturally characteristic natural values in the vicinity of the road.

#### Project Indicators

Retained segments of road (both horizontally and vertically), varying width of road, limited ditches, old road culverts, lack of road markings, lighting and surface paving, constitute the basis of the character of the road as an old village road.

The rich occurrence of fencing and hedges, gateposts, outhouses, garden plants, deciduous trees, etc., both in an around the site, constitute together with the settlement the basis for experiencing the diversity and density of the cultural environment.

The presence of dry hillsides, garden plants which have gone wild, and older cultivated plants, large deciduous trees, and trees and bushes which produce fruit or berries constitute the basis of the natural values characterised by culture.

*Example of project goal in initial study. So-called project indicators are also given here, being used to assess goal fulfilment. The initial study has been included in the development work. Goals and Levels for Natural and Cultural Values. (Source: Initial study Road 290 sector Kullsbjörken-Tällberg.)*

## Physical Environment

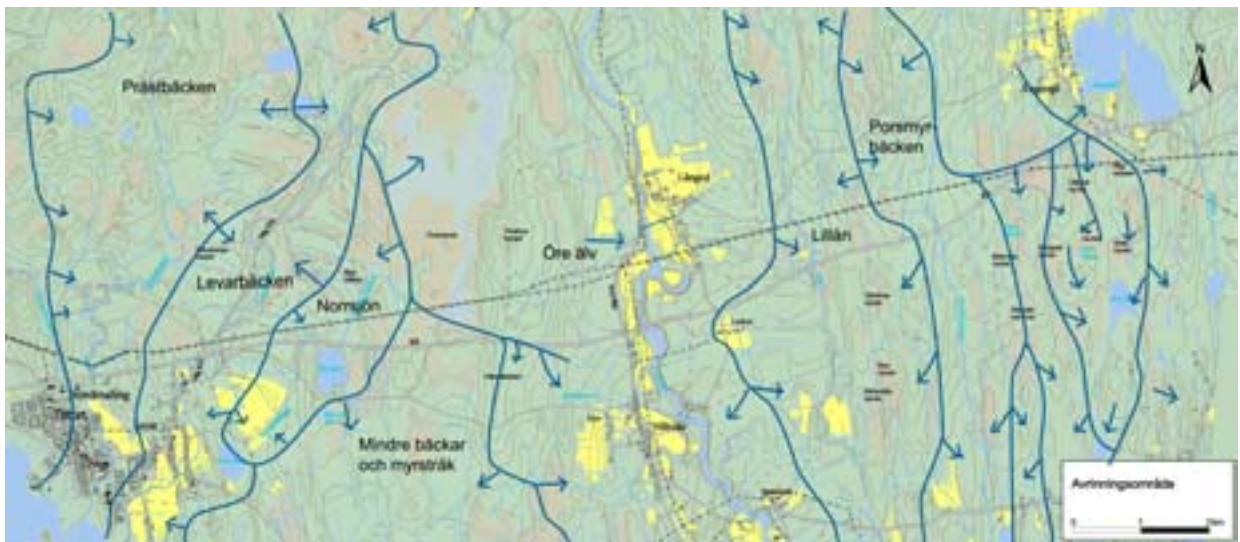
The concept of physical environment includes not only land, water areas, landscape, cultural environment, infrastructure, installations and buildings, but also ecosystems and their intrinsic components, such as plants, animals and other organisms, like climate and experiences in the physical environment, for example, in the form of silence and sound (according to the alternative advice on EIAs from the Swedish National Environmental Protection Agency, NFS 2001:9)

## Checklist

Running through a checklist helps so that you do not forget any important characteristic or environmental quality which could affect the project or future assessments of environmental impacts.

- Land. Type of land, type of soil, type of rock  
Geo-hydrology
- Landscape. Visual qualities, morphology, shape, structure
- Hydrology. Surface water, ground water dividers/drainage areas  
Watercourses, aquifers, outflow areas and inflow areas
- Air. Air quality, precipitation  
Climate (local climate) wind, CO<sub>2</sub>
- Plants. Biotopes, species
- Animals. Life environments, migration routes, species
- People. Population, structure, outdoor activities, well-being  
Effects on health/disturbances, sensitive groups
- Cultural heritage. Ancient remains, cultural landscape, settlement environments, structures
- Material assets. The physical environment, for example, infrastructure, installations, buildings
- Interplay in the landscape between environmental factors, use by people and existing effects
- Economic management. Materials, raw materials and energy
- Existing and planned altered use of land
- Anticipated settlement development, etc., not planned

*Checklist – existing environmental prerequisites*



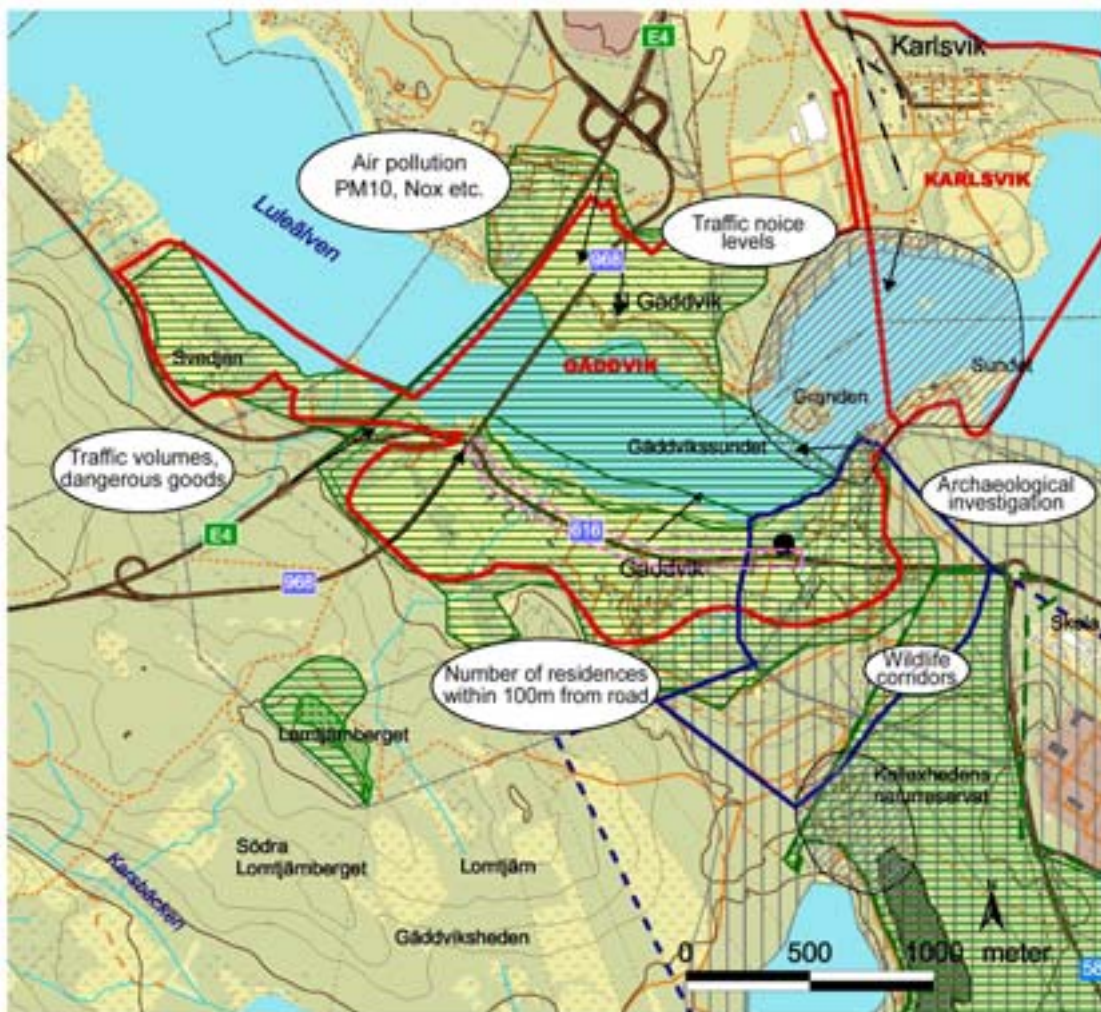
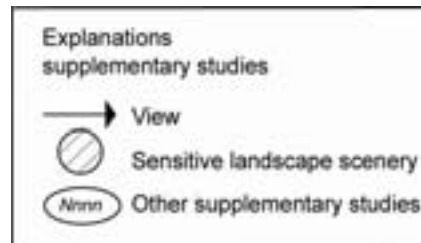
*Example of presentation of drainage area.*



## Supplementary Studies and Surveys

Knowledge of conditions and qualities in the search and influence area is the basis of the analysis of effects and assessments of impacts, both for the do-nothing alternative and the alternative solutions or routes which are under consideration. At the same time, it is the basis for reasons as to why parts of the search area, or certain alternatives, should not be studied further.

*Example of environmental studies and knowledge which needs to be added to the information collected earlier. (Compare Page XX). The map below applies to a road project. Further depth is made to the EIA for the work plan. (Source: fictitious example based on Feasibility study, Alternative Road Connections between Road E4 and Kallax Airport/Bergnäset.)*



## Generation of Alternatives – Environmentally Sound Alternatives

Analysis of the environmental conditions forms the basis of location and detailed design, and thus constitutes a prerequisite for environmentally suited alternatives being identified. It is important to give reasons as to why certain alternatives are not studied or are dropped, and to refer to how alternative solutions have been considered at a more general level. The county administrative board can then make requirements concerning

presentation of other comparable methods than that chosen to achieve the same purpose, in accordance with the Environmental Code, Chapter 6, Section 7. This can mean that information is required on alternatives which are outside the road transport system.

### Initial study

A description of the environmental conditions gives support for the types of measures and alternatives that should be included in continued work. Sufficient data for identifying alternative road corridors which are to be studied and compared is not normally available in the initial study. It can therefore be more appropriate to talk about an area, a search area and the scopings from standpoints that include environmental ones

### Feasibility study

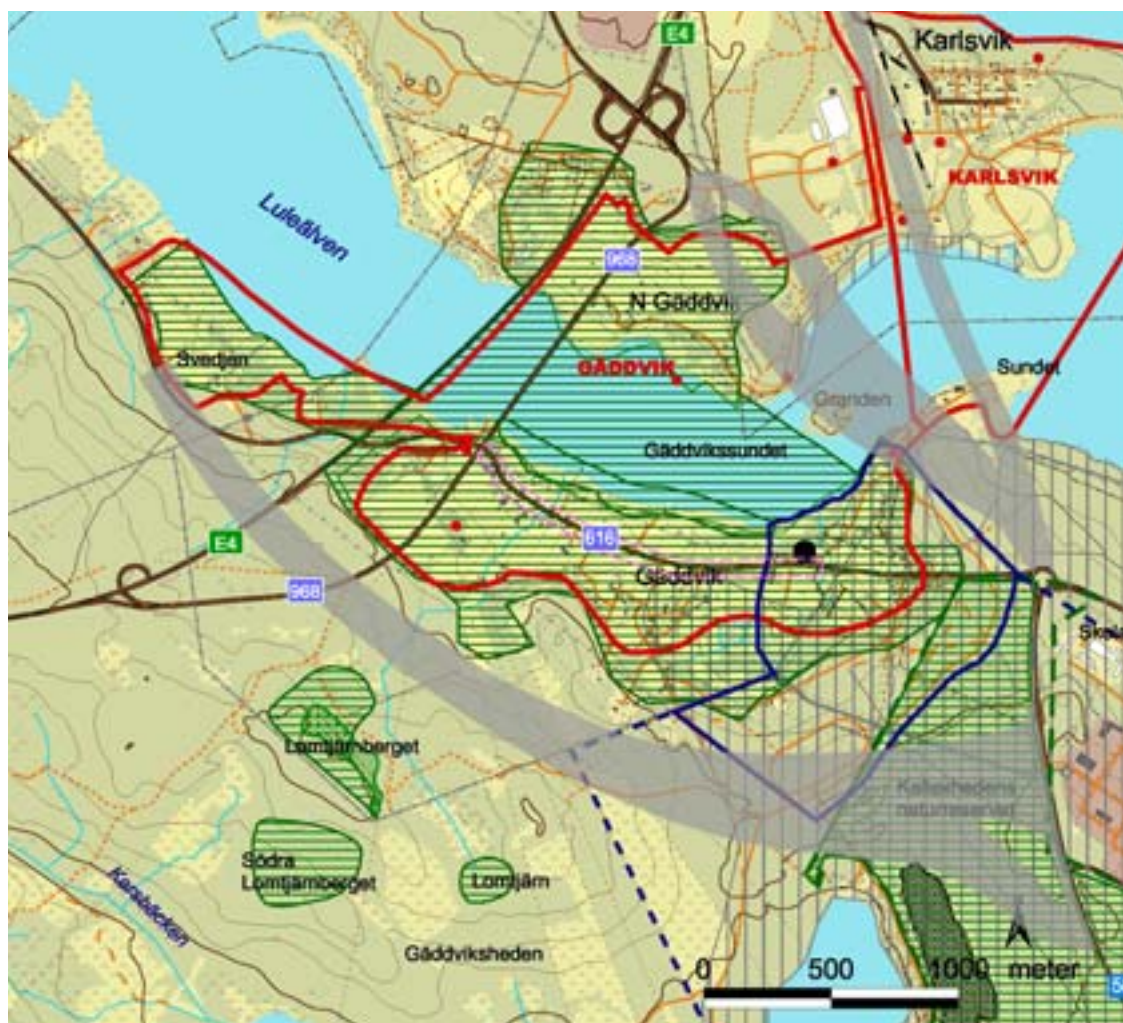
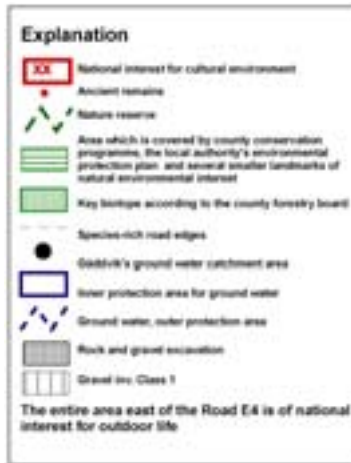
Analysis of the environmental conditions can contribute to generating alternatives by highlighting more possibilities and contributing to mapping of the conditions for location of conceivable effects and impacts. Identification of the alternatives to be highlighted for closer studies and comparisons must be based on environmental information, among other things. If the conditions in a relatively large search area for location or for variants of road segments are assessed superficially, so that difficulties or appropriateness are made evident, this can in itself, be sufficient reason as to why more alternatives have not been studied. Even among possible alternatives, a ranking can sometimes be appropriate, in which environmental considerations can be an important part of the reasons.

There can also be reason to present alternatives with normal sections or geometric standards other than those recommended in the SNRA's road design rules if this involves large differences in impacts. Such "minimum alternatives" should then be dealt with in the same way as other assessment alternatives. Some geometric road design can involve a limitation of the possibilities of environmental suitability.

On alternative mitigation measures, etc., see Chapter 11, "Mitigation Measures, etc."

### Design plan

Alternative designs at the design plan stage can involve the position of the road line in plan and section, the positions of the road junctions, the terrain, vegetation, fences for wild animals. In the EIA such alternatives should be elucidated before the selected design is assessed. However, not everything is determined in the design plan, and important design alternatives for the environment which are to be carried forward to a later stage must clearly be included if they are to be considered in the construction documents or affect the contractor's alternative choices.



*The analysis of existing conditions in the landscape shows conditions and environmental qualities which to some extent guide identification of appropriate location alternatives. In the example above, one can see how the feasibility study's corridor is adjusted to important environmental conditions. (Source: fictitious example based on Feasibility study, Alternative Road Connections between Road E4 and Kallax Airport/Bergnäset.)*

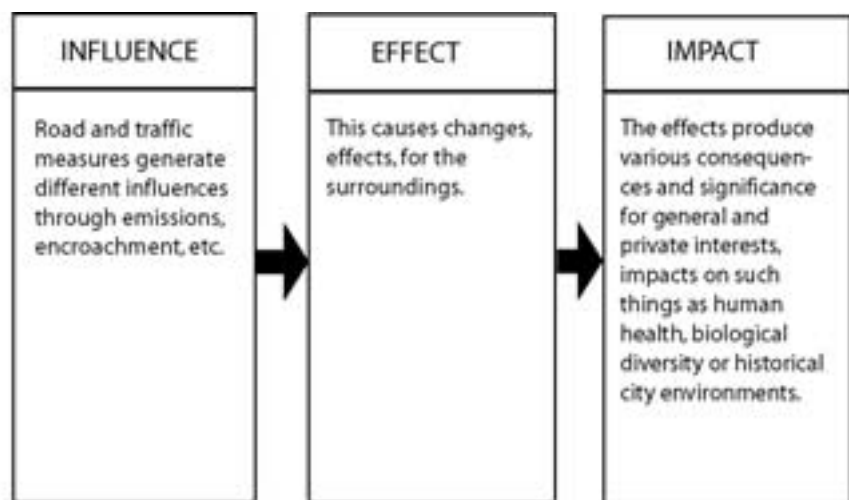


## 10. Environmental Effects and Environmental Impacts

This Chapter describes the bases for assessing and reporting environmental effects and environmental impacts. In addition, advice is given concerning how effects and impacts can be classified in EIA, together with the importance of presenting bases of assessment. The Chapter is based on the statement requirements of VVFS 2001:18.

### Influence – Effect – Impact

The impacts that can be expected are analysed on the basis of knowledge of which disturbances and other influences the project can give rise to. The significance of the most important effects is then evaluated in an impact assessment. It is not sufficient to present the conclusion. An explanation is required of what is going on, etc.



*Influence – effects – impacts (see explanation of concepts, Page X)*

### Influence

Analysis of **environmental effects** is based on the **impact** which the project is expected to involve, for people, fauna, flora, land, hydrology, air, climate, landscape and interaction between these factors, and also material assets and cultural heritage.

The **construction** of the road structure (excavating, blasting, transport, use of chemicals) can involve disturbances in the form of noise, air pollution, vibration, muddying of water, water pollution and barrier effects. Questions of temporary transport routes and traffic diversions, economic use of materials, temporary stocks and depositions can be very important as regards the environment. Effects, during the construction phase, are often temporary, but if, for example, one single accident occurs involving discharge of oil, the impact can be devastating.

Always go through the events in connection with the construction, the installation itself, traffic, operations and possible secondary development or similar, which in the individual case can produce environmental effects of importance.

- Will the handling of rock and quantities of earth be considerable, deposits?
- Will the transport of dangerous goods be permitted?
- Does the construction of the tunnel also involve ventilation towers?



The road as a **physical structure** involves requisitioning land or areas of water, and impacts on visual qualities. Requisitioning land can involve removal of ancient remains and buildings or blocking of natural resources, for example, areas of gravel deposits.

**Encroachment involving cutting off** gives barrier effects, which involve impacts for people, animals and plants, hydrology, working units, etc. **Splitting up** a biotope can lead to its function in the ecosystem being disturbed, which in turns leads to secondary effects for flora and fauna. Splitting up can also mean that the connections in a cultural environment are broken. Hydrological impacts can lead to water deposits or biotopes being affected over relatively large distances. This applies especially in the case of tunnel solutions. As regards people, the effect on the **visual quality** can be that which is most evident.

Impacts from **traffic** on the road and **operational measures** give noise, vibrations, exhaust gases, particulates, road salt and possible pollution from accidents involving dangerous goods. Polluted surface water from the road can also be a problem. The **character of the traffic** influences the total experience of the road.

Environmental quality is used as a collective concept for qualities of flora, land, water, air, climate, landscape, interaction between them and with material assets and cultural heritage. It applies to qualities which are of interest for the specific project, with regard to its possibilities of retaining and developing. The concept thus also covers the supply of natural resources and qualities in such things as settlements created by people.

### Effects

Effects, changes and alternative locations or design are expressed as change compared with conditions in a do-nothing alternative. Changes are expressed in a neutral way and, if possible, in quantitative terms. (For example, as a change in the number of people who are subjected to a certain traffic noise level.)

On the basis of the landscape analysis and other information on such things as expected traffic, possibility of crossing the road, etc., expected changes are calculated or estimated regarding:

- the health of people, safety, well-being, etc.,
- environmental quality

	ROAD	CONSTRUCTION PHASE	TRAFFIC	SECONDARY DEVELOPMENT	MAINTENANCE
ASPECTS OF IMPACT	Physical barrier, encroachment, impact on land and water, damage (direct and indirect), fragmentation	Vibration, noise, creation of dust, temporary roads, handling of materials	Changes in the traffic network, noise, car exhaust, dangerous goods	Surface water, salt, road edge maintenance	The environmental impact direct and via population changes, establishment of operations

*Environmental impacts are of various kinds and have differing causes*

### **Primary and secondary effects**

Sometimes, there can be a chain of changes in which one change causes another change. In this case one can talk about primary effects, secondary effects, etc. Sometimes, secondary and tertiary effects refer to indirect effects and impacts.

An example is when a hydrological change, caused by the road body results in an area of plants drying out, and thus changes in the flora. Another example of chain effects is to do with car exhaust, which changes the composition of the air and contributes to precipitation that changes the acidity of ground and water, which in turn affects flora fauna, ancient remains, etc.

Possible synergy effects and cumulative impacts should also be included in the analysis. The concepts as such do not need to be used.

## **Impacts**

### **Direct and indirect impacts**

In many EIAs, it is stated that a new road will be a barrier for wild animals. In order to describe the effects and impacts, it is necessary to have already found out what functions various biotopes have for animals. In addition, it is necessary to have information as to how sensitive present animal populations are. Subsequently, conclusions can be drawn up, for example, that dividing up an area leads to an animal population being split up and having difficulty in surviving.

In assessing impacts, the effects are evaluated that are of importance as positive or negative impacts with regard to any interest as regards environment, health and management of natural resources. The analysis should include both direct and indirect impacts of a road or traffic solution, its location, formulation and/or construction.

Most impacts from a road project are caused by the structure itself, the construction of it and traffic on it, and by operating and maintenance. When we talk about **indirect impacts** of road projects, what is meant are impacts which are not a direct result of encroachment or disturbance caused by the road project. It is, instead, about occasions when the road structure is expected to give rise to such things as building development, changed traffic behaviour or moving of some operation, which in turn can affect people and environmental quality. The way in which the presentation of this type of impact is made in EIA for a road project is dependent on if and how it is dealt with in municipal land use plans.

The road project can involve changed land use structure, or changed economic development and population development. The environmental impacts which these social changes bring with them shall be assessed in EIA. The EIA work thus requires additional studies of impacts regarding economic development etc., as far as they are judged to be relevant.

#### **EXAMPLE: INDIRECT EFFECTS AND IMPACTS**

Certain requirements and encroachment that are not directly connected to the construction and use by traffic of the road can, nevertheless, occur as a result of the road construction, or be shaped by it. Pressure of development arises most often in locations that are close to roads. Development requirements that can occur as the result of the establishment of Kallax Cargo and increased operations at the airport area, and as a result of social development in general, can take various forms depending on the design of the road system.

A possible increased requirement for localities close to the airport for industrial establishment, will probably be satisfied south of the river, and it is probable that this will partly occur between the roads E4 and 580 (Kallaxvägen). This applies, irrespective of which road alternative is chosen, but with the expansion of one of the Gäddvik alternatives, establishment will probably be channelled to the vicinity of the new road.

With the development of one of the Karlsvik alternatives, there will probably also be increased development pressure directed towards the Karlsvik peninsula.

The new road segments improve transport to and from the area. Any consequent effects from this are difficult to predict, but it could lead, for example, to increased pressure of felling in the forest area adjacent to the road.

A possible future expansion of the Norrbotnia railway, along the segment south of Gäddvik and via the airport and Svartön, influences the assessment of the long-term impacts of the road for the Gäddvik alternative. There will, nevertheless, be encroachment of the area south of Södra Gäddvik with the railway being along this segment, irrespective of whether the road is located to this area or not. The selection of the road segment is, on the other hand, judged to influence the choice of segment for the Norrbotnia railway.

*Example of the presentation of indirect effects. (Source Road project Alternative Road Connections between E4 and Kallax Airport/Bergnäset.*

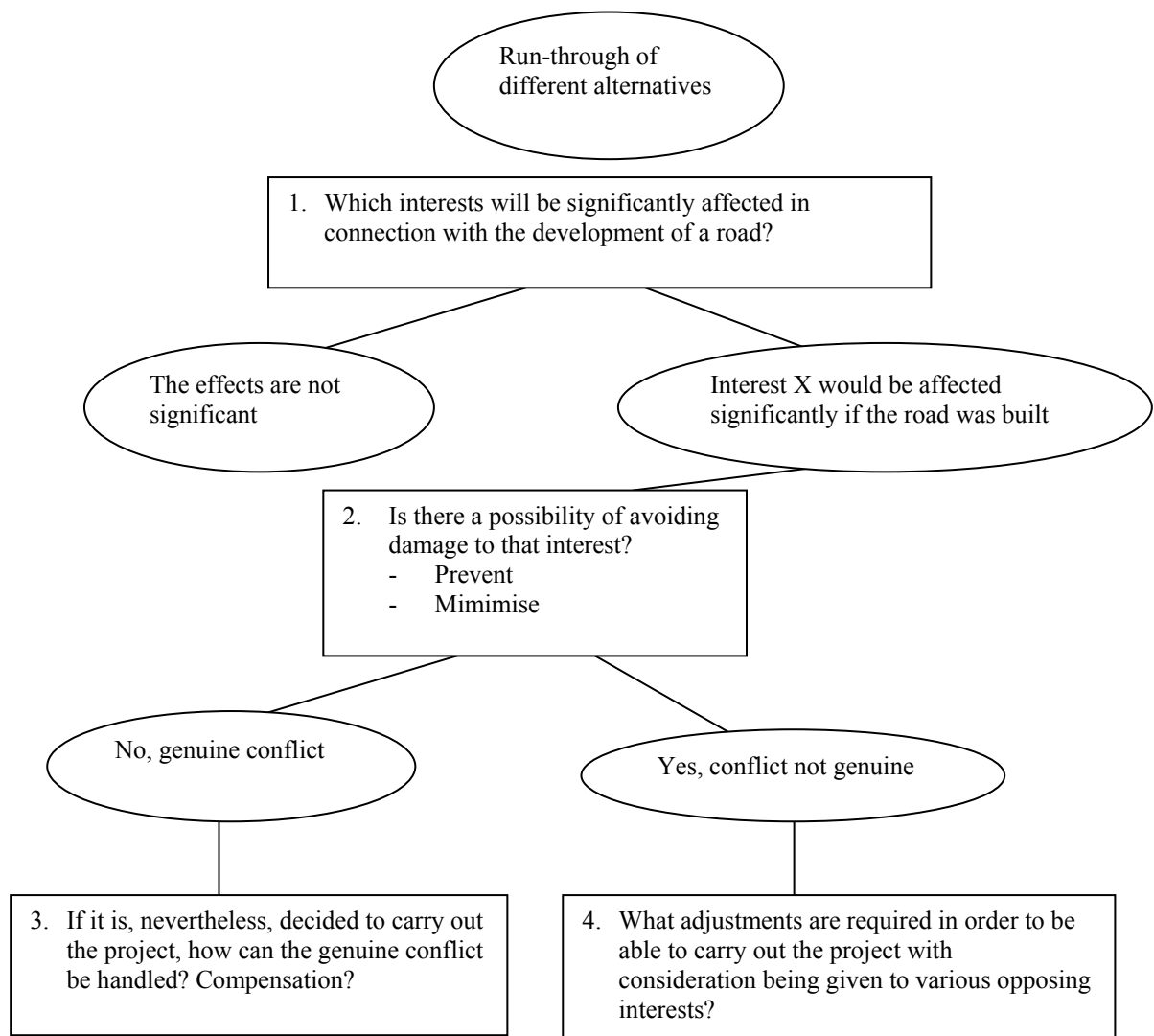
See also Chapter 16 in this Handbook, on general interests which affect EIA

### Motivate Assessment

Apart from the actual impact assessments, the EIA also needs to present the way in which the underlying assessment was put together. Conclusions are drawn on such things as damage and evident damage to national interests, or how the values which are defined in the area protection are influenced. Types of damage and their extent must be given.

In addition, it is necessary to have assessments as to whether the impacts are acceptable, with regard to the economic management requirements of the Environmental Code, guidelines/limits, environment quality norms, environment quality goals and environmental goals for the project, the locality or the region.

### Description of the Procedure



*Principles for ranking impacts, which enable the most important and decisive ones to be highlighted.  
After IVL B1313, 1999*

## Grading of Effects and Impacts

### Interests and Aspects

It is necessary to have a broad approach in the analysis, so that no important effects are missed. Which aspects the more detailed assessments are to cover must be decided from case to case, and justified. A basic rule is that all effects and impacts which could become important shall be assessed and described.

Equally necessary is subsequent ranking and sifting of the impacts which have been analysed, in order to see what is important and how the impacts are divided up geographically and for what groups of people and interests. The division of positive and negative impacts should be shown and not fudged through cancelling out one against the other. Some examples of questions that should be raised are given below.

- Which interests weigh most heavily?
- Which impacts are important or decisive?
- Which negative impacts can not be avoided?
- Do residence and health carry more or less weight than natural environmental interests or retention of agricultural land?
- Can water be protected in a satisfactory way? The existing road is perhaps already a threat to a source of water supply. Are there reserve sources of water supply?
- Who will see the new road, and from where?

By all means connect visual effects to actual interests.

	Aspects	Encroachment	Noise	Vibration	Light disturbance	Barrier effects	Air pollution	Visual effects	Pollution ground and water	Effect of development caused by the road
<p><i>Many aspects affect many interests. This matrix shows an example. Which aspects are relevant for each respective interest must, however, be assessed from case to case. This type of matrix can be used as a checklist.</i></p>	General Interests									
	Nature resources and their use Water assets, agricultural land, forest land, energy, total emissions of air pollutants, materials (requirements, requirements for deposits, minerals, etc.)	x				x	x		x	x
	Natural environments Flora, fauna, geology and landscape types, water and hydrological effects	x	(x)			x	(x)		x	x
	Cultural environments Valuable settlements and structures, ancient remains, historical patterns and road structures	x	x	x		x	x	x	x	x
	Recreation/outdoor activities Mobile outdoor activities, fixed installations, recreational buildings, hunting and fishing	x	x	x	x	x	x	x	x	x
	Living environment including health and safety, adjacent recreation, etc.	x	x	x	x	x	x	x	x	x

## Impacts for Whom?

A usable EIA must show clearly how impacts are distributed between different interests. In a review of a road project, weighing up between various interests is central. The **collected impacts** for the relevant land and hydrology interests shall be elucidated.

In the EIA, **interests** are taken up which are affected by or benefit from changes in environmental quality.

Some interests which are often affected are:

- local businesses
- economic management of gravel
- ground water supply
- natural environment
- cultural environment
- outdoor activities
- housing environment and health
- town environment

Dealt with environmental interests	Impairment	Unchanged	Improvement
<b>Most important</b> - Cultural environment, landscape - Natural environment	x  x		
<b>Very important</b> - Outdoor activities - Agricultural land - Traffic noise, residents - Air pollution, residents	  x	   x	x  x (x)
<b>Important</b> - Forest land - Ground water catchment - Surface water catchment - Other means - Dangerous goods - Vibration, residents - Building disturbance, residents	x      (x)	   x  x	  x x  x (x)

*Examples of a summary of environmental impacts, in which improvements or impairments for various interests are shown, together with ranking of the importance of each respective interest.*

The impact assessment can, of course, be made for combinations of some interests, for example:

- natural and cultural environment,
- town environments including cultural environments and housing environments.

Questions occur now and again as to where the borderline should be drawn between which impacts belong in EIA, and which belong in other impact assessments. The basic principle is that EIA deals with effects and impacts which affect the **surroundings** of a planned road structure, not the user. Uncertainty regarding ranking of impacts should not lead to important effects and impacts being dropped and not being included in the decision-making data at all. This can be the case regarding encroachment on buildings which is only included as a question to do with payment, despite the fact that it involves considerable physical change that affects individual people in many different ways.

A risk analysis regarding accidents on the road can be important for several types of impact. When dangerous goods are an important environmental aspect, the extent and type of goods shall be described in the EIA, together with results from assessments of change of the probability of an accident, and assessment of the impacts an accident would cause.

Changes in road safety, which are expected to change the probability and impacts of traffic accidents involving injury to road users, are naturally dealt with, together with other impacts on traffic and road users. In conformity with the National Rescue Services Agency's publication *Olycksrisker och MKB [Accident Risks and EIA]*, it can be appropriate for the EIA to state briefly in the section on health that the number of traffic accidents is generally expected to decline, and for the traffic impacts of such things as traffic safety aspects to be dealt with in a separate impact assessment.

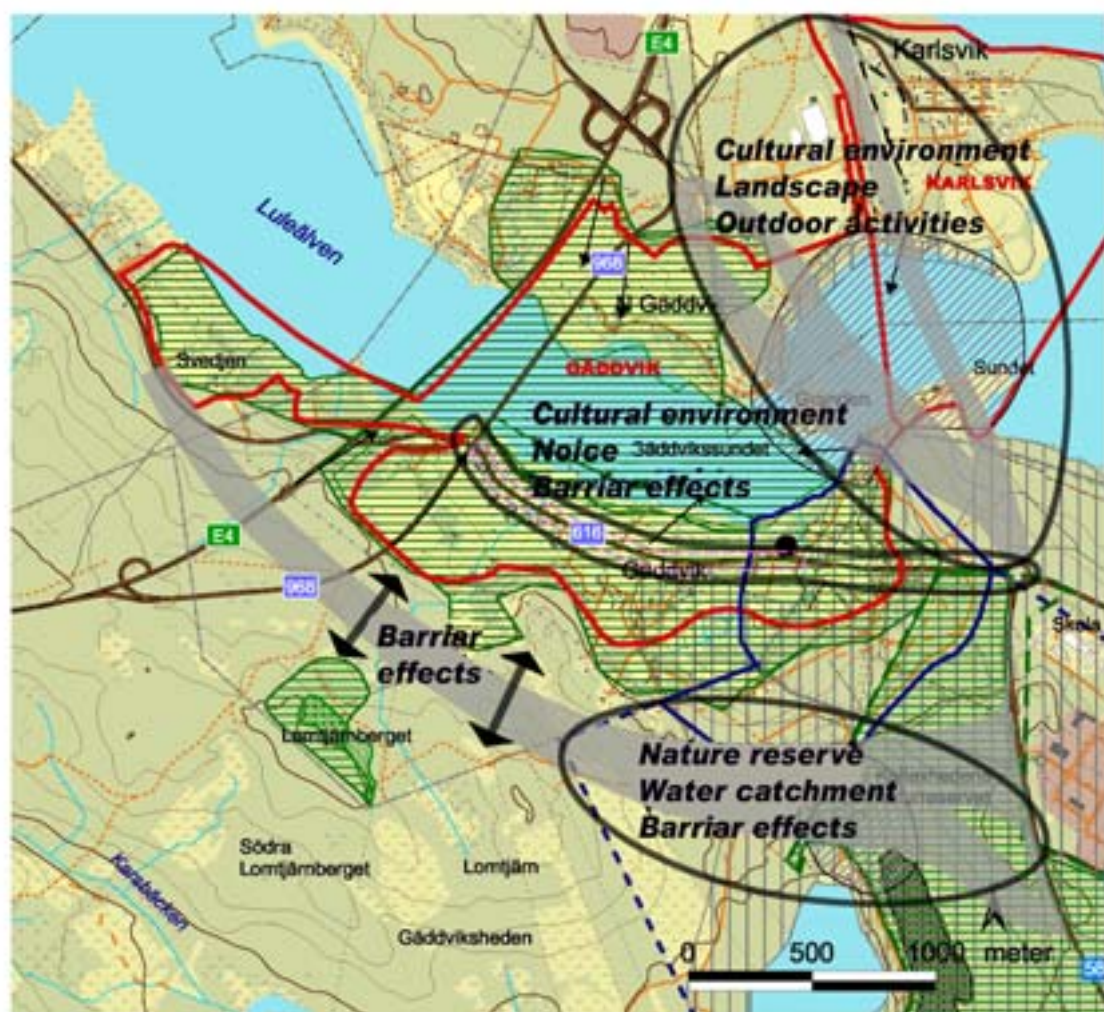
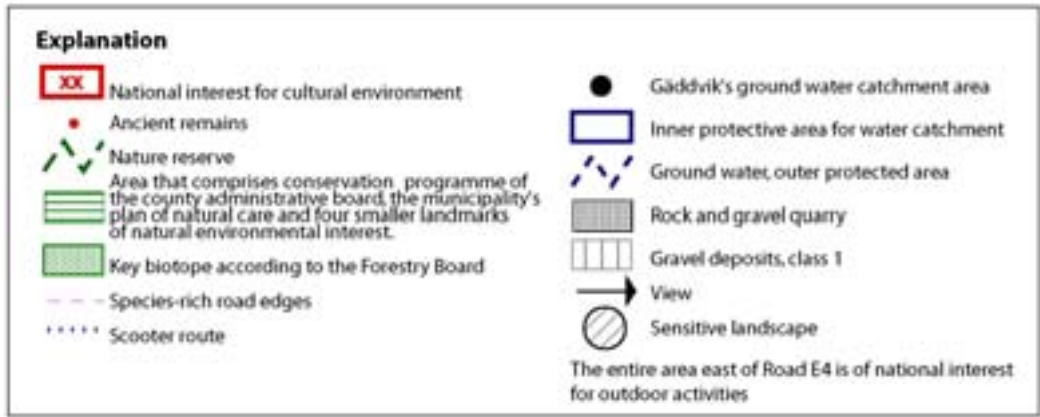
Barrier effects regarding people are included in EIA if it is a matter of experience of the physical environment for those who live in the vicinity of the road. The impacts can be about the connection between two parts of a community, or a settlement being broken, or that the barrier is reduced. This, in turn, influences the identity of the place. Other impacts of a barrier are about accessibility and road safety, and thus belong to other impact assessments.

Strict demarcation between impacts on the neighbourhood and the people there, as opposed to road users and as regards social development are not desirable. One should, however, be aware that grouping of effects and impacts in statements can affect the assessment of the collected impacts of the various alternatives.

<b>Interests</b>	<b>Do-nothing Alternative</b>	<b>Improved Roads</b>	<b>Rebuilding Existing Segments</b>	<b>Structure in New Segments</b>
<b>Natural Resources</b>	Agriculture and forestry and materials are affected to a small extent. Unsatisfactory protection of ground water remains.	Agriculture and forestry and materials are not affected very much. Unsatisfactory ground water protection remains	Agriculture and forestry are affected to a relatively great extent. Material must be supplied from borrow pits. Ground water protection is improved.	Agriculture and forestry are affected to a relatively great extent. Material must be supplied from borrow pits. Ground water protection is fully satisfactory.
Ranking	1	1	3	4
<b>Natural environment</b>	The natural environment is affected very little. Unsatisfactory protection of watercourses remains.	The natural environment is affected very little. Unsatisfactory protection of watercourses remains.	The natural environment, geological values, are affected by a new interchange at Ledsjövallen.	National interest N17 is affected at the edge. Geological values are affected by the new intersection at Ledsjövallen. Several land enclosures, Class 3, are split up.
Ranking	1	1	3	4
<b>Cultural environment</b>	The cultural environment is affected relatively little. Road E20 constitutes a barrier between Kyrkbyn and the position of the station at Vätzlösa.	Road E20 constitutes a barrier between Kyrkbyn and the position of the station at Vätzlösa. A new pedestrian and cyclist gateway affects the village environment.	The barrier effect is strengthened at Ledsjö. Road E20 constitutes a barrier between Kyrkbyn and the position of the station at Vätzlösa. New pedestrian and cyclist gateway affects the village environment.	The barrier effect is strengthened at Ledsjö. The village site at Ledsjö can be affected. Cultivated land is cut off from the Gullhammar farms.
Ranking	1	1	3	4
<b>Outdoor recreation</b>	Open-air recreation areas are not affected. Very low safety level for unprotected road users.	Open-air recreation areas are not affected. Low safety level for unprotected road users.	Open-air recreation areas are not affected. Improved safety and accessibility for unprotected road users.	Noise disturbance in the open-air recreation area at Götene is reduced. Improved safety and accessibility for unprotected road users.
Ranking	5	4	3	1
<b>Landscape</b>	Little effect.	Intersection at Road 44 exposed from the north.	Intersection at Ledsjö and Road 44 respectively exposed in the open landscape. At Ledsjö there is good terrain support and the line of the horizon is strengthened by the bridge at the intersection.	The landscape is split up, primarily at natural environments. The intersection at Road 44 is exposed in open landscape. Good terrain support for the bridge strengthens the horizontal line of the embankment at Ledsjö.
Ranking	1	1	3	4
<b>Residential environment</b>	Housing environment remains bad. Assessed number disturbed by noise after action: about 100.	Housing environment remains relatively bad. Assessed number disturbed by noise after action: about 50.	Housing environment improved. Assessed number disturbed by noise after action: about 15-20.	Housing environment improved very considerably. Assessed number disturbed by noise after action: about 2-3.
Ranking	5	4	3	1

*Example of presentation of environmental impacts, in which the most important impacts have been collected in table form. The proposals have been put in order of precedence under each sub-heading, from 1 to 5, in which 1 is best and 5 worst. (Source: Feasibility study, E20 section Lundsbrunn – Holmestad.)*





*This map shows how effects and impacts are graded. The most important conflict areas, i.e., where the most important environmental effects and environmental impacts occur, have been marked on the map. The aspect the conflict is about is given in the commentary on the map. It is the **degree** of effects and impacts which is ranked, not the occurrence of conflicts. By “cultural environment” is meant not just that the area is indicated, but that such things as important impacts on the cultural environment occur there. (Source: fictitious example based on Feasibility study, Alternative Road Connections between the E4 and Kallax Airport/Bergnäset.)*

I Temablad till EIA för vägprojekt. VV publ 1995:40 beskrivs bl a bedömningsgrunder. Sådan kortfattad information kan för läsrens skull tas in i EIA:n eller bifogas

## Bases of Assessment

In order that the reader of an EIA can form an opinion on impact assessments, sources and bases of assessments should be described, i.e., what the conclusions regarding influence, effects and impacts are based on.

The reader should be able to see that the conclusions follow logically from the analyses and assessments. In the adjacent example, the author has pointed out clearly that it is the investigator's assessments which underlie the analysis and how the investigator has reached the conclusions. However, EIA documents for minor road projects often contain conclusions such as "the measure does not affect the natural environment". Here, the people making the decision have difficulty to see why that result was arrived at.

It must be made clear what are objective descriptions and what are appraisals. Conclusions based on appraisals should be grounded in society's representatives for the interest in question (the county administrative board or municipal experts). Methods and bases of assessment should, if possible, be checked off with the county administrative board's EIA function.

As regards the degree of disturbance and health impacts of traffic noise and car exhaust gases, norms and guidelines are important assessment bases for evaluation, but further evaluations can be fitting when various alternatives are to be compared.

Regarding descriptions of interests, (natural environment, cultural environment, etc.) ranking of values is an important basis, i.e., an area's specific qualities and assessments of them. Regarding protected areas, value assessments should be available, but these are not always sufficient and need to be given depth in order to be used for road EIA's so called directed assessments.

If possible, measures are used which, in each special case, are appropriate for assessing whether the impacts involve specific environmental goals for the project being achieved – an assessment key.

## **EXAMPLE: ASSESSMENT OF IMPACTS ON NATIONAL INTERESTS**

### **Resting birds**

Scientific knowledge concerning the sensitivity to disturbance of resting birds is incomplete. Experience shows that geese, for example, are less sensitive when resting than when nesting. The development of the airport, reduction of access to grazing areas because of transition to scrub and other increased disturbances in the area have, until now, not led to a reduced number of resting birds in the area. They have, instead, increased. Investigations by the Ecological Group show that disturbances caused by planned train traffic cannot be expected to cause significant impact on the value of the National Landmark as resting area. The National Rail Administration assesses, on the basis of the survey by the Ecological Group, that the railway will not constitute a risk of changing the resting behaviour of the birds in a way that would substantially change the values of the National Landmark. The birds will probably avoid the fields closest to the railway, and instead choose other fields to graze on. See also proposals for measures below.

### **Nesting birds**

Felling for the railway will lead to a number of nesting birds outside the National Landmark having their territories affected. The most sensitive species are those that require the largest territories, for example, the white-backed woodpecker. The National Rail Administration does consider, however, with the support of the Ecological Group's survey, that the conditions for successful nesting of this species and of other deciduous woodland bird species that are worth protecting in the delta of the Umeå River, will only be affected only to an insignificant extent by the Botnia railway. The risk of effects through train crashes can, however, not be excluded.

There is an evident risk that the three-toed woodpecker will cease to nest in the Storsandskär/Gamla Delta. It is, however, in natural pine and mixed forest, which is not directly connected to the ecological character of the Umeå Delta, in which the values of the National Landmark are primarily connected to the bird fauna of coastal deciduous forest and wetlands. For this reason, the National Rail Administration assesses, on the basis of the Ecological Group's survey, that the possible disappearance of this species from the area will not change the ecological character of the National Landmark.

*Extract from presentation of assessment bases. The so-called National Landmark consists of the Umeå River Delta, where there is an area of national interest with respect to natural environment in accordance with the Environmental Code, Chapter 3, Section 6, together with a CW area, a Natura 2000 area and a nature reserve. (Source: Permissibility assessment of the Botnia Railway.)*

## 11. Mitigation measures, etc.

This Chapter describes what is meant by mitigation and environmental improvement measures, and also compensation measures. The Chapter is based on the statement requirements of VVFS 2001:18.

### Mitigation and Environmental Improvement Measures

In EIA work, analysis is made as to which **mitigation and environmental improvement** measures can be carried out in order to environmentally adjust a road action. In the first place, negative impacts shall, as far as possible, be prevented by such measures which include locating the road so that damage can be avoided. In the second place, encroachments and other negative effects should be limited by means of various measures. Not only selected measures should be described in the EIA, but also alternative measures and reasons why these have been discarded.

### The Importance of the Planning Stage

**In EIA for a road project**, it may normally already be established that mitigation measures are included in the road alternative which is being assessed. It is, for example, common to count on locating a road partly in a cutting and partly with noise prevention earth walls being established, and this means that traffic noise at the sides of the road will not exceed 55dBA. In addition, attention is given to assessing to what extent it is **possible** (with measures which have been planned, or with other measures) to mitigate, limit or compensate damage. Principal solutions and rough estimations of effects and costs required to compare alternative mitigation measures, etc., are also made.

In the **EIA for the design plan**, **detailed solutions** are dealt with in order to elucidate the choice of how mitigation measures can be carried out, etc., on the basis of effects and costs. Unintended side effects should also be taken up.

In EIA, both for road project and for design plan, the measures which have already been planned are separated from those which the EIA includes in the form of alternative or further measures.

**Compensation measures** shall also be included in the EIA for design plan, when this can be particularly justified.

Regarding the construction stage, there are a number of measures that are normally present. See VV publ 2001:15, Environmental Requirements during the Construction Period. The EIA can refer to such a list, but should, in addition, analyse specific possibilities of the place and project for degrees of care or measures to prevent damage and inconvenience. It may sometimes be possible, for example, to reduce noise disturbance from construction work with planned noise barriers being erected right from the start of the construction period.

## What are Mitigation measures?

**Adjustment of location and design** of a road are important in order to prevent damage, etc., and shall be influenced by the EIA. Moving road corridors, road lines, bridges, intersections, in plan or section/height, are normally not dealt with in EIA as mitigating, special measures. A basic environmental adaptation of a road shall, in principle, be accomplished through identification of alternative locations and designs that can be considered, for which the EIA contributes data and analyses. The EIA work shall be so integrated that slope design and the depth of cuttings in the design plan are discussed, with consideration for the environment, before final proposals are formulated.

EIA should also highlight the possibilities of improvement of environmental qualities which can occur with measures which involve small costs. If, for example, surplus spoil is present, it can be used to limit traffic noise, even if this is not disturbing, or to improve visual quality.

## Examples of Mitigation and Environmentally Improving Measures

- location of a number of culverts through a road bank to retain surface flowing ground water,
- removal, re-cultivation of a road which is not needed and which does not have historical value (also has compensatory effect),
- fauna crossings, for example, tunnels and bridges for wild animals,
- taking care of surface water on a local basis, by means of flood areas or infiltration
- mitigation measures such as special road safety barriers, close ditches or reduced speed on account of ground water catchments,
- special adjustment in historically, sensitive environments.

Being observant in the choice of limitation measures is important regarding how the measures themselves will affect the environment. A noise barrier can, for example, mean that the barrier effect along the road has such great negative impact on people and animals that it should not be erected.

## Compensation Measures

If mitigation is not possible, the road manager can create, or contribute to positive development of environmental quality by means of **compensation measures**. The purpose is that the total quality of the environment measures within an area shall not be reduced because of road measures.

Consideration on compensation measures should be based on consultation with the county administrative board, the municipality and the general public affected, as to **what** is appropriate, and **where**.

Compensation measures can

- replace a function at the same place as the damaged one,
- replace the function at another place, by means of, for example, improving the quality of existing wetland as compensation for another wetland disappearing.

## Examples of Compensatory Measures

Measures which replace functions at the **same place**.

- New planting of trees as replacement for those which must be removed during the construction of the road. (Young trees do not equate to the value of older trees, for which reason not only tree per tree should be taken into account)
- Re-cultivate old, abandoned gravel pits in the vicinity of the road project as replacement for other encroachment into the environment.
- Increase existing wetland elsewhere than where encroachment occurs.
- Laying of new spawning beds in streams after they have been dug out.

Measures which replace function at **another place**.

- As compensation for tree-lined roads which cannot be saved on account of the road construction, one or more other roads in the vicinity should be lined with trees.
- Develop recreation possibilities by improving the cycle path system in the same area as increased barriers result from the main road.
- Planting of vegetation on residual areas as replacement for vegetation removed at another place.
- Arranging information areas about interesting cultural landmarks can compensate for encroachment into cultural environments.
- Establish a sports ground, track with lighting, etc.

There are many reasons for being restrictive in suggesting compensatory measures at another place than the one that is damaged. In the first place, it must be possible to demonstrate (as with mitigation measures) that it is probable that the measure will work over a longer period of time.

Creating new biotopes which are to work in nature involving certain species of plant and animal is not easy. In addition, measures outside the road area require that the road manager has suitable land/water areas at its disposal.

## How to Compensate?

Compensatory measures are mentioned in VVFS 2001:18 regarding EIA for design plan and design plan itself. Compensatory measures were updated in 2001, through the introduction of new sections in the Environmental Code regarding special conservation areas (Natura 2000 areas).

Compensatory measures should primarily provide value equivalent to that which has been damaged at the same place, and secondarily, provide other environmental value and/or to another place. The measures shall, however, be connected with the negative impacts which arise or are anticipated. (negative impacts on a certain environmental interest, a certain species, or similar cannot be compensated with measures which favour another environmental interest, another species or similar.)

Compensatory measures shall, however, be directed so that they compensate the “affected” party. If, for example, an area rich in birds is damaged, and the impacts are assessed to be that a certain bird population stops breeding there, this shall be compensated within the geographical area where it is judged the same bird population can find a new breeding area. Another example is that encroachment on an open-air recreation area, used by people living nearby in a certain town area, cannot be compensated with a new open-air recreation area located on the other side of the town. The basis of which compensation measures are taken shall be the values that are damaged in the environment affected.

How compensatory measures shall be carried out depends on **what** (what function) is to be compensated and **how** (with what) compensation shall be made.

## Responsibility for Management

It is very doubtful whether the road manager should take responsibility upon itself for maintenance and operation of a compensatory landmark which lies entirely outside the road area. Operation and maintenance of vegetation, biotope, etc., can perhaps be solved by means of undertakings by other parties. If the function is dependent on maintenance, a maintenance programme must be drawn up and someone must take responsibility for it.

## 12. Follow-up

This Chapter describes the follow-up of effects and impacts, checks and feedback of experience. The Chapter is based on the reporting requirements of VVFS 2001:18.

However much the Environmental Impact Assessment is reviewed, and however it good it may be, it is not until the road or traffic project has been carried out that it becomes apparent whether the required environmental quality is attained, and whether the effects and impacts conform to those which were described in the EIA. There is a risk that environmental questions can get lost between the design plan stage and the construction document stage, and also between the construction document stage and the construction stage. There is thus a risk that the intentions presented by the manager, with the support of the EIA, do not survive into the end product.

In the design plan, the requirement of EIA is controlled by the Roads Act. The regulations of the SNRA regarding EIA etc. (now VVFS 2001:18), have clarified the legislation since 1993, and so, given a requirement for the need for an environmental follow-up shall always be stated in EIA, with proposals for any follow-up programme, each section of which should be explained. In accordance with international practice, the follow-up opportunities are important for making fullest use of EIA. A special handbook, "uppföljning av vägprojekt" ["environmental follow-up of road projects"] has been published by the SNRA, publ 1999:159 (also available on [www.vv.se](http://www.vv.se)). In addition, there is an aid for requirements placed on the contractor (Miljökrav under byggtiden [Environmental Requirements during the Construction Period]) VV publ 2001:15. The environmental follow-up programme is also included in the SNRA's handbook on statement of construction documents. (*See also Vägverkets miljökrav vid upphandling av projekteringsuppdrag och entreprenader [the SNRA's Environmental Requirements for Procurement of Project Assignments and Contracts], VV publ 2001:105*)

See also, Part 1, Chapter 11 of the Handbook, on requirements for internal control, in accordance with the fifth section of the Environmental Code.

According to the Environmental Code, the supervisory authority, normally the municipality, can require the road manager to give a proposal for a monitoring programme to follow up the project. The road manager must therefore be prepared that such monitoring may happen due to its responsibility for the permit being carried out in accordance with the Environmental Code. This requirement applies as long as there is a risk of damage or inconvenience. The purpose of this includes monitoring that requirements or advice imposed by a supervisory or scrutinising authority are followed. The road manager, with its environmental responsibilities, very often benefits from a follow-up, which can justify the road manager deciding on one even when there is no legal requirement for one. The road manager can set aside uncertainties that led to the postponement of a choice or requirement for protective measure. I.e., security increases, and the risk of investing in the wrong thing diminishes in such cases.

The decision on a follow-up is made on the basis of the design plan's EIA. When the EIA is compiled, it is therefore important to present clearly which environmental aspects should be followed up, giving good reasons. The decision is taken by the road manager itself, and is stated in the design plan or through the determining decision. In practice, the decision on a follow-up may need to be taken as early as when the road manager decides that detailed project work is to begin for a certain road corridor. This is necessary when



there is reason to begin collecting surveyed environmental data in good time before construction begins, for example, information on ground water levels or on ground water quality.

Working out the actual follow-up programme itself is undertaken in parallel with working out the construction documents and after recommended separate consultation on the subject with the municipality and the county administrative board. The county administrative board often expresses disquiet regarding actual consideration for the environment, for which reason its participation during the follow-up, in the form of site visits or similar, to look at the follow-up activities, is positive for all parties. The follow-up programme is included as an appendix to the construction documents.

### **EXAMPLE: ENVIRONMENTAL FOLLOW-UP – CONSULTATION**

#### **Extract from the design plan:**

Before and during the construction document stage, questions of detail, planning and follow-up shall be looked at, in consultation with the municipalities and the county administrative board, among others. A “Monitoring Programme for the environment during the construction period” shall be drawn up and included in the questionnaire data for the structural work. The monitoring programme deals with the prerequisites, requirements, checks, measures, things to be taken into consideration, etc., which are to be followed during the construction stage in order to limit environmental impacts on the surroundings. ...

The SNRA will draw up a “monitoring and follow-up programme” in consultation with the relevant departments of the county administrative board involved. The objective is to make a joint analysis of conformity of the completed result with agreed design principles and requirements for possible adjustments, once the road has been taken into operation. ...

#### **From the opinion of the county administrative board regarding the design plan:**

The county administrative board notes with satisfaction that the SNRA states, in its memo regarding points of view received, that both the extent of the protective measures and the content of the programme for monitoring continuation of work with the construction documents shall be decided in consultation with the county administrative board.

*Example of ongoing consultation concerning environmental follow-up. In the project in question, an environmental follow-up programme has been produced at the construction stage, but through a minuted consultation, the county administrative board has been assured that it will have influence during production of this. Note that in this case, a document was produced for follow-up during the construction period, and for the period after the road was taken into operation. (Source: Design plan for Road E6 section Håby-Rabbalshede.)*

## **EXAMPLE: ENVIRONMENTAL FOLLOW-UP**

### **Environmental follow-up programme, content**

1. Introduction
  - 1.1 Background
  - 1.2 Purpose
  - 1.3 The status of the programme
  - 1.4 What is meant by environmental follow-up?
2. The programme
  - 2.1 Organisation
  - 2.2 Sub-programme
  - 2.3 Revision
3. The project
  - 3.1 Organisation
  - 3.2 Road sections
4. Method
  - 4.1 Follow-up
  - 4.2 Responsibility
  - 4.3 Description
  - 4.4 Deviation
  - 4.5 Discussion
  - 4.6 Consultation
  - 4.7 Quality assurance
5. Reference list

### Appendices

- |                   |                      |
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| Sub-programme 1.  | Traffic flow         |
| Sub-programme 2   | Air pollutants       |
| Sub-programme 3.  | Dangerous goods      |
| Sub-programme 4.  | Noise and vibration  |
| Sub-programme 5.  | Landscape            |
| Sub-programme 6.  | Animal life          |
| Sub-programme 7.  | Outdoor activities   |
| Sub-programme 8.  | Cultural environment |
| Sub-programme 9.  | Geology              |
| Sub-programme 10. | Ground water         |
| Sub-programme 11. | Surface water        |
| Sub-programme 12. | Marine environment   |
| Sub-programme 13. | Photographs          |
| Sub-programme 14. | Information          |
| Sub-programme 15. | Attitude survey      |
| Sub-programme 16. | Environment training |

*Example of list of contents of an environmental follow-up programme.  
(Source: Road E6 Forshålla – Torp)*

## 13. Methods, Uncertainties

This Chapter describes the importance of stating what methods are used for impact assessment and what uncertainties exist. In addition, examples are given of methods for assessing damage to national interests and to Natura 2000 areas respectively. The Chapter is based on the statement requirements of VVFS 2001:18.

### Why describe Methods?

In EIA, a statement shall be given of how the EIA work was carried out and that it was conducted with consultation. Those who have participated should be responsible for rules in laws and regulations having been applied. Reference can be made to sections of laws, but citations and lists of statutory rules should not be included.

It is very important to show what methods were used in mapping the environment, and in analysing the effects and assessments of impacts. They can be shown, for example, in connection with presentation of the results obtained from the methods.

### EIA Methods

Classical EIA methods usually include:

- network analyses, system analyses, analysis of chains of event,
- checklists of various types,
- consultation, questionnaire surveys,
- spatial analyses, GIS-based analysis,
- model-based analyses, modelling,
- visually illustrating methods,
- analysis of load-bearing capacity of the ecosystem,
- matrix-based analyses and presentations.

Analysis of goal attainments is also often used in EIA. In addition, of course, differing calculation and assessment methods are used within each area of effect

For anyone who is to participate in the EIA; it is important to be able to separate information/descriptions that are objective fact from those that are evaluated assessments.

For information on general facts concerning the effects of traffic noise on people, and on guidelines, etc., descriptions can be found in the Temablad [Theme Sheets] of the SNRA and the Swedish National Environmental Protection Agency. A suitable number of these can also be appended, in order not to burden the EIA with information not specifically about to the case in question.

## Principles in Rules for Consideration

**That** the general rules for consideration in accordance with Chapter 2 of the Environmental Code are applied in the EIA work is self evident, and really does not need to be commented on the EIA. For clarification it can be stated in the introduction, that the EIA has secured the majority of the principles. The decision-maker should be able to see from the EIA **how** the rules for consideration have been satisfied in the project.

**The rule of the burden of proof** is satisfied through the EIA or road project or design plan as such.

**Requirement for professional knowledge** is applied when requirements are placed on the production of EIA and on the baseline data and further studies considered necessary, including information from the general public.

**Principle of caution, best possible techniques and remedial principle** are applied particularly in EIA which analyse and assess mitigation measures, etc., including for damage which has occurred previously.

**The location principle** is applied when EIA gives baseline data for selection of a suitable location with respect to the environment.

**Economic management and the ecocycle principle** are satisfied by means of economic management of natural resources being described in the EIA.

**The product selection principle** is applied partly in the EIA for design plan, to the extent that questions regarding the materials and similar can be decided upon. The main application occurs when requirements are placed on the contractor during the construction stage.

**The principle of fairness** is applied by the EIA giving baseline data for a balance between environment, economics and techniques.

## Uncertainties

Environmental impact assessments always involve uncertainties at various stages.

Uncertainties in the baseline data concern:

- social development as regards population, the business community, employment, the economy,
- future use of land and construction developments,
- travel patterns and distribution of methods of travel, the development of goods transport,
- society's controls by means of taxes, charges, decisions on overall plans, protection of nature, etc.,
- changes of vehicles, fuel, technical development and traffic control,
- the precision of traffic analysis.

Uncertainties associated with environmental analyses apply to:

- information and knowledge on basic environmental data,
- models and methods of calculation of various kinds,
- conclusions concerning impacts for people and the environment.

In addition, there is considerable uncertainty in evaluation assessments, which can be due to:

- lack of concrete objectives,
- many different opinions and ideas produced during debates,
- the experts can disagree on difficult questions,
- the situation is unusual, both for those involved, the experts and those who must take the decisions (for example, a tunnel solution).

Regarding methods of calculation, the degree of uncertainty should be known. Otherwise, uncertainty can be elucidated using alternative developments and sensitivity analyses. The degree of uncertainty should be commented upon and, of course, figures or other material must not be presented in a way that gives an incorrect picture of exactitude or precision.

Life cycle analysis is a method of attack for analysing what happens “from the cradle to the grave”. It can include several tools, for example, EIA and risk analysis. Seldom does the life cycle analysis include problems specific to the place in question. Regarding choice of materials and such things as residual materials, it is often the distance from the supplier of the materials to the road construction site that is decisive for whether residual materials are preferable from the point of view of the environment. Life cycle analyses should be set up specifically for general recommendations of material for road construction, and be the basis of descriptions of goods. When project-specific choices are available, the EIA should set up life cycle perspectives for various solutions, if they involve fundamental environmental impacts, and this perspective has something to give.

## **Risk Analysis**

Risk analysis in connection with EIA for a road project is primarily applied as regards environmental impacts from accidents involving dangerous goods. Information on the probability of such accidents should be available from road engineering studies. Information concerning the type and quantity of dangerous goods can be obtained from the homepage of the National Rescue Services Agency ([www.srv.se](http://www.srv.se)) or by means of calculations based on information from traffic surveys, proportions of goods vehicles and assumptions on the properties of various types of dangerous goods. By means of knowledge of what an accident with each type of dangerous item involves, it can be assessed which risk objects may be affected, and what the impacts would be for people or water catchments, or something else in the vicinity of the road. Change of risk as a result of measures, and differences between possible alternatives are compared, as in a conventional EIA.

A national interest is a resource which is considered to have such value that it should be protected in a national context. A national interest exists within different factual areas, such as cultural environment, nature protection, active outdoor life, communications, reindeer herding, etc. The national interest is primarily protected by means of regulations in the Environmental Code. Municipal general plans shall show how the municipality intends to weigh up competing land usage against the national interest.

Regarding the national interest, see also Section 1, Chapter 11 of the Handbook.

## Damage to National Interests

Damage to preservation interests is often a decisive question in making decisions on permissibility or determination, or other permit decisions. Regarding national parks and nature reserves, there are well-defined values and rules as to what may or may not be done. National interests are often more vaguely assessed, and geographical delimitations not always justified. Scoping and weighing up against other interests should be dealt with in general municipal plans. Relevant assessments from such maps shall be included in EIA for road project or design plan. The general plan is also a basis for decision making in itself.

Conservation values can also be found outside the identified areas. Regarding national interests, the Environmental Code gives specific rules to the effect that damage should not occur in principle.

When a national interest for conservation is threatened by another national interest, for example, for communication purposes, the following rules apply.

**Evident damage** within a Chapter 4 area is a obstacle against immediate operations, even though such a thing as a road project constitutes a national interest, according to Chapter 3. Weighing up between interests has occurred with decisions on national interests being in accordance with Chapter 4. On the other hand, the regulations concerning protection of national interests, according to Chapter 4, are not a obstacle against for development of existing urban areas or of the local business community, or for defence installations.

Only when two or more national interests are incompatible, according to Chapter 3 of the Environmental Code, can evident damage to a national interest be accepted.

**Assessment of damage and evident damage** regarding the national interest should first describe what changes are expected to occur, by all means in the long-term, and taking into account what other changes occur in land use.

- State what environmental qualities are significantly changed.
- State how specific values are damaged, if the value is reduced in extent or quality. The possibility for mitigation measures is taken into account in the assessment, moreover, compensating measures can be determined during review.
- State conclusions regarding the degree of damage to the entire national interest or to parts of it.

That mitigation measures are possible must also be shown at a location stage. If the concept “risk of damage” or evident damage is used, it should be evident what the risk consists of, and whether the damage can be avoided or lessened through correct location, planning or mitigation measures. If existing roads affect the same conservation values, then measures that reduce the old encroachment, for example, can also influence the total assessment of damage.

In assessing environmental impact (damage etc.), it is important to take into account the indirect effect which can for example occur from a road which is located outside an area of conservation interest, for example.

## **EXAMPLE: NATIONAL INTERESTS**

### **Prerequisites**

Gäddvik and Karlsvik are identified as national interests for cultural environmental protection, in accordance with the Environmental Code, Chapter 3, Section 6. Both areas are affected by the various alternative road routes. In order to assess the type and degree of effect, the respective area's various value cores have been produced. By value core is meant here, a carrying value which constitutes a central basis for being pointed out as being of national interest. This has been done by means of historical studies of the areas and through field studies with overall surveys. After that, a cultural environment analysis was made of each value core. In this analysis, the basic structures of the value cores are analysed, together with structures which strengthen or weaken respectively the value cores in question. Finally, the impacts on the cultural environment of the different road alternatives have been analysed on the basis of their respective value core's cultural environment analysis.

### **Cultural environment analysis**

Value core 2: Remains and buildings from the iron works in Karlsvik

The former industrial buildings and remains from the iron works are very obvious remains from the industrial epoch. Through them we can understand how the industries were established, functioned and what they looked like. The railway network constituted a basic prerequisite for the iron works. Nowadays, this is an older physical structure that dominates the landscape in Karlsvik. Remains of quays, which can be found in several places, are also a basic part of the industrial past. The housing is closely associated with the industrial buildings, and demonstrates the material and social structure of the industrial community.

The value core includes the museum, which is run by the Friends of the Ore Railway, and the built-up environment around the railway, which is a strengthening value. The museum shows Karlsvik as it used to be, and the conditions of the society there in general at about the turn of the century, and also the connection to the ore harbour. This gives deeper understanding of Karlsvik's history. The built-up environment shows how a railway environment in the province of Norrbotten looked, with its railway station, platforms, privies, water tower and locomotive shed.

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*Example of an impact assessment of damage to an area of national interest. Continues on the next page.*

## **EXAMPLE: NATIONAL INTEREST, cont.**

### **Basic structure**

Situation: The location of the iron works relative to the export harbour, railway and workers' dwellings.

Segments: Between the workers' dwellings in North Gäddvik and the iron works, between the workers' dwellings in Karlsvik and the iron works and the school, the route of the railway through the area and the siding to the ore harbour, between the railway/coal store and the remains of the coal quay, and also between the railway and the quay for export via Lulefjärd inlet.

### **Strengthening structures**

- 1) Clear remains of the central structure of the iron works, are Raä 628, Nederluleå sn, including remains of the coal quay and coal store in the western part of the ancient remains.
- 2) Remains of the iron quay and weighbridge, part of Raä 627, Nederluleå sn.
- 3) Well-preserved housing in Karlsvik.
- 4) The old school building in Karlsvik.
- 5) The museum and built-up railway environment.

### **Weakening structures**

- 1) Neglected maintenance and signposting of the remains of the iron works.
- 2) Neglected maintenance of the remains of the coal quay.
- 3) Damaged remains of the People's House, Raä 629, Nederluleå sn, belonging to the iron works.



*Example of an impact assessment of damage to an area of national interest. In the example, the analysis focuses on so-called value cores within the area of national interest, i.e., the carrying values which constitute an essential basis for identification as of national interest. The orange shading on the map shows value core 2. (Source: Road project, Alternative Road Connection between E4 and Kallax airport/Bergnäset.)*

### **Environmental impacts**

The segment affects value core 2 of the national interest of Karlsvik “remains and buildings from the iron works”, by:

- 1) the road corridor, and structure of level-separated junctions in the northern part of the area change the spatial picture by the railway, to the disadvantage of cultural historical considerations. If one breaks the track at Gammelstad, or removes the segment of railway towards the remains of the iron works, an important part of the components of the industrial memory is removed. Understanding of the location of the industry and of the good prerequisites of the Karlsvik area for industrialisation at the turn of the century is impaired.
- 2) the road corridor goes over the area of the ancient remains, with remains of the iron works, Raä 628, Nederluleå sn, at its western end. The remains are very important from a historical and educational point of view, as they constitute clear remains from the time during which the province of Norrbotten was industrialised. The remains of the coal quay, with associated coal store, are wholly inside the road corridor. If these remains are removed, the evidence of a basic prerequisite for the operation of the iron works, and an important segment of the value core is obliterated. The environment of the buildings at the quay is similarly spoiled in the same way as described above for the housing area.
- 3) The connection between the iron works, railway and exportation is destroyed to a great extent, to the detriment of the area as a whole.
- 4) The old school house is located very close to the road corridor, and will be surrounded on three sides by roads. At present it is on a large site, and is located on the outskirts of Karlsvik by the housing area. Despite the fact that the school house is surrounded by housing, its character has been preserved. Its environment and the location of the site will be impaired because of the size of the new road and high traffic load, which are foreign to the old-time railway.



## Impact on “Special Conservation Area”

Natura 2000 is a network of valuable natural areas which is being compiled within the EU. The purpose is to safeguard types of nature and ecosystems of species which the EU countries have agreed to conserve.

### Basis of Permit Review

In accordance with the requirements of the Environmental Code, an advantageous status of conservation shall be maintained, or regained, for ecosystems and species in special protection and conservation areas, which have been designated in accordance with the Environmental Code, Chapter 7, Section 27 (Natura 2000 areas). (*See also Section 1, Page XX.*)

Government Bill, 2000/01:111 **Protection of certain animal and plant species and their habitat** states, “if there is a probability that an activity or action can have significant impact on such an area, those who carry out the activity or undertake the action shall ensure that necessary assessment is carried out and that it shall be reviewed”. The county administrative board shall draw up descriptions of the purpose of the conservation and of the ecosystems and species for which an advantageous conservation status shall be maintained or regained. These assessments are a basis for assessment of effect and damage.

It is always those who carry out the activity who are responsible for the assessment if permission is required; the principle of caution should then give guidance. If there is risk that a road project (or other action) can have an impact on the area directly or indirectly, for example, by land being required, noise disturbance occurring, or water or light conditions being changed, a permit should be sought.

The economic management provisions of the Environmental Code, Chapter 4, mean that a road project which can significantly affect a special protection and conservation area cannot be carried out unless authorisation has been given, in accordance with the Environmental Code, Chapter 7, Section 28a. This means, among other things, that any permit review needs to be carried out before a design plan is established, or before the government can give permission, in accordance with the Environmental Code, Chapter 17. A permit is normally given only if the road project does not entail a negative impact on the conservation values of the area (criteria are given in the Environmental Code, Chapter 7, Section 28b).

In Chapter 6 of the Environmental Code, it is stated that an EIA should always contain the information required for a permit review.

EIA shall contribute to location and planning which does not involve negative impacts for the ecosystems which are worth conserving, and species in special protection and conservation areas. The degree of detail of EIA shall be adjusted to the planning stage in question, but it must be possible to determine whether an alternative in various choices (for example, of a road corridor) is compatible with the purpose of conserving the area. EIA shall contain the information required for a review in accordance with the Environmental Code, Chapter 7, Sections 28 and 29. With the support of the EIA, the county administrative board shall assess, by means of a review, whether the road project will damage the ecosystems which it is intended should be protected in the area, or whether the project involves those species which it is intended should be protected being subjected to disturbance which can, to a significant extent, make the conservation of the species more difficult. EIA for the special permit review should be part of the project’s EIA, but must be clearly scoped in the document so that it is possible to refer it in connection with the permit review. In approving the EIA, the county administrative board should also assess whether it can be the basis of the special permit review. The position taken should be explained.

## Assessment of Damage to a “Special Conservation Area”

The basis of assessment of damage is that a **favourable conservation status** for affected ecosystems and species shall be preserved. Special consideration shall be taken with regard to prioritised species and ecosystems (Section 16, Ordinance 1998:1252 concerning area protection in accordance with the Environmental Code, etc.). In the third annex of the ordinance is a list of the ecosystems which are of community interest in accordance with the Directive. Conservation status of an ecosystem is the sum total of the factors that affect an ecosystem and its typical species, which can affect its natural geographical extent, structure and function in the long term, and the survival of the typical species in the long term. The conservation status of a species is the sum of the factors which influence the affected species and which can affect the natural geographical extent and size of its population in the long term.

In somewhat simplified terms, one can say that the **conservation status of an ecosystem** is considered to be favourable when the area of geographical extent is stable or increasing, when its structure and when its special functions which are necessary for the ecosystem to be maintained in the long term are present, and the conservation status of its typical species is considered to be favourable.

In somewhat simplified terms, one can say that the **conservation status of a species** is considered to be favourable when the population development is positive, when the area of geographical extent does not reduce, and when there is a sufficiently large ecosystem for the population of the species to be maintained in the long term. (See Section 16 of the ordinance 1998:1252).

The county administrative board has a duty to compile assessments for the purpose of conservation, and the ecosystems and species for which an advantageous conservation status shall be maintained or regained. (Section 17 ordinance 1998:1252).

The basis of assessment of environmental impacts is thus the assessments that the county administrative board compiles for the area:

- Which areas/ecosystems and species is it intended should be protected? Is the area prioritised in accordance with EU Directive?
- Which key factors are of importance for a favourable conservation status being maintained?
- Will the project affect any factors of significance? What will the effects be (the actual changes), and what will the impacts be (what do they involve for ecosystems/species which are the main purpose of the protection)?

For good quality in the EIA in this regard, it is essential that there should be a good description of the protection area as a basis for assessment, and that the assessment should not stop at assessment of impacts but should also contain an analysis of the ecological impacts, which requires special competence.

**EXAMPLE: NATIONAL INTEREST AND “SPECIAL CONSERVATION AREA”**

In the table below, the following headings are used:

**Influence** = Expected influence without evaluation of consequences.

**Effect** = A neutral assessment of the consequences for the respective area that the expected influence can lead to.

**Impact** = The assessment by those carrying out the activity of the effects which are expected to occur. The assessments presume that reasonable impact limiting measures will be taken.

**Conclusion** = The assessment by those carrying out the activity of whether respective alternatives can be expected to constitute *evident damage* to a national interest, or counteract a *favourable conservation status* of those species and life environments within the Natura 2000 areas, which are covered by the Species and Habitat Directive or the Bird Directive. In the case of any damage, it shall be assessed whether this can be expected to be *insignificant* or *more than insignificant*.

Alternative	Influence	Effects	Impacts	Conclusion
<b>West</b>	The Lögde river is crossed by bridge at a very meandering section. Erosion protection is required for three areas of water's edge.	The erosion process will be counteracted in this area. Muddying can occur during the construction period. Outdoor recreation and angling along the Lögde river will be affected. The undisturbed nature at this part of the river will partly disappear.	The impacts of a changed course of erosion are difficult to predict. Geo-scientific values are damaged, and the negative impacts for the national interest of the natural environment are assessed as considerable. Muddying during the construction period can damage the spawning areas of the river bottom temporarily, and also possibly damage the stock of river mussels, but it is assessed that this can be reduced through measures being taken. The negative impacts for the Natura 2000 area are assessed as small. The potential of the area for angling is assessed to remain unaffected. The negative impacts for the national interest of recreation is assessed as moderate, primarily on account of noise.	Can be expected to involve considerable damage to the national interest of natural environment. Cannot be expected to involve considerable damage to the national interest of outdoor recreation, or national interests in accordance with Chapter 4 of the Environmental Code. Cannot be expected to counteract the advantageous conservation status of the Natura 2000 area regarding specified species and ecosystems. The damage is assessed to be not more than insignificant.*
<b>East</b>	The bridge crosses the Lögde river in an area which is already impacted, where the river is straightened directly east of the existing Road E4, including an old river line.	The effects refer to the construction period, in the form of muddying. Geo-scientific values are affected, however, to a considerably lesser extent than with the West alternative. Outdoor recreation is affected by traffic noise at the river crossing.	Damage to the geo-scientific values will be much less than with the West alternative. The negative impacts for the national interest of natural environment and the Natura 200 area are assessed as small, for the national interest of outdoor recreation moderate, primarily on account of noise.	Cannot be expected to constitute obvious damage to the national interest of natural environment, outdoor recreation or Chapter 4 of the Environmental Code. Cannot be expected to counteract the advantageous conservation status of the Natura 2000 area for specified species and ecosystems. The damage is assessed to be not more than insignificant.
* The difference in assessing damage to the national interest of natural environment and Natura 2000, respectively, with the West alternative is due to the national interest being based on values including geo-scientific ones, which are damaged through the course of erosion being stopped. The geo-scientific values do not constitute a basis for the area being proposed as Natura 2000 area.				

*Example of how assessment of damage to national interest, and effect on “special conservation areas” can be made. Lögde River is a natural environment of national interest and an area of national interest for outdoor activities, in accordance with the Environmental Code, Chapter 3, Section 6, and is covered by the regulations in Chapter 4 of the Environmental Code. The river is also a Natura 2000 landmark. (Source: Botnia Railway, permissibility review.)*

## What should be dealt with at each respective Planning Stage?

### **Initial study**

The Initial study shall assess whether there is any special protection area in the area under investigation (or close to it), the extent of the area, the purpose of the protection and what factors are of importance for maintaining an advantageous conservation status. It is an advantage for the EIA work if project managers can determine **what** shall be attained/got through for continued advantageous conservation status, with the help of experts and the county administrative board, and establish it as a goal for the project.

### **EXAMPLE: “SPECIAL CONSERVATION AREA” – INITIAL STUDY**

Deciduous marshland wood (P9080, deciduous marshland wood of a fenno-Scandinavian type) is an ecosystem which is covered by protection, in accordance with ordinance 1998:1252.

There is a deciduous marshland wood in the area, which constitutes a special area of protection – the area is drawn in on map X. The area contains the following species which are worthy of protection/typical species. . . Important factors for retaining the character of the area are that the water supply (ground and surface water flows) are not changed, that the quality of the water is not impaired and that there is no increased admission of light. The goals of the project will be that these factors are not affected negatively.

The following measures are assessed to be compatible with established goals/requirements made...

The following measures are assessed not to be compatible with established goals/requirements made. ...

Observation: Here, essential aspects are given prior to continued planning, for example, that a road corridor should not be located in a certain area, and competence for continued work, in this case geological and biological competence.

**Road project**

In a road project, the natural prerequisites which affect the key factors of importance for the function of the area and its worth, are assessed with a degree of detail which makes it possible to assess which corridors are compatible with an advantageous conservation status, and which are not. Aspects that shall be discussed above all are which road corridors **can entail** negative effects, and an assessment of the effects and the impacts. In addition, an assessment of possible adjustment, and in such a case, what type of adjustment and measures that should be carried out for each respective corridor, and what uncertainties there are in the assessments.

**EXAMPLE: “SPECIAL CONSERVATION AREA” – ROAD PROJECT**

Natural prerequisites: The drainage area has been scoped by experts having made an assessment on the basis of geological maps and existing survey results, etc., of which surface and ground water flows there are in the area. With the support of known prerequisites, assessments are carried out that corridor A does not affect the water flow to and in the area, as it is located outside the outflow area. Corridor B lies within the outflow area, and irrespective of where the line is drawn, the corridor will cut off the water flow to the area. Technical solutions which mitigate the impacts are possible, but there is, nevertheless, risk of certain effects on the water flow, and so on.

**Design plan**

In the design plan, the natural prerequisites must be described in detail, so that it is possible to assess effects and impacts of various plans and what special measures it is possible to take. Proposals regarding consideration and protective measures are an important part of the design plan's EIA.

If it is evident from EIA that the project can involve damage or disturbance in a protected area, the government shall assess permissibility. EIA shall then look at possible compensation measures that would make it possible to satisfy the purpose of the protection of the area.

## 14. EIA in Feasibility study – Examples

This Chapter gives some examples from EIAs in road projects. The Chapter is based on the statement requirements of VVFS 2001:18.

### Contents

Two examples are given below of the content of EIA in road projects, one for an urban area project and one for a motorway project. Note how the characters of the projects affect the contents of the EIA. Sections on direct and indirect effects and impacts describe how existing conditions are changed, while a more in-depth assessment of existing environment is put in appendices.

<p>Summary</p> <p>Feasibility study</p> <p>Scoping of the EIA (focusing, degree of detail – differences compared with future EIA for design plan, prioritisation of environmental aspects and environmental goals of the project)</p> <p>Environmental considerations in identifying alternatives and taking note of environmental impacts in the survey (states which alternative road corridors and road standards are assessed, including do-nothing alternatives and improvement alternatives)</p> <p>The existing environment, use of land and traffic conditions</p> <ul style="list-style-type: none"> <li>- A summarised topographical picture + reference to the next section, together with appendices.</li> </ul> <p>Expected environmental effects and environmental impacts, ranking of alternatives</p> <ul style="list-style-type: none"> <li>- Town environment (development trends, impacts of do-nothing alternatives and action alternatives)</li> <li>- Housing environments, including health and safety (development trend .....</li> <li>- Cultural environment (development trend .....) (reference to methods of calculation and assessment)</li> </ul> <p>Comparative assessment in general, decisive factors, goal fulfilment</p> <p>Mitigation measures, possible environmental adjustment</p> <p>Coherent land use planning – important for the environment</p> <p>Information sources</p> <p>Experts who have participated</p> <p>Appendix: Existing environment and its development.</p> <p><i>Example of the content of EIA in road project for a road project in an urban area.</i></p>	<p>Summary</p> <p>Feasibility study</p> <p>How have environmental considerations affected identification of alternatives? How have the environmental impacts of the alternatives already been considered?</p> <p>Scoping of the EIA (focusing, degree of detail – difference compared with future EIA for the design plan, prioritisation of environmental aspects and environmental goals for the project)</p> <p>Alternative road corridors and road standards which are assessed (including do-nothing alternatives and improvement alternatives)</p> <p>Existing environment, use of land and traffic conditions</p> <ul style="list-style-type: none"> <li>- A summarised topographical picture + reference to the next section, together with appendices.</li> </ul> <p>Expected environmental effects and environmental impacts, ranking of alternatives</p> <ul style="list-style-type: none"> <li>- Ground water and agricultural land (development trends, impacts of do-nothing alternatives and action alternatives)</li> <li>- Natural environment, especially the hydrological environment (development trend .....</li> <li>- Outdoor activities (development trend .....) (reference to methods of calculation and assessment)</li> </ul> <p>Comparative assessment in general, decisive factors, goal fulfilment</p> <p>Mitigation measures, possible environmental adjustment</p> <p>Information sources</p> <p>Experts who have participated</p> <p>Appendix: Existing environment and development trends.</p> <p><i>Example of the content of EIA in road project for a motorway project in a rural environment.</i></p>
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### Especially for EIA in Feasibility study

The content of EIA in a road project should reflect that which is special with that EIA in particular in the road project. For reporting, the following four points apply over and above the general requirements of VVFS 2001:18, Sections 12-13, together with the Environmental Code,

and also special requirements of VVFS Section 27. It should be possible to find the following information without difficulty.

1. To what extent environmental considerations have affected the identification of the road corridor being studied.
2. A comparative assessment of alternative road corridors or other action alternatives. (Elucidate the alternative differences, without hiding the mutually important impacts).
3. To what extent it is assessed possible to be able to solve any conflicts at a later stage, prevent damage and improve the environment.
4. Important prerequisites for environmental adjustment of the segment of road and formulation of continued planning. (Connection can perhaps be made to creation programmes, if such are available separately).

### **Comparative Assessment and Synthesis**

In the road project, the environmental impacts collected for each alternative are described, together with comparisons between the alternatives. The purpose is to facilitate a collective total assessment of the project. EIA gives support in adoption of a standpoint which shall promote suitable land use, especially regarding weighing up between general interests.

Standpoints from authorities and from the general public also contribute to the assessments which the impacts consist of, i.e., the importance of the effects.

In the case of increased consultation, in accordance with the Environmental Code, Chapter 6, Section 5, that which is possible at the planning stage in question is dealt with at the road project stage. "Formulation" is about the formulation of principles such as consumption of land and road standards.

Alternatives that are considered shall be compared with one another, and with a do-nothing alternative. In many cases, the do-nothing alternative is only a reference and not a realistic alternative. Before the environmental impacts are described collectively, the grading of the alternatives should be shown for each group of environmental impacts (without the need to use any points system). Grouping, in accordance with the interests to which the impacts apply, is often appropriate as regards location of roads.

In order to make the comparison possible, the alternatives and their impacts must be assessed in a way that gives equality. Good and consistent designation of alternatives is important for the reader.

One basis is for all aspects and interests that occur being evaluated for all alternatives, with similar degrees of detail. Effects and impacts should be described as comparisons in absolute terms, not in relative terms (better than/worse than). Expressions such as small, moderate and large impacts are not sufficiently concrete. If the environmental goal for a project is quantified with simple measurements, this is a good method for evaluating.

Total ranking of the alternatives from the environmental point of view is not always appropriate, and is very difficult when it is a matter of such things as extensive encroachment effects being set against human health in a through-road alternative. This conflict should be elucidated.





Environmental Interests	Do-nothing Alternatives	Improvement Alternative	Alternative A	Notes, examples of questions
<b>1. Natural resources – economic management</b> Ground water Agricultural land (areas used and difficult to farm)	In these cells the environmental impacts are described in text			Potential threats, protection measures. Secured in all alternatives, no differences
<b>Goals</b> Project goals referring to natural resources		Yes	No	Contributes to fulfilment of goals
Regional goals referring to natural resources				--
National environmental goals referring to natural resources				--
Transport-policy goals referring to natural resources				--
Economic management of materials and of land, hydrology, energy and other natural resources, re-use				--
<b>2. Housing environment including health and safety</b>	In these cells the environmental impacts are described in text			Air quality and vibrations are of small importance in the project, and are not discussed
Dangerous goods				Which are improved and which are worsened? Probability, how many people would be affected within X00m
Traffic noise				Who would experience improvement or worsening respectively? The number of residents, children in schools, sports locations ...
Barrier effects, intrusion				Types of building and the number that would be damaged, demolished, be difficult to use, lose considerable value. Totally or partially. Fjälkinge, hit and run traffic
Development of population area Fjälkinge				Land for expansion of buildings?
<b>Goals</b> Project goals referring to housing environment		No	Yes	Contribute to goal fulfilment
Regional goals referring to housing environment				--
National environmental goals referring to housing environment				--
Transport-policy goals referring to housing environment				--
<b>3. Natural and cultural landscape including outdoor recreation</b>				The table continues with further environmental interests, same type of arrangement

*Example of presentation in matrix form in which environmental interests have been prioritised. The figure 1 in front of Natural Resources – economic management, means that this interest has the highest priority. The alternative's goal fulfilment is also given. (Source: fictitious example.)*

**EXAMPLE: PRESENTATION IN MATRIX FORM WITH GRADING OF ASPECTS**

A summarised assessment of the road proposal's impacts compared with the do-nothing alternative is given here. In evaluating the road proposal and its various parts, the technical and economic factors described, together with use of land and environmental interests, should be prioritised as follows:

<b>Very high priority:</b> Function of the road Road safety Economy Natural resources (agriculture) Cultural environment Natural environment	<b>High priority:</b> Technical standards Passability Natural resources (other) Landscape (for residents, etc.) Noise (for residents) Water environment	<b>Very high priority:</b> Municipal plans Tourism Barrier effects (for residents) Recreation and outdoor activities Air pollution (for residents) Vibration (for residents) Dangerous goods
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TECHNICAL AND ECONOMIC IMPACTS		LAND USE IMPACTS	
Interests	Impacts	Interests	Impacts
The function of the road	These cells describe the impacts in text	Natural resources (agriculture)	These cells assess the impacts in text
Technical standard		Natural resources (other)	
Passability		Municipal plans	
Road safety			
Construction costs		Tourism	
Traffic-economic benefit		Barrier effects (for residents)	
Net ratio			

*Example of presentation of collected assessment in feasibility study. The aspects which are evaluated have been prioritised. Prioritisation is given both in text and through different colours in the tables. The darkest colour = the highest priority. The tables for technical and economic impacts, together with land use impacts, are only presented in principle here. (Source: Feasibility study, Road 50, Alternative Improvement Alvastra-Motala.)*

**EXAMPLE: PRESENTATION IN MATRIX FORM WITH ORDER OF PRECEDENCE OF ASPECTS cont.**

<b>ENVIRONMENTAL IMPACTS</b>	
<b>Interests</b>	<b>Impacts</b>
<b>Cultural Environment</b>	Alternative East goes through a very old cultural settlement with an existing road network, the framework of which has its roots in the Middle Ages. A completely new road in this relatively unaffected landscape is an impairment of the cultural environment in general. Three areas of the highest class are affected by the proposed road corridor. Regarding the Väderstad area, a road through the area involves considerable degradation of the cultural environment – in the first place because of the road’s divisive effect. The Västra Stenby and Södra Froberg areas, which are also of the highest class, will be affected physically and visually through incursions into the ancient remains and building environments.
<b>Natural Environment</b>	Alternative East goes through an intensively farmed agricultural landscape, in which the number of valuable natural environments is limited. The road crosses the Väderstad area’s agricultural landscape, which is rich in variation, and which in the short-term is expected to lead to significant changes in the landscape and a significant effect on the flora and fauna in the vicinity of the road. In addition, the road constitutes an encroachment into the landscape as a whole, as it is located in an area which is affected to a very minor extent by larger roads and other development. The road thus contributes to a general fragmentation of the landscape, which is negative in a general nature conservation perspective. Except for the Väderstad area, direct encroachment can be avoided in many cases by means of appropriate location in the terrain. In some cases, there was a risk of indirect impact through the road coming very close to valuable environments, for example, Hilltorp’s limestone marsh.
<b>Recreation and Outdoor Activities</b>	Alternative East does not affect any area of considerable importance for recreation and outdoor activities. Some noise effect in the area of local interest can occur. As regards recreation and outdoor activities in the vicinity of the existing Road 50, a new road involves positive effects because the traffic in the area will diminish.
<b>Landscape (for residents, etc.)</b>	Alternative East goes through an open landscape, which is relatively unaffected by structures, and in general has considerable effect on the landscape. The most sensitive segments are the crossing through the small-scale Väderstad area, the crossing over the Skena river in a very level landscape, and the traffic junction with the existing Road 50 at Södra Freberga.
<b>Noise (for residents)</b>	Alternative East goes through a sparsely settled area. 7 or 8 properties are estimated to have noise levels in excess of 55dBA. Compared with the do-nothing alternative, the total number of properties disturbed by noise (>55dBA) along the existing Road 50 and the existing Road 32, will decline by about 150 properties if the speed on the new road is 110 km/hr, and by about 115 properties if the speed is 90 km/hr.
<b>Air Pollution (for residents)</b>	A new Road 50 will cause increased emission quantities of nitric oxide, sulphur dioxide, hydrocarbons and particulates. Emission quantities of hydrocarbons are expected to decline. All changes are marginal.
<b>Vibration (for residents)</b>	The risk of disturbing vibration occurring is assessed as small, and the number of properties which could conceivably be so close to the road that they would be affected by vibration is small.
<b>Hydrology Environment and Dangerous Goods</b>	A new segment, in accordance with Alternative East involves few conflicts with regard to the water environment. In some sensitive crossings, measures are suggested for protecting surface and ground water. If it is possible to divert the traffic, especially dangerous transport, to the new road, the existing roads will have reduced traffic loads, where very sensitive water environments are found, as is the Vätt river, for example.

## Fulfilment of Environmental Goals

The examples below and on the next page, show the way in which the fulfilment of various environmental goals can be described, together with impact statement.

In most projects, there are general environmental goals that are not affected by the measures. This can either be because of the measures themselves, or the geographical position. After having explained why certain of the goals have been dropped, those which are directly relevant can be used. Examples of this are shown on the next page.

Note that laws and regulations do not required any type of separate statement of effect on national goals. On the other hand, the decision-maker shall arrive at conclusions based on the EIA.

Project-specific or local environmental goals can, of course, be used in the statement of impacts.

Subsidiary Goals	The Do-nothing Alternative	Improvement of Existing Road
<b>Good Environment</b>		
Limit encroachment in the surrounding environment.	3	3
Limit damage from construction work and similar.	3	2
Within the national interest of Stråkendalen Bottnarydsfältet no effect may be made on key landmarks. The collected value of this national interest must not be reduced through fragmentation and reduced accessibility.	3	3
The hydrological system in Dumme Marsh must not be affected by the water-retaining function of the marsh being impaired compared with the present situation.	3	3
Encroachment into valuable nature types, habitats, which are protected through the EU Habitat Directive, shall occur as little as possible.	3	3
The planned road shall have a minimum possible effect on species connected to the Bird Directive within the Natura 2000 area, Dumme Marsh.	3	3
For significant parts of the area with species of bird that are especially sensitive to disturbance and/or are protected, the noise level must not exceed 40dBA (equivalent value).	2	2
Accessibility to Dumme Marsh, both visual and physical, should be increased, both for road users and for outdoor activities.	0	0
With regard to outdoor activities, disturbance from road traffic as regards noise should be limited to a guideline value of 40dBA (equivalent value).	1	1
Polluted surface water must not reach the water system of Nissan and the Taberg river. In addition, any discharges from dangerous goods accidents should be capable of prevention so that there is time for cleaning up.	0	1

*Example of how goal fulfilments are described in the feasibility study's Chapter "Compilation and Assessment", as regards environmental goals for a project. The table above is abbreviated, in fact there are several road alternatives. (Source: Road 40 Borås-Jönköping, the section county border-Haga.)*

### **EXAMPLE: GOAL-RELATED ASSESSMENT IN EIA, CONSTRUCTED ON PROJECT GOALS IN ROAD PROJECT**

In the initial study phase it has been established that the work should be directed towards attempting to fulfil things that include four project goals, of which the two that are described below apply to environmental aspects. These goals shall be adapted to determined levels, according both to national requirements/guidelines and locally established goals, and also proposed environmental quality norms. The ways in which the goals can be fulfilled or obstructed by the various road alternatives are described below.

#### **Environment in Södra Gäddvik is to be improved with respect to the value of the old cultural buildings**

In the *do-nothing alternative*, the goal is obstructed. The heavy traffic on the existing 616 road makes it difficult to visit the area and assess the cultural environmental values under satisfactory conditions.

In the *improvement alternative*, the goal is also obstructed through additional land being required along the existing road. The effect on the cultural environment values Gäddvik is assessed to be considerable. Access to the area does, however, increase for unprotected road users, by means of a separate pedestrian and cycle path being constructed along road 616.

In the *new construction alternative* the considerable reduction in traffic on road 616 is positive for the experience of the cultural environment, and favours the goal considerably. Access to the area increases for unprotected road users, both with regard to the possibility of getting there and of being there in order to experience the cultural environmental value of the area. The volume of traffic declines most in the Karlsvik alternative (see also the following section on road safety).

In the new construction alternative, a pedestrian and cycle path are also included along the existing road 616 through Gäddvik. Because traffic on road 616 will be considerably reduced in these alternatives, the width of the present carriageway can probably be reduced somewhat, and part of it used for a pedestrian and cycle path. A smaller amount of new land is thus required than in the improvement alternative.

#### **Traffic-related environmental disturbance, primarily with regard to air pollution, noise and encroachment in Luleå Centre will be reduced**

The environmental disturbances related to traffic in Luleå Centre are only affected to a small extent by the studied alternatives.

The *do-nothing alternative* and the *improvement alternative* do not contribute to the goal being fulfilled. Traffic movement in the centre increases in relation to the existing situation.

The goal is favoured somewhat by the *new construction alternative*; compared with the do-nothing and improvement alternatives; traffic movement declines somewhat on the affected road network (the roads where the volume of traffic is affected) in the centre, by some 4% in the Karlsvik alternative, and by some 2% in the Gäddvik alternative.

*Example of how the environmental goal for a project is considered in the Environmental Impact Assessment. (Source: Feasibility study. Alternative Road Connections between E4 and Kallax Airport/Bergnäset.)*

## 15. EIA in Design plan – Examples

This Chapter gives some examples of statements from EIA in design plan. The Chapter is based on the statement requirements of VVFS 2201:18

### Contents

Some examples of the content of EIA in design plan are given below. Note how the character of the project affects the content of the EIA.

#### **EXAMPLE: CONTENT DESIGN PLAN WITH EIA FOR WIDENING OF ROAD, ETC.**

##### SUMMARY

##### BACKGROUND, PURPOSE AND PREREQUISITES

Planning and project procedure

The project

Inquiries and decisions carried out earlier

Scoping projects

Actuality

National interests

Environmental goals, legislation, etc.

Proposal

##### ENVIRONMENTAL IMPACT ASSESSMENT

Description of present situation

How is the Environmental Impact Assessment carried out? Effect on the design

Do-nothing alternative

System effects

##### PROBABLE GENERAL IMPACTS

##### PROBABLE IMPACTS PER AREA

Section 1 Börringe – Lemmeströ

Section 2 Lemmeströ – Stenbäck

Section 3 Stenbäck – Skurup

##### FOLLOW-UP AND MONITORING

##### CONSULTATION, CONTACTS AND REFERENCE MATERIAL

List of sources

Consultation and contacts

Appendix A

MAP

*Example of the contents of EIA in design plan for a TS project – the existing road is widened and provided with a central safety barrier, the side area is reworked with flat slopes and shallow ditches. (Source: Based on Design Plan Road E65 Börringe-Skurup.)*

## **EXAMPLE: CONTENT EIA IN DESIGN PLAN FOR NEW CONSTRUCTION PROJECT**

<b>FOREWORD</b>	6.3 Cultural environment
<b>1. INTRODUCTION</b>	6.4 Recreation and outdoor activities
<b>2. SUMMARY</b>	6.5 Noise and vibrations
2.1 Project in brief	6.6 Air
2.2 Environmental impacts – conclusions	6.6.1 Air: External environment
2.3 Monitoring and follow-up	6.6.1 Air: Effect on vegetation
<b>3. BACKGROUND</b>	6.6.2 Air: Air in tunnels
3.1 Background decisions	6.6.3 Air: Separation of dust
3.2 New decisions and actual planning	6.7 Water and land
<b>4. PROJECT ASSESSMENT</b>	6.7.1 Management of water
4.1 North link, purpose and section in its entirety	6.7.2 Ground water
4.2 Effects of traffic	6.7.3 Ground pollution
4.3 The planning of the road system	6.8 Safety
<b>5. JOINT PREREQUISITES</b>	6.9 The construction phase
5.1 General, use of land	6.9.1 Work places, construction work, etc.
5.2 General environmental goals	6.9.2 Environmental impacts
5.3 National interests	6.9.3 Conclusions
5.4 National town park	6.10 Economic management of natural resources
5.5 Inter-municipal and local interests	<b>7 MONITORING AND FOLLOW-UP</b>
5.6 Do-nothing alternative	7.1 Monitoring programme
5.7 Traffic forecasts	7.2 Follow-up
5.8 Methodology-uncertainty	<b>8 COSTS</b>
<b>6. ENVIRONMENTAL IMPACTS</b>	<b>9 PARTICIPATION</b>
6.1 City and landscape	<b>10 REFERENCES AND BACKGROUND SURVEYS</b>
6.2 Natural environment	

Appendix: The extent of the design plan and associated work

*Example of content of EIA in design plan for a new construction project in city environment. Among the things that are evident in the contents are that questions of air quality have been important. (Source: Design plan for the North Link, Stockholm.)*

**EXAMPLE: CONTENT EIA IN DESIGN PLAN FOR NEW CONSTRUCTION PROJECT**

**SUMMARY**

**1. INTRODUCTION**

Background and purpose

Previous surveys

**2. PREREQUISITES**

**ROAD PROJECT**

The road section

Traffic conditions

National interests

Environmental prerequisites

Plan conditions

Do-nothing alternative

Methodology

**3. ENVIRONMENT**

Natural environment

Cultural environment

Recreation and outdoor activities

Landscape

Environmental effects during the construction period

**4. HEALTH AND SAFETY**

Noise

Air pollution

Barrier effects

Vibrations

Dangerous goods

Housing environments – other

**5. ECONOMIC MANAGEMENT OF NATURAL RESOURCES**

Agriculture

Forestry

Valuable substances and materials

Water resources

Materials – access and handling

**6. SUB-SEGMENTS WITH PROPOSAL FOR MEASURES**

Map 1, km 0-2/7

Map 2, km 2/7-5/6

Map 3, km 5/6-8/4

Map 4, km 8/4-11/2

Map 5, km 11/2-14/0

Map 6, km 12/0-16/6

Map 7, km 16/6-19/4

Map 8, km 19/4-21/5

Map 9, Road 70 Kumla km 0-2/2

Map 10, Road 70 Kumla km 2/2-5/0

Appendices:

Appendix 1 Environmental interests, plans 1:20,000

Appendix 2 Consultation and sources

Appendix 3 Proposals for planning of traffic service structure.

*Example of content of EIA in design plan for a new construction project in country environment. Things that are evident include, as shown in the contents, that maps are presented, both in general terms – in Appendix 1 – and in more detail for different sections of segments – in Chapter 6, which is primarily intended for people living in the vicinity, land owners, etc. (Source: Design plan for 67 and 70 at Sala.)*



### For review of hydraulic activities

Separate out influence on the actual watercourse from the EIA!

Examples:

- What happens with the surface water?
- What happens with water, bottoms of watercourses and their edges?
- Extent in time and space,
- Loss of fish reproduction and vegetation.

For the Swedish National Board of Fisheries, who are to comment:

- Biological diversity
- Species of fish, etc., especially salmon, eel, crayfish,
- Presence of reproduction areas upstream, which means that fish will pass by,
- Presence of spawning and reproduction areas downstream, which can get filled with mud or be damaged because of the work in some other way.

### EXAMPLE: CONTENTS OF EIA FOR HYDRAULIC ACTIVITIES

#### SUMMARY

#### BACKGROUND AND PURPOSE

#### ENVIRONMENTAL PREREQUISITES

Hogdal Brook and its tributaries

General

Brook and vegetation at the location of the bridge

Fishing

Survey of spawning grounds and fry areas of sea trout

Survey of watercourses

Electric fishing

Annual cycle of the sea trout

Natural flows of the watercourses

Calculation of surface water pollution

Limits for toxic substances in salmon water

#### BRIDGE ALTERNATIVES STUDIED

Evaluation of design plan

#### DESCRIPTION OF STRUCTURE, SELECTED ALTERNATIVE

Bridge with approach dams

Brook excavation

Erosion protection

Period of work

#### ENVIRONMENTAL IMPACTS

Bridge and brook excavation

Surface water

Period of work

#### PROTECTIVE MEASURES

Restoration plan

New line of brook

Planting

Foundations of bridge

Construction period

Old line of brook

Environmental follow-up

Management of surface water

#### CONSULTATION

#### REFERENCES

*Example of content of EIA for application for permit for hydraulic activities. The main part of the content can be taken from the design plan's EIA. It constitutes a basis for the decision by the Environmental Court regarding terms. (Source: Bridge over Tvetvatten Brook, Road E6 Hogdal-Norby.)*

A joint EIA can be drawn up for several items of smaller road rebuilding, or several that hang together, in accordance with VVFS 2001:18, Section 10.

## Especially about EIA for Design plan

Apart from the general requirements concerning EIA for road projects, VVFS 2001:18, Section 36, stipulates special requirements for EIA at this planning stage. One possibility, but not a requirement, is to draw up a joint EIA for several smaller road reconstruction schemes, see Chapter 2 of this handbook.

### **EIA work**

According to VVFS, EIA should state how the EIA work has affected the design of the road, how environmental considerations taken earlier in locating a road line in plan and profile could be described here, for example, plus how alternative designs were considered.

### **EXAMPLE**

Existing surveys of valuable road edges, historical segments of roads and tree-lined roads have been an important basis and have contributed to more variants being produced than just the widening of existing roads. In addition, the cultural environment has been mapped by means which included an archaeological survey. Together with studies of natural values and outdoor activities, this has contributed to variants from road rebuilding to road improvements in existing segments not being located to the most valuable area as regards conservation, which is the north side of the existing road. An alternative which has been studied only involves the extension of a cycle path, because of consideration for the sensitivity of the environment, and has been presented as a variant in the design plan. Note, it is shown on the map illustration.

### **Impacts of chosen formulation**

**Detailed planning which has not been decided upon** in the design plan stage can also be counted as belonging to the construction stage, as it is drawn up in connection with the construction documents being worked out. Various designs and solutions can give varying effects and impacts. EIA can both describe what effects and impacts various solutions involve, and propose suitable detailed adjustments. The EIA of the design plan thus becomes a decision-making basis for selection of detail planning at the construction stage.

### **EXAMPLE**

In the ravine there are valuable flora and fauna. The ravine constitutes an important migration route for many animals. Proposed solutions over the ravine are a bank, or some sort of bridge, but a decision has not yet been made. A bank will partly destroy a large part of the ravine, and also obliterate the flora and fauna, a bank also means migration opportunities for animals being impaired, and also makes it more difficult for people to get through, i.e., it is assessed that nature and recreational value will suffer. The solution with a bridge can be carried out with minor damage in the ravine, and the migratory opportunities can be retained, i.e., the negative impacts are assessed to be small. In order to avoid damming and negative impacts on natural values in the wetland, a construction is required which enables water to pass through the road body.

### **Environmental impacts and compensation measures**

According to VVFS, the environmental impacts of the selected design of road project, and compensation measures which can be especially justified shall be stated.

#### **EXAMPLE**

Proposed design plan involves existing road being used only by motor vehicles, and that a cycle path is built on the side of it and completely outside the tree-lined road. The proposal is based on speed reduction, applying to vehicles on that section. This means that the environmental impacts will not be on this section. The encroachment of the cycle path is made on pastureland, and will not produce any visual change of consequence. On the other hand, on the other sections, widening of other sub-segments of the existing road will occur, which will damage botanically valuable road edges. This gives cause for a compensatory measure, in equivalent road-side flora being established along the new road sides. This can be done by moving large chunks of the existing ground surface to those parts of the rebuilt road's edges, which have equivalent dampness.

### **Follow-up**

According to VVFS, requirement for follow-up of the road project's environmental impacts, and proposal for possible follow-up programme shall be given and justified in each section.

#### **EXAMPLE**

Moving large chunks of ground, with vegetation, must be described in the construction documents, as must the goal of moving flora so that it establishes itself on suitable sub-segments. That this is actually carried out in an appropriate way should be checked during the construction phase. In addition, the re-establishment of the flora at the new places along the road, should be checked during the remaining botanical season, during the following botanical season and for a further two years after that. Responsibility for watering during the first period must be clarified if this action is decided upon, and included in the construction documents.

## Mitigation and Environment Improvement Measures

A control requirement in EIA for design plan is an analysis of the **environmental measures**, with the purpose of hindering, mitigating or compensating damage and possibly adding environmental qualities.

If the proposal for the design plan has good environmental adjustment, perhaps thanks to the integration of EIA, there is no reason to describe the environmental measures in great detail, if they are already included in the design plan proposal, if they are appropriate and do not need to be compared with alternatives, or questioned as to whether they are sufficient. The EIA shall describe how the environmental adjustment is sufficient with regard to the environmental goals, rules of consideration and environmental quality norms, the general public and opinions from property owners.

When questions of formation are important, a **formation programme** should have affected the design of the road, in parallel with the work with the EIA. The EIA subsequently describes the impacts of the proposal for design plan, plus alternatives and possible further environmental measures (in addition to those stated in the design plan). In this way, the ideas from the formation programme will be elucidated in the EIA.

When necessary, the EIA shall suggest and elucidate **further environmental measures**, in order to avoid or lessen those negative impacts which the “final design” is expected to entail. Here, proposals for **alternative measures** are given, including the effects of these measures and cost levels, if possible. Requirements concerning design/adjustment of the measures for attaining intended function and management requirements are given. General requirements that are placed on all projects, for example, noise requirements regarding work vehicles, are not described. The presentation shall clearly show what is required for consideration requirements and environmental quality norms being fulfilled when there is a decisive aspect for a decision to be made, as regards which measures, etc., shall be carried out (included in design plans).

The results of follow-ups and research projects give valuable information on such things as how purification dams should be designed and managed to work well, or how fauna crossings shall be designed. Negative effects can perhaps occur as a result of a measure. The EIA should therefore deal with suitable adjustments of measures; it can be a matter of the effect on the cultural environment of a noise barrier.

Before EIA is finally presented, time should be allotted for listing and checking that all environmental measures included in the design plan's drawings, or in the assessment, have been taken into account in assessing the environmental impacts, and that this is stated in the EIA.

The example below shows how it is possible to show clearly the differences between measures that are included and other measures.

**EXAMPLE – NOISE BARRIERS**

Location of noise barriers is given in the design plan.

In the impact assessment, it is presumed that they will be 2.5 – 3 metres high, so that they give the required reduction of traffic noise, i.e., by 8-10dBA equivalent level for the 24-hour period. This requires that they are so constructed from such material that reflection between the two sides of the road does not occur, and that echoes between the two surfaces does not occur either. According to the formation programme, material and design of the barriers shall be chosen to conform to the buildings. Glass cannot be used, for the reasons given.

An alternative, with sloping barriers, (which are required if the material reflects) would increase construction costs by 1/3. A rough polished surface of porous blocks of stone can be compared to strong wooden plank as regards reflection.

The cost of foundations, materials, construction and maintenance vary. A stone wall will be about 50% more expensive, but in principle, will have an unlimited life if it is maintained. The material of a wooden barrier may need to be replaced after 25 years, and must be constructed so that the muffling function is not weakened by movement of the material. The choice of material should also be considered in relation to the life of the structure, and whether the function of the road and traffic on it can be assumed to be similar in 25 years. At present, no planning is underway which would change the use of the land from detached houses to anything else. The houses are attractive and will be maintained. In any case, the road will not be taking traffic to any other route in the future. In both alternatives, residents can be given the opportunity, collectively, of influencing choice of colour on the inside of the barrier. Climbing plants also function in both alternatives (illustrated in the EIA).

After having obtained opinions from consultation with affected residents and property owners, some of these choices of material should be included in the list of material in the construction documents.

## Level of Detail

At the design plan stage, the EIA has information which makes it possible to affect detailed solutions and elucidate other things that can be done at the construction stage, with respect to the situation at the place. For example, it can be shown that surplus spoil can be handled in a way which is good for the environment. Below, and on the next page, are shown an example in which appropriate places for storage of surplus spoil are proposed, and a general presentation of the amount and type of spoil, risk of pollution, etc., has been undertaken.

### **EXAMPLE – PRESENTATION OF HANDLING OF SPOIL IN EIA FOR DESIGN PLAN**

The project generates the following spoil, according to general calculations:

Excavated earth (of which sulphide earth 23,500m <sup>3</sup> , topsoil 10,000m <sup>3</sup> )	420,000m <sup>3</sup>
Excavated rock	295,000m <sup>3</sup>
Removed vegetation	50,000m <sup>3</sup>
Excavation of peat and clay, of which sulphide earth 10,000m <sup>3</sup>	50,000m <sup>3</sup>

According to general calculations, the following spoil will be used in the project:

Filling banks (earth spoil)	250,000m <sup>3</sup>
Backfilling excavations (earth spoil)	50,000m <sup>3</sup>
Pressure bank (earth spoil, of which 10,000m <sup>3</sup> has a sulphide content)	19,000m <sup>3</sup>
Protection of slopes (rock spoil)	40,000m <sup>3</sup>
Excess load (rock spoil)	15,000m <sup>3</sup>
Bottom ballast (rock spoil)	330,00m <sup>3</sup>
Ballast (rock spoil)	55,000m <sup>3</sup>
Roads built over (rock spoil)	40,000m <sup>3</sup>
Covering of slopes (removal of vegetation)	50,000m <sup>3</sup>

The total means a deficit of rock spoil of some 185,000m<sup>3</sup>, and a surplus of usable earth spoil of some 87,500m<sup>3</sup> (of which 10,000m<sup>3</sup> is topsoil). The surplus of unusable spoil consists of excavated spoil, and 23,500m<sup>3</sup> of sulphide earth, a total of some 73,500m<sup>3</sup>. The total excess of spoil (serviceable + unserviceable) is about 161,000m<sup>3</sup>. The excess topsoil is sold or given away by the SNRA, or alternatively becomes the property of a contractor for use on some other project or for selling on. Demolished asphalt, some 900m<sup>2</sup> of usable thickness, is delivered for recycling on the asphalt tip at XX.

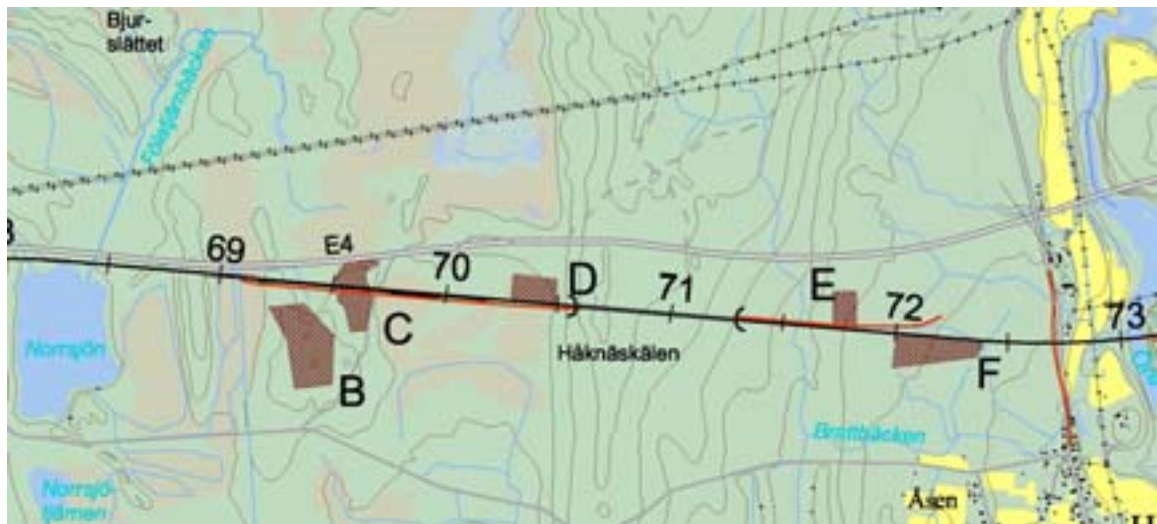
On the map, and also in the Tables, a proposal for location of the surplus spoil is described. The proposal is intended to show that there is room for the spoil which the project is calculated to produce, not to control precise management of it

*Example of presentation of handling of spoil. The example is a railway plan which corresponds to a road design plan. See also map and table on the next page.*

**EXAMPLE: PRESENTATION OF HANDLING OF SPOIL IN EIA FOR DESIGN PLAN,**

No.	Position (km)	Description	Area (m <sup>2</sup> )	Volume about (m <sup>3</sup> )	Type of Spoil	Recipient	Assessment of Pollution Risk
B	69+300 150m H	Extraction at Håknäs 4:9 and 2:12. Type of soil: flow sediment, moraine, rock.	40,000	110,000	Permanent: soil, excavation, sulphide soil	Brunns Marsh about 110m, Norrsjön Lake about 1km	Not insignificant
C	69+500 – 69+700, V- +H	Timber felling. Type of soil: moraine, rock.	24,000	30,000	Permanent: soil, excavation	Adjacent marshes	Insignificant
D	70+300 – 70+500 V	Forest. Type of soil: flow sediment, moraine.	12,500	35,000	Sometimes: rock	Adjacent Marshes	Not insignificant
E	71+700 – 71+800, H	Forest. Type of soil: moraine, rock.	15,000	45,000	Sometimes: rock	Bratt brook about 400m, Öre river about 1.5km (sensitive)	Not insignificant
F	72+000 – 72+350, H	Timber felling. Type of soil: river sediment.	30,000	90,000	Permanent: soil, excavation	Bratt brook about 400m, Öre river about 1km (sensitive)	Not insignificant

*Notes: The given areas in the Table are based on map studies, estimated volumes in field studies of how much and what area respectively can be filled up without the view of the landscape being affected negatively. In the Table there is also an assessment given of how the reserve can give rise to “not insignificant risk of pollution”, which requires permission from the county administrative board’s environmental investigation delegation, or “insignificant risk of pollution”, which shall be reported to the affected municipality. This is based on the type of spoil which it is proposed shall be stored, and the sensitivity of the recipient affected.*



*General map with proposals for location of surplus spoil. (Source: The Botnia Railway, railway plan Nordmaling – Ångersjö.)*

## Environmental Questions at the Construction Stage

EIA of the design plan shall of course also contain assessment of effects and impacts which activities the construction stage can involve. It is important that the effects and impacts respectively, are described so that it can be seen which are temporary and which can be expected to be of long-term duration, or permanent. Important negative impacts can be upgraded further in the design plan, adoption of decision or procurement for construction, should be included in the EIA. This can apply, for example, to surplus spoil. Responsibility for surplus spoil, and any permit application, can subsequently be made the responsibility of the contractor, by agreement.

The construction stage is of great importance, as regards how the project's actual environmental considerations will depend on **if** the environmental measures given in the design plan are carried out, and **how** they are carried out, and whether the construction is carried out in such a way that unnecessary damage does not occur. The road manager has responsibility for the environmental measures and considerations given in the design plan being included in the construction documents (VVFS 2001:18), and should therefore have routines for this.

Important questions to discuss and decide upon before the construction documents are worked out are as follows. The EIA shall give the basis for assessment of these questions.

- What environmental considerations, adjustments and environmental measures shall be carried out, including satisfying the rules for consideration?
- Which questions need to be investigated further, and what competence is required?
- Who is responsible for the measures being worked into the construction documents, the road management authority or the consultant? Where in the construction documents should certain information be given? Procurement requirements for consultant?
- Which consultations should be carried out when the construction documents are produced?
- Is there a requirement for a follow-up programme for the construction stage?

### See also

VV publ. 2001:15, Miljökrav under byggtiden [Environmental requirements during the construction period].

VV publ. 2001:105, "Vägverkets miljökrav vid upphandling av projekteringsuppdrag och entreprenader [The SNRA's environmental requirements for procurement of project assignments and contracts].

VV publ. 2000:104, Vägverkets regler för kvalitetssäkring av planerings-/projekteringsuppdrag och entreprenader [The rules of the SNRA regarding quality assurance of planning and project assignment contracts].



Many **prerequisites** concerning the construction stage are uncertain at the project stage, partly because the contractor has the opportunity of choosing how to carry out various construction activities, and most often has the responsibility for handling the materials (covering permission, where surplus spoil shall be deposited, etc.), and partly because many detailed requirements (for example, geology and areas of ground water) are not yet completely known. It is, however, important that the EIA for the design plan shall, as far as possible, assess the effects and impacts which can occur, state what needs to be investigated further in connection with the construction documents being worked out, and any cautionary measures and check measurements which need to be made during the construction stage. The EIA in the road project must also give prominence to important impacts during the construction stage, especially those which can be separated into alternatives.

**EXAMPLE**

There is a risk of lowering the ground water level in the area. The exact position of it in the area is not known – a lowering of the ground water level would mean that several smaller water catchments would be negatively affected, and hydrology in the valuable wetland negatively affected, which would involve negative impacts on natural values and the ecosystem. In connection with the construction documents being produced, further surveys should be carried out in order that the ground water level can become known. If digging work does not affect the ground water surface (i.e., is carried out above the ground water level), the negative impacts will be small.

The EIA marked area harbours natural and cultural values, and should therefore be protected from encroachment and other damage caused by such things as temporary transport roads and deposits.

**EXAMPLE**

The Lillån river contains sea trout. The excavation work can cause temporary muddying, which is not damaging for the adult trout, but could cause the roe-corn to die, and because of this almost the entire population would be eliminated if the excavation work was carried out during the spawning period. This implies serious negative impact for the natural and recreational value of the river. Proposals for further precautionary measures are that work is carried out during a certain period, alternatively, measures are taken which prevent muddying occurring, so that no negative impacts on the sea trout population occur.

## 16. General Interests which affect EIA

This Chapter gives a description of the general interests stand for, that Environmental Impact Assessments for road projects are usually tied to.

### General Interests

Environmental impacts are assigned to general interests, especially in early stages. In a road project and consideration of suitable location of a road, it is general interests that are weighed up, one against the other, the road or communication interest is weighed against other general interests. In an equivalent way, only general interests are dealt with in the weighing up which is made with the general plans, in accordance with the Planning and Building Act (PBL).

### Legislation and Municipal Planning

Most of the general interests which are normally affected in Environmental Impact Assessments for road projects are dealt with in the Environmental Code. In Chapters 3 and 4 of the Environmental Code, general interests are given in the form of national interests, which shall be taken into consideration in the event of competition involving land and water. In this are communications interests, which, a road project for example, shall satisfy.

The economic management regulations of the Environmental Code are of general character and cover large parts of the landscape to varying degrees. However, only certain areas (landmarks) are especially identified. Consideration shall be taken, irrespective of whether an area is pointed out or not. Below is given an assessment of what the most common interests are in connection with what the EIA stands for, and especially as regards national interests according to the Environmental Code.

The general plans of the municipalities are a forum for weighing up between general interests which shall subsequently be taken into account in deciding various sector interests. Questions of housing environments mainly belong in the Planning and Building Act (PBL). In the Planning and Building Act, it is stated that, in such things as planning, regulations of the Environmental Code, Chapters 3 and 4, shall be applied. Here, that which is stated in Chapter 3 can be stressed, regarding the requirement for green areas in urban areas and in the vicinity of urban areas being especially taken into account.

### The Concept of the National Interest

The fact that **agriculture and forestry** are of national interest does not imply any protection, but in Chapter 3, Section 4 of the Environmental Code, requirements are made regarding taking into account the possibilities of alternative solutions. In addition, it is stated that the purpose of requiring land which has utility value, shall be an essential community interest. Regional and local interests with regard to conservation are normally used for classifications of areas which are worth protecting, but do not in themselves imply any protection.

The National Interest: general interest in a geographical area (according to the Environmental Code) is of such strength that it can be considered to be important from a national or international perspective.

## The National Interest of Communication

The SNRA has, after consultation with the National Swedish Board of Building, Planning and Housing, identified a network of roads which have such special functions for the road transport system that the road and water areas affected by the roads are of national interest as regards communication structures in accordance with the Environmental Code, Chapter 3, Section 8. The reason for identifying this is the function, primarily, of inter-regional and other long-distance transport of people and goods.

The road and water area affected by the road network which has been identified shall be protected against measures which manifestly impede the establishment or utilisation of road construction. The SNRA considers that this means that the function of the roads shall be protected regarding the possibility of obtaining

- good transport quality and good access to other regions,
- good accessibility for all road users who travel both along the road and across it (which includes avoiding locations that would mean that the road causes increased barrier effects),
- good traffic safety.
- good environment (both from a health point of view and protection of town and countryside, and opportunities of arriving at aesthetic design).

In those cases in which the SNRA and the municipality have produced joint principles regarding how the local area should be used and designed, the SNRA considers that these guidelines constitute clarification of the function of the road, and that the economic management regulations of the Environmental Code should therefore also be applied to the vicinity of the road.

## Surveys of Valuable Areas

The county administrative boards have carried out various types of survey, with the purpose of protecting valuable areas. These can, however, not be considered to have full cover, nor be sufficient for giving consideration in connection with road planning.

What surveys there are varies somewhat between the counties. As regards natural values, the following are normally surveyed; meadows and pastureland, wetlands, deciduous woodland, grass and minerals, marsh woodland and key biotopes. The county administrative board is normally responsible for most of these surveys, but the county forestry board make surveys of marsh woodland and key biotopes.

The surveys have involved classification of valuable areas. All landmarks of a certain class in a survey have comparable value. (I.e., all deciduous woodland, Class I has a higher natural value than deciduous woodland of Class II, etc.) It is, however, not correct to compare these natural values in areas which have been given the same class in different surveys. This is because the criteria for classification have varied between surveys. Value descriptions in black and white are found in surveys and national interest assessments, etc., and say more than just classification.

## Natural Resources

Those natural resources which are basic for production, and which are often relevant to include in connection with EIA for road projects, can be assigned to the following interests:

- global effects that are important for utilisation of land and water, example through nitrogen precipitation and climate change,
- land and water for area sustenance (agriculture and forestry, commercial fishing, use of water, reindeer herding),
- water supply interests,
- materials, requirements for covering and depositing, gravel management interests,
- energy/fuel with regard to energy conservation.

## The Natural Environment

Natural environment interests refer to protection and care of values in nature and in the cultural landscape, conservation of species and a rich stock of natural environments, which make studies and understanding of nature possible.

During 2000, The Swedish National Environmental Protection Agency has carried out a survey of areas of national interest for the protection of nature. The results of this work are given on the Swedish National Environmental Protection Agency's website ([www.naturvardsverket.se](http://www.naturvardsverket.se)) under the heading "Natur och naturvård" ["Nature and the Protection of Nature"]. The county administrative board in question can give more information and a more detailed description of the delimitation of the areas which are of national interest for the protection of nature.

The main criteria for the selection of areas of national interest for the protection of nature are as follows.

- Areas with outstanding examples of landscape types or natural types or combinations of natural types which show the development of the landscape and the processes of natural development in various ecological systems especially well, both on land and in water.
- Essentially unaffected natural areas.
- Areas with rare types of nature, threatened or vulnerable biotopes and species.
- Areas with very rich flora/fauna.
- Areas with very unusual and notable characteristics.

In Chapter 3 of the Environmental Code, the following basic stipulations are made, which can be applied to the natural environment interest.

- Large land and water areas which are not affected, or are only insignificantly, affected by development companies or other incursions into the environment shall be protected as far as possible against action which can manifestly impact on the character of the area.
- Land and water areas which are especially sensitive from an ecological point of view shall be, as far as possible, protected against action which can damage the natural environment.

It can be relevant here to point out that the survey of national interests for the protection of nature in Reports 3771 and 4037 of the Swedish National Environmental Protection Agency, are no longer complete. An overhaul has been carried out by national interests for the care of nature, the results of which have included value descriptions and boundaries being changed, and addition of a large number of new national interests (788 of them).

## Outdoor activities

The interests of outdoor activities apply to protection of nature and cultural qualities for recreation and outdoor activities. Sports installations, ball game fields, paths and tracks, i.e., pure exercise interests, are also normally included in this section in the EIA.

By outdoor activities is meant being in nature for experiencing nature, physical activity and relaxation. Such things as variation in the landscape are part of essential natural qualities for outdoor activities.

The national landmarks for outdoor activities are areas which have such large outdoor activity values on account of special natural or cultural qualities and accessibility for the general public, that they are or can be attractive for visitors from the entire country or from parts of the country or from abroad.

On the Swedish National Environment Protection Agency's website ([www.naturavardsverket.se](http://www.naturavardsverket.se)), under the heading "Natur och naturvård" ["Nature and the Protection of Nature"], and in Report No. 3771 from the Swedish National Environment Protection Agency, are given the national interests for outdoor activities. The areas are described in Report 4037 from the Swedish National Environment Protection Agency. Each county administrative board can give more detailed information concerning detailed descriptions and delimitations of the areas which are of national interest for outdoor activities.

The main criteria for selection of areas of national interest for outdoor activities are as follows.

- Especially good conditions for positive experiences and for natural and cultural studies.
- Especially important conditions for hiking or long-distance skating journeys, and associated positive experience of undeveloped areas.
- Especially good conditions for wandering, cycle trips or ski trips and associated positive experience of built-up areas.
- Especially good conditions for bathing, boating sport, canoeing or skating trips and associated positive experiences.
- Especially good possibilities for hobby fishing, hunting, collecting berries and fungi, and associated positive natural experiences.

## Cultural Environment

Management of the cultural environment is nowadays guided both by cultural policy and environmental policy.

The objectives of cultural work are:

- adjustment
- the understanding of everyone, and their participation and taking of responsibility for their own cultural environment.
- national and international solidarity and respect for the cultural heritage of other groups.

In the Government Bill, **Swedish Environmental Goals – Sub-goals and Action Strategies** (Government Bill 2000/01:130), it is established that the “cultural environment and historical values” are of essential value, and shall be the basis of the sub-goals and measures required to attain the 15 environmental quality goals.

The themes for describing the cultural environment and its content of historical values are many. There are no fixed definitions. In the Government Bill, **Cultural Heritages, Cultural Environments and Cultural Landmarks** (Government Bill 1998/99:114), some of them are explained.

The **cultural heritage** consists of the traditions and values which we consciously or unconsciously acquire from earlier generations. They are both material and immaterial. Their content is open and dynamic, and is continually influenced by changing values, both through time and socially. They comprise separate cultural memories and cultural environments and artistic works, myths and customs, and are witness to the conditions of people at different periods and in different civilisations.

The **cultural environment** is the collective expression of people’s material and immaterial affects on the surrounding environment.

**Cultural environments** are areas in which there is a clear historical and geographical connection due to human influence and imprint which has formed the place and given it a meaning.

In EIA, the cultural environment shall be taken into account in the landscape as a whole, in urban areas, in areas with high natural and cultural values and in heavily developed areas. In each area type, for a cultural environment analysis, it is a question of finding out the main cultural historical themes or closely connected cultural environments, which are the basis of the identity of the place and its cultural historical value.

The **cultural environment analysis** shall be based on what today’s landscape can tell regarding how natural resources were utilised and what historical time perspective or activities have especially characterised the area. It should also be related to the type of road action in question (new location or rebuilding of existing road), and contain an assessment of how the historical values can affect the road action in question, if the road action is adjusted to the cultural environment or if it is not.

In order to make the impact assessment easier, goals can be formulated, both for which historical values should be conserved or taken care of, and which can be changed or developed, and how the road action can be combined with preserving these values. The method of work has been developed in the project **Mål och mått för natur- och kulturvärden** [**Goals and measures for natural and cultural values**]. (See *VV publ 2001:50*)

The main themes of cultural history can be both linear, as for example, a road network, delimited cultural environments, such as a parish centre, and the functional or historical connections between various cultural environments in a landscape.

Especially valuable cultural environments are characterised by:

- a coherent cultural environment,
- well preserved cultural values
- good opportunities of experiencing the area's cultural historical content

Cultural environmental values in the area of national interest are so significant that the area has few equivalents in the region, nationally or internationally.

## **Housing Environment**

The housing interest includes aspects of social character. The basis of the assessment is people, often from the perspective of those living there. Aspects of health especially can, however, be important for work place environments, schools, hospitals, day nurseries, etc. Take into consideration local activities, target points, neighbourhood/community spirit, city quarters, the character of place or village and its identity.

Here, it is intended to secure good quality for people in the built-up environment in connection with EIA for the road project. Examples of aspects which can be taken into consideration are:

- noise disturbance,
- health effects from air pollution,
- risk of health effects from accidents involving transport of dangerous goods,
- vibration,
- effects on local recreation,
- visual experience,
- barrier effects,
- effects on experience of community belonging/neighbourhood,
- changed living conditions.

## 17. Quality Assurance and Procurement of EIA

This Chapter describes what good quality is in the EIA context as regards things for which quality assurance is required, and how it is carried out. In addition, descriptions are given as to how things should be incorporated into a procurement as regards environmental questions in the road project. This Chapter is primarily intended for project managers and to support them as regards procurement.

Good quality in **EIA Work** involves:

- that EIA work shall be integrated in the planning process with a decision on confidentiality,
- that EIA work affects planning/project work,
- that EIA work contributes to a good total solution
- that points of view put forward in consultation regarding EIA shall be taken into account to a reasonable extent.

Good quality in **documented EIA** involves:

- scientifically correct, sufficient depth and broad assessment
- well founded analyses, assessments based on professional experience and good practice
- relevant and focused presentation of the most important questions
- clear, easily read and easy to grasp document, even for non-professionals
- neutral document, i.e., not angled in structure or with ornamented descriptions
- can be related to other decision-making data, i.e., comparable, so that it shall be possible to make a collective assessment of the effects of the project.

### Good Quality in EIA Work

Effective EIA work balances quality, usability and cost. Good quality should reflect professional work in conformity with rules and international practice, using relevant methods and assessment bases, etc. Specialist assessments can be important on the one hand, but on the other hand it is necessary that the work be integrated with other parts of the project development. Co-operation between technicians, practitioners, the general public, etc., and in work with studies of environment and environmental impact must be taken forward by them, in order for an integrated effect to function and for EIA as decision-making basis being experienced as usable. The costs shall, of course, be in proportion to the extent of the environmental questions and the degree of difficulty, and the importance of the decision.

### What does EIA Work Cost?

Various phases of EIA involve separate costs, which should be taken into account when estimating costs, apart from the environmental aspects that there are, and the extent of the project and its effect.

Collection of existing material, site visits and any field studies can cover a great amount of the total work. The input should not be underestimated, but at the same time, the work needs to be limited. Uncertainty can involve more work than planned.

Co-operation with consultation, and in producing data for discussions regarding scoping, etc., can in complicated cases, require extensive input.

Analysis and assessment of impacts should make up a good part of the total work input, and assessments may need to be tied in.

Regarding presentation and statement of draft and final documentation, requirement for supplementation and adjustment should be taken into account, even after presentation.



In order to keep costs down, the following points should be noted.

- Agree with other players concerning appropriate scoping of what aspects will be essential in the EIA, and the degree of detail that will be needed. (See also Chapter 7 in this Handbook on scoping.)
- Track down and re-use information/databases from earlier phases of the work.
- Keep down the extent of the presentation! Write briefly and concisely! Correctly used, one picture/map can, “say more than a thousand words”.
- Ensure that the EIA for the design plan can be used for other review to the greatest possible extent.

## **Procurement of EIA**

When an EIA is to be put together by a consultant, it is of course, the procurement procedure, questionnaire data and assignment description that are the factors for the quality of EIA and the quality of the environmental adjustment of a road project. Access to qualified people to carry this out is a prerequisite. EIA is often procured together with road project and design plan. This should promote integrated work, but should not mean that the EIA part of the assignment is treated in too abbreviated a way. Special requirements regarding competence should have been discussed in early consultation during the initial study stage, and should be stated in the questionnaire. The consultant should state whether he or she lacks any competence required in the questionnaire and should specify sub-consultants. The consultant must, however, have competence to discover requirement for special expertise which was not foreseen earlier. The road project or traffic project and its environmental prerequisites must be assessed as completely as possible, with the help of such things as the initial study, in order that the consultant will be able assess competence for an EIA assignment. The ability to increase the competence and assignment must be clarified. The road manager must also assess the expected result of the assignment, as fully as possible. Special requirements and work in the form of particular methods, aids, calculation models, field surveys, co-operation in consultation concerning particular illustrations, etc., and involving content, degree of detail and extent of the presentation.

It can also be necessary to define target groups. Is there a great deal of interest from the general public and from politicians? Will the governmental review be carried out according to Chapter 17 of the Environmental Code. Such a review, as with re-examination of the design plan and the governmental review, in those cases in which the SNRA and the county administrative board have different opinions, together with consideration by the environmental court can involve extra stringent requirements concerning clarity and information for someone who does not know about the case and has no knowledge of the area affected. It is appropriate for those carrying out EIA assignments that require several areas of competence, to have an EIA co-ordinator

The transfer of knowledge between consultants at different stages, and between consultants and principals, imposes stringent requirements concerning documentation. Data and work material which are not used in the statement are important for several reasons. It can also involve listing personal contacts and people who have given information. This must be included in the assignment description. The material that the consultant receives (including information on earlier consultants/competence), and what he/she shall deliver, must be clarified. It can be necessary for consultants involved in the present stage to meet those who were involved with the earlier stage.

With regard to impacts assumed to be difficult to assess, it is valuable if the principal can state whether there is a possibility of tying it to expert knowledge as regards the county administrative board, and possibly of the municipality, of choice of methods and principles for evaluation of impacts and assessments of any damage, etc.

The questionnaire on assignment of EIA should contain information on such things as:

- how the EIA work is integrated into the planning process,
- target groups for EIA documents,
- which data is provided by the orderer,
- which contacts shall be made for collecting facts,
- participation in consultation, number of consultative meetings,
- how information can be fed back from earlier stages,
- Geographical scoping, decided upon,
- Scoping of the assignment, decided upon, for example, as regards the number of alternatives which are to be studied,
- what environmental qualities, interests and problems are especially important and may require special expertise,
- what types of survey and field studies shall be carried out,
- Whether supplementary surveys are to be carried out, and what type of expertise will carry them out,
- how the EIA shall be presented, and what documentation shall be delivered, at what times, maximisation of extent,
- Time factors, for example, important deadlines and how the planning of the project is getting on.

## Review of EIA Document

Various kinds of review of EIA are a method of ensuring **objectivity**, and other properties, which are important for good quality.

The following appraisals are carried out (given in chronological order).

- Appraisal in the form of internal monitoring by those responsible for preparing the EIA.
- Appraisal of reception check.
- Appraisal by county administrative board (and municipality) prior to approval.
- Public appraisal by the general public, organisations, other authorities.
- Appraisal by decision-making authority prior to decision.

The county administrative board assesses whether the EIA is of sufficiently good quality as regards content and extent, and whether it has been prepared with a satisfactory work procedure and with integrated planning/project work. The approval of the county administrative board can apply to methods, but not to conclusions or evaluating assessments, and neither to the degree to which the characteristics and impacts of the project are acceptable. Standpoints view regarding conclusions of value type and on further environmental adjustment and environmental measures that are required, etc., can be raised by the county administrative board and municipality in their observations concerning the road project and the design plan in its entirety.

Appraisal of EIA prior to approval is presumed to cover it completely and elucidate strengths and weaknesses. Those carrying out the appraisal shall primarily demonstrate whether all relevant questions have been dealt with, show that the EIA focuses on the most important questions, and reveal weaknesses of content. As regards the actual content, the reasonableness of assertions and conclusions are appraised, as are ease to understand, openness, transparency and logic of presentation.

## The Road Manager's Quality Assurance

The regulations of the SNRA concerning EIA, etc., VVFS 2001:18 gives requirements concerning EIA being quality-assured by the road manager before it is given to the county administrative board for approval.

On the following pages, a template is given, which can be used to document quality review of EIA (which applies both to EIA work and the EIA document), and also a reminder list of the requirements stipulated in VVFS 2001:18 and in the Environmental Code concerning the actual EIA report.

Note that different people with the road management body can inspect and sign different items on the list, for example, the project manager, EIA expert, etc.

With respect to statement, see the reminder list of requirements in accordance with VVFS and MB on the next page.

<b>Quality Assurance of EIA by the Road Manager, in accordance with VVFS 2001:18</b>	
<p>By means of monitoring, it shall be ensured that the EIA, together with other project documents gives the reviewing authority the required guidance.</p>	
<p><b>Question</b></p> <p>1. Does the EIA give guidance as regards choice of environmentally sound solutions, and contribute to the environmental goals being fulfilled?</p> <p>Comments:</p> <p>2. Does the EIA give guidance as regards understanding what the important environmental conditions are, and the important environmental impacts are?</p> <p>Comments:</p> <p>3. Does the EIA give guidance as regards presentation and comparison of all relevant alternatives?</p> <p>Comments:</p> <p>4. Does the EIA give guidance as regards how the rules for consideration and environmental quality norms have been satisfied, in accordance with Chapters 2 and 5 of the Environmental Code?</p> <p>Comments:</p> <p>Rules for consideration:            Burden of proof of the road manager            The required knowledge            The principle of caution            The location principle            Economic management and cycle principles            The product selection principle            Responsibility to rectify damage            The stop rule for damage or inconvenience of essential importance</p> <p style="text-align: right;">Environmental quality norms:            NO<sub>x</sub>, SO<sub>2</sub>, lead, particulates (PM10)</p> <p style="text-align: right;">Limit values:            Guide values</p> <p>5. Work with the EIA, and that it has been carried out in accordance with current regulations, work procedures</p> <p>Comments:</p>	<p><b>Signature, Inspector</b></p>

## Reminder list for quality appraisal of EIA statement

Comment on each respective item below (statement requirements in accordance with FFVS 2001:18 and Environmental Code).

### **Non-technical summary**

#### **Road Project**

- Purpose, requirement, connection with other projects and conformity with .....
- Where, how, when? What – activity/measure?
- How have alternative solutions to the problem been handled? Reasons for alternatives. What does the do-nothing alternative involve?

#### **Reasons for scoping**

- Is it evident what is expected as regards being substantial effects/impacts?

**Existing environmental qualities**, use of land and traffic conditions. (Can be dealt with together with assessment of impacts).

- What happens, impacts on if the project does not materialise?

#### **Expected direct and indirect environmental effects and environmental impacts**

- How various interests are affected by such things as the requirements in Chapters 3 and 4 of the Environmental Code.
- Main effects on human health, the environment and economic management of land and water and other resources which the activities or measures can be expected to involve, also as regards the construction stage.
- Also include existing roads in those cases in which there is new road construction.
- Improvement alternatives shall be included unless there are special reasons for not including such alternatives.

#### **Mitigation measures**

- Assumptions on measures that will be included in impact assessment.
- Comparative assessment of alternative or supplementary measures, effect-cost.

#### **Methods, uncertainties, sources of information**

##### **Contributing expertise**

**Have EIA questions been dealt with in earlier consultations?**

**Can EIA (part of) be used for reviewing hydrologic operations** if supplemented with more detailed technical descriptions of detailed planning?

#### **Especially for EIA in Feasibility study**

- environmental considerations in the identification of road corridors
- comparative assessment of alternative road corridors
- possibilities of solving any conflicts, preventing damage, improving the environment at a later stage
- important prerequisites for environmental adjustment of the extent and form of the road in continued design

#### **Especially for EIA in design plan**

- how the EIA work has affected the road design
- environmental impacts of the selected design and supplementary measures which can be especially motivated
- requirement for follow-up, proposals for any follow-up programme

## 18. Interplay and Roles in EIA Work

This Chapter describes in summary the interplay, both between the different players in a road project as a whole, and within the work group which produces the EIA.

### Interplay between EIA and Other Studies

All competence involved in the planning and project work of road and traffic measures shall contribute to a good total solution as regards the purpose of the project and characteristics of the place (or alternatively, places). The requirement for competence is guided by the character of the project and the characteristics of the place.

Using environmental competence and work with the EIA, knowledge and other studies with their competence are added, together and vice versa. Geological, hydrological and climatic knowledge of the landscape can be required, both for preparatory engineering work and for environmental analyses.

The engineer focuses on the solutions for the primary function, the use of the structure, while those who work with the environmental impact analysis work on the basis of that which is happening at the place and its surroundings. But, work with EIA and other impact assessments shall not be considered to be defensive. The structure must function for its surroundings as well!

By drawing up a **formulation programme**, the architectural questions concerning a road project shall be elucidated and analysed. Here, overall contexts can be put into tangible form, as for example, concerning the relationship between the road and the topography of the landscape, and also principles at a more detailed level can be formulated, for example, in the choice of material, lighting, plants, etc. Certain basic studies can be mutual for the formulation programme and EIA. During the course of the work, the formulator and the engineers respectively, can do some of the work or be involved in it, by assessing visual impacts for the surroundings as part of the EIA. Knowledge of visual effects is also required in order to assess impacts for road users. (In principle, this lies outside the EIA, however.)

When the EIA document is worked out, which solutions are proposed and which alternatives are to be compared must be clarified, i.e., principles from a possible formulation programme shall be taken into consideration.

Structural engineering studies	Road engineering studies	Environmental studies, EIA	Formation programme	Study of traffic and TS impacts	Socio-economic studies
--------------------------------	--------------------------	----------------------------	---------------------	---------------------------------	------------------------

*Interplay – work integration. In order to create a good totality of a project, co-operation is required between all competencies involved.*

The traffic-policy goals are about:

- accessibility,
- high transport quality,
- safe traffic,
- good environment,
- positive regional development,
- transport system on an equal basis.

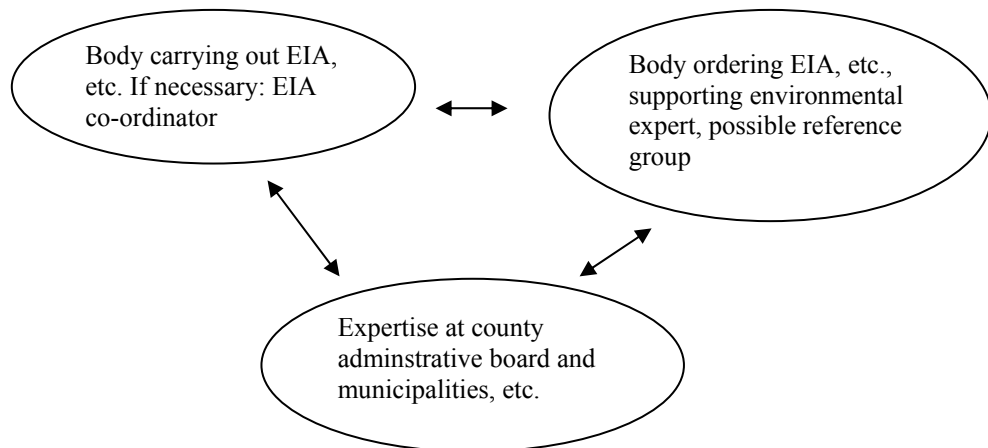
In order that a project can be environmentally sound and contribute to other traffic-policy goals, all competencies involved must enter into a discussion on the difficulties and possibilities of the place. There may be factors which can make a reasonable project impossible, these should preferably be taken up at the stage of decision making on choice of action strategy.

### Interplay in EIA Work

The importance of co-operating over competence borders cannot be stressed enough, and also for the EIA work itself. As regards larger road projects, EIA work can definitely not consist of one single competence. Several should be involved, so that everyone sees the totality and scrutinises and questions within the group. This does not prevent certain scoped sub-studies being carried out in isolation. An **EIA co-ordinator** is responsible for the totality, but must also be able to discuss and be responsible for details in the report.

It can be equally important for the road manager/principal that there is a **project group** or similar with representatives of several specialities, including EIA expertise or environmental expertise being involved as early as before procurement of those who will carry it out. The **environmental expertise of the road manager** should be able to give some support to an external person who will carry it out and, if possible, be involved in several phases. Involving the expertise of a road manager at a later follow-up is important for the transfer of knowledge. Otherwise the road manager's environmental experts contribute as a support to the road manager's project manager.

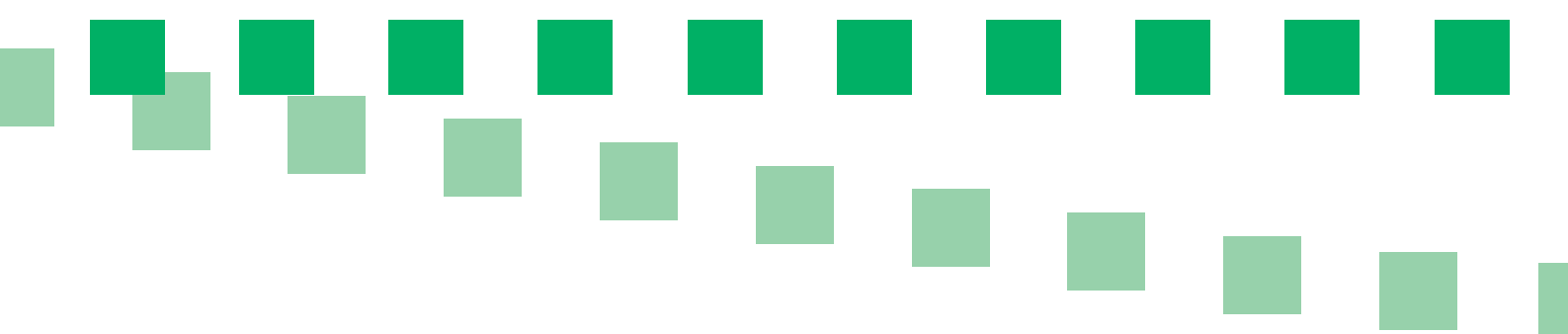
From the central SNRA, there is also expertise that has a supporting role, which in special cases, can be involved actively in an EIA operation.



*Interplay between various participants*







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P1928:46-033 E

FOREST DISTRICT

SMALL STREAM IN FOREST  
DISPERSAL CORRIDOR

DISPERSAL CORRIDORS

SMALL SCALE MOSAIC LANDSCAPE,  
RICH BIOTOPES

AGRICULTURAL LAND, SOME BIOTOPES  
VALUABLE FOR THE FAUNA

OLD AVENUE, IMPORTANT  
FOR INSECTS, BIRDS

RIVER WITH DECIDUOUS SHRUBS  
AND TREES, DISPERSAL CORRIDOR

# ASSESSMENT OF THE ECOLOGICAL EFFECTS OF ROADS AND RAILWAYS

## Recommendations for Methodology



Vägverket Swedish National Road Administration Publication No 1996:33E



BANVERKET Swedish National Rail Administration Publication No 1996:3E



P1928:96-033 E

## FOREWORD

The methodology for the assessment of ecological effects and the consequences of road and rail construction projects must be developed. The process has long been based on methods applied in the conservation planning of the National Environmental Protection Agency. Functions and relationships in the landscape have often been disregarded.

In 1994 the National Road Administration initiated development work on the assessment of ecological effects which was conducted in collaboration with the National Rail Administration and the National Environmental Protection Agency. The project manager was Inga-Maj Eriksson. The assistant project manager was Jan Skoog of the National Rail Administration. Researchers from the National University of Agricultural Sciences SLU, the Royal Institute of Technology KTH and the National Road and Transport Research Institute VTI were involved; see Publication No 1996:32 of the National Road Administration and Publication No 1996:2 of the National Rail Administration. This publication sets out recommendations regarding working procedures in assessing the ecological effects and is based on the above report. The aim of these recommendations is to ensure that the environmental impact assessments of the National Road Administration and the National Rail Administration, and environmental adaptation of the projects, meet the targets for biodiversity.

The intention is that this publication should provide support for those who are engaged on analysing and assessing the effects on nature and ecosystems, and assessing the significance and consequences, which these effects will have on biodiversity or other targets and interests. The introductory sections are also

addressed to those who are in charge of work on road and rail projects and are thus responsible for environmental impact assessments.

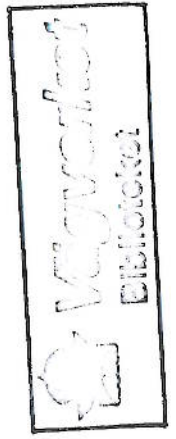
These recommendations will be instrumental in putting into effect the rule (set out e.g. in VVFS 1993:14) based on the EC Directive, which lays down that the effects on people, fauna, flora, land, water, air, climate and landscape, and the interaction between these factors etc ... shall be analysed within the framework of an environmental impact assessment. Ecological effects are to be considered in planning within the framework of the EIA, in which connection all the interests enumerated according to the Nature Conservancy Act, Decrees in pursuance of the Nature Conservancy Act, biotope protection etc shall be taken into consideration in assessing the impact. See Manual on Environmental Impact Assessments, Publication No 1996:30 of the National Road Administration.

The publication has been collated and designed by Koinberg Landscape Architects, Desirée Johansson, Architect LAR. A reference group has given its views regarding both reports.

The National Road Administration and the National Rail Administration will endeavour to ensure that this subject area is developed, so that more empirical material will become available from Sweden and our neighbours.

*National Swedish Road Administration  
Jan Brandborn*

*National Swedish Rail Administration  
Monica Andersson*



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## WHY MUST THE ECOLOGICAL RELATIONSHIPS IN THE LANDSCAPE BE ANALYSED?

In order to promote biodiversity, we must consider the ecological processes in the whole natural and cultural landscape, and not only in protected areas of limited extent. In planning roads and railways, this should take the form of rough assessments as early as during strategic planning and initial studies, and refined later.

In order to assess the ecological effects, plant and animal species must be analysed in their proper contexts and in relation to a dynamic landscape, a landscape that changes over time and is dependent on flows of water, air, materials and nutrients.

### ECOLOGICAL INFRASTRUCTURE

Many species are dependent on a number of different environments and need the ability to move between different parts of the landscape, inside a web. For roe deer, for instance, it is important that they should be able to move between the forest, meadows and watercourses.

It is the *ecological infrastructure* that creates the conditions for biodiversity, in the same way as technical infrastructure creates the conditions for trade, business and welfare. Inter alia, ecological infrastructure makes it possible for species, individuals and thus genetic material to move about in the landscape.

*Human technical infrastructure* often comes into conflict with ecological infrastructure. Roads and railways as such do not occupy particularly large areas, but they form long barriers which cut off movement, and traffic creates disturbances for animals and plants.

It is important that the ecological infrastructure and the technical infrastructure created by Man should work well together. In order that this may be realised, we need more knowledge of, and better consideration for, the ecological relationships in the landscape.



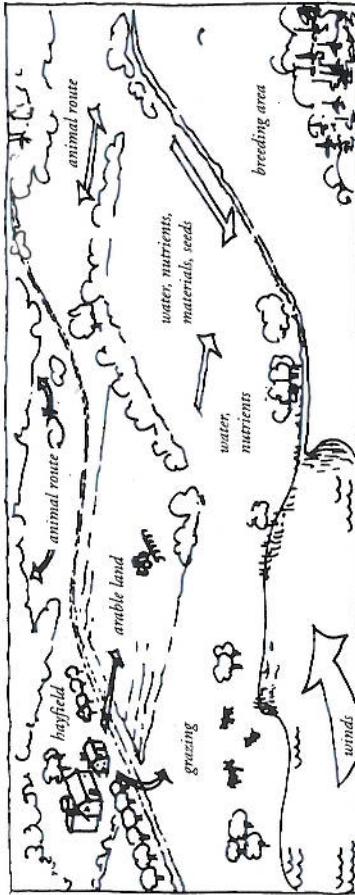


## HOW DOES THE LANDSCAPE FUNCTION?

### ARRANGEMENT AND DEVELOPMENT

It is the bedrock, soils, climate, availability of water and topography which create the conditions and limitations for the landscape. These components are abiotic (non-living). The biotic components are plants and animals. Together they form an ecosystem such as deciduous or coniferous forests, cultivated landscapes, etc.

Ecosystems may contain different biotopes, i.e. spatially separate areas which have a characteristic environment with regard to soil, vegetation and fauna. Biotopes are a concept which are usually defined from a human perspective. Biotopes may be meadows, rivers with riverbank vegetation, groves, etc. The different parts of the landscape are all the time influencing one another by exchanging species, water, nutrients, etc.



Examples of functions and relationships in the landscape

Most of the landscape is affected by Man to a greater or lesser extent. Activities needing large areas and exploitation have profoundly changed the landscape. Reclamation and ditching of the land for agriculture and rational large scale forestry have caused impoverishment of species diversity in large parts of the landscape. Other cultivation-dependent biotopes such as meadows and enclosed

pastures are dependent on human activity for retaining their species diversity. The supply and leakage of nutrients affect large areas.

The landscape is in constant change. Over a long perspective, glaciation modifies and transforms the landscape. Elevation of land, natural climatic changes and overgrowth of lakes are factors which work over centuries. Forest fires and uprooting of trees by storms are natural causes of forest rejuvenation. More recently, it is human influence on the landscape which has caused the greatest changes. Development tendencies, differing from landscape to landscape, can be discerned.

Many ecosystems need a long time to become established. In order that areas resembling ancient forest should be formed, with e.g. the insect fauna that is dependent on old dead trees, several centuries of undisturbed development is needed.

### SPECIES AND POPULATIONS

Ecosystems are made up of the organisms which they contain and their interactions with their surroundings. Ecosystems undergo different succession stages. Certain species, pioneer species, first colonise new areas, others take over later on and build up more stable and complicated ecosystems.

*Generalists* can live in many different environments. They often disperse easily and it is they who first colonise new areas. Among plants, birch and aspen are examples of generalists. Among animals, the badger is a generalist; it thrives both in nature and in urban environments.

Other species, *specialists*, require special conditions and ecosystems to thrive. Specialists are more sensitive to changes in their environment. One prominent specialist among plants is *Geranium lanuginosum* whose seed must be heated before it germinates (it is thus dependent on forest fires). As a rule, our unusual and threatened species are to be found among the specialists.

*Key species* are species which are of great significance for ecosystems. Examples of key species are old oak trees which may be necessary as biotopes for certain insects, or woodpeckers which drill holes that can be used by other birds which live in holes. *Indicator species* have special demands on the environment and can therefore provide information on conditions in the environment such as the supply of nutrients, earlier land utilisation, etc. Communities which are spatially or temporally isolated from other similar groups form *populations*. Species which are tied to specific biotopes are often scattered in the landscape. Other species may have a more contiguous dispersal.



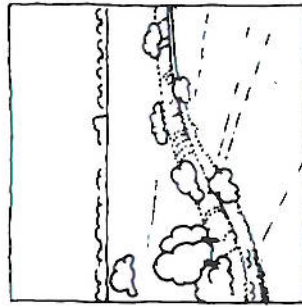
### FUNCTIONS AND RELATIONSHIPS

Biotopes are of different significance depending on the function(s) which they have for the species in the landscape. Plants may be entirely dependent on the hydrological relationship between a biotope and a water conducting part of the landscape.

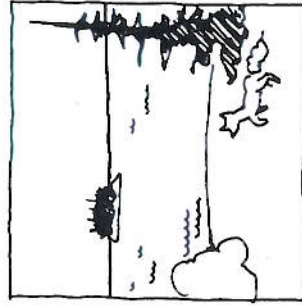
Animals must be able to find suitable biotopes for feeding, for rest and reproduction, and must be able to move between these environments. These movements take place daily or seasonally.

Contacts between different populations reduce the risk of local extinction. Facilities for movement also increase the chances of survival when the environment changes, for instance when there is a shortage of food.

Natural dispersal corridors and also natural barriers often form prominent structures in the landscape. Small watercourses such as streams and rivulets are often important dispersal corridors, while larger watercourses may also act as barriers.



Small watercourses can act as dispersal corridors



... larger watercourses may form barriers

### BIODIVERSITY

The term biodiversity denotes the variety of all living things. The most evident are the differences between different species. Within a species also there may be great variation. This is *genetic variation*. This is important, for instance with regard to the ability of the species to adapt to changed environmental conditions. There is also diversity at a third level, namely within and between the different *ecosystems* and all the structures, relationships and processes which form these systems.

### CONSERVATION OF THE DIVERSITY

In December 1992, as a result of the UN Conference in Rio, the convention on biodiversity was drawn up and signed by 167 countries and the European Union. This is the most comprehensive international treaty ever. The countries which are signatories to the convention, among them Sweden, undertake to draw up plans and action programmes (e.g. work on Agenda 21) with a view to conserving biodiversity.

The Environmental Bill adopted by the Swedish Parliament in 1991 states that .... land and water shall be used in a way that makes it possible for a rich variety of types of nature, biotopes and species to be retained and for naturally occurring species to be conserved in viable populations.

### THREATS

Biodiversity has never been static. Species and ecosystems undergo a constant slow development independent of human action. New species form and others die out. Over the past centuries, however, there has been very rapid extinction of species, due entirely to human action. Predatory hunting of animals, loss of biotopes due to agriculture, forestry and exploitation, and the discharge of environmental poisons, has reduced biodiversity. The construction of large roads and railways, and the disruption caused by these, also contributes to impoverishment.

Conservation of the biodiversity of today, everywhere and in an unaltered state, is not possible. But the impact on biodiversity can be reduced, and the effects of exploitation can be alleviated. In order that this may be done, it is necessary to identify and assess ecological effects and their consequences.



## ECOLOGICAL EFFECTS OF ROADS/RAILWAYS

Roads and railways modify the ecology of the landscape in many different ways. If the new road causes an increase in traffic, this contributes to a rise in the general background load on the environment, such as nitrogen and ground level ozone. This diffuse large scale impact of traffic is not dealt with here. The effects of secondary exploitation due to investments in infrastructure must naturally be noted, but these also are not treated here.

Construction causes encroachment due to the use of land and also materials. Plants are destroyed or damaged, in some cases even outside the construction area itself. Transport to and from the site causes disturbance. The road or railway itself, with traffic, operation and maintenance, then makes a continuous impact on the landscape. The intensity of this impact depends on traffic density, kind of traffic, the layout of the road/railway, where it is situated in the landscape, etc. Emissions by traffic affect the environment locally through noise, dust, salt and nutrients.

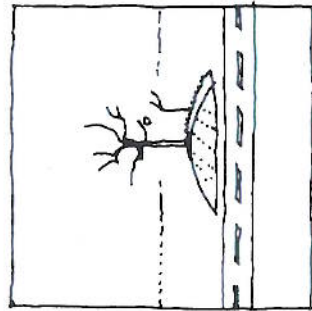
### LOCAL EFFECTS

The local effects chiefly involve the species which use the areas near the road. These effects are mainly

- biotope losses/changes
- barrier effects
- corridor effects
- disturbances
- fatalities caused by traffic.

### BIOTOPE LOSSES/CHANGES

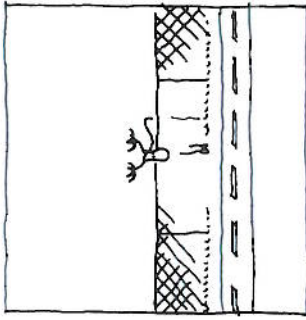
Biotope losses and changes occur when new installations make use of natural ground. Natural ground outside the actual road area can also be damaged during the construction period, because changed hydrological conditions in the ground affect vegetation, or because the local climate changes. New biotopes form along the verges of



the road or the tracks. Normally, these mostly favour generalists among animals and plants. Verges may serve as important residual biotopes in the cultivated landscape.

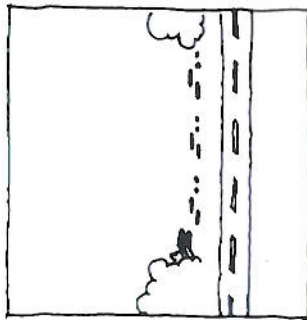
### BARRIER EFFECT

Roads and railways cut through the ecological infrastructure and act as barriers. The barrier effect depends on traffic volume, road width, surfacing, the contrast between verge vegetation and the surroundings, but also on the behaviour, size etc of the different species. The barrier effect may be absolute, i.e. it may completely separate populations, or relative, i.e. single animals may cross. Fenced motorways are normally absolute barriers for large terrestrial mammals, while smaller roads may be absolute barriers for small animals.



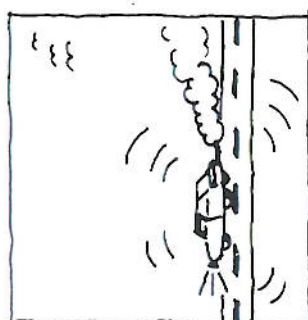
### CORRIDOR EFFECT

Verges may also serve as dispersal corridors. The way dispersal can take place is through vehicles or trains carrying seeds or small animals, or through mammals following the verges in order to move quickly. The corridor effect may be important when the verges form a contrast to a surrounding homogeneous landscape, for instance an agricultural landscape.



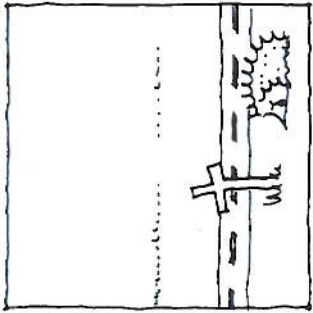
### DISTURBANCES

Roads and railways affect adjacent nature by changes in groundwater levels, sharp temperature alterations, exhaust gases, salts and other chemical compounds, noise, light, increased human activity, etc. The disturbance effect on animal life and vegetation is at times pronounced. It has been found that the concentration of heavy metals in vegetation near the road may be so large that it is a threat to herbivorous birds and mammals, which may pose an even greater danger to predators since





the poisons accumulate higher up in the food chain. Noise and human activity may have a disturbing effect on animals. Breeding and reproductive success among birds living in open country may be affected at distances exceeding one kilometre from motorways. Many disturbing effects at first decrease rapidly with distance from the road, but the rate of decrease then flattens out.



#### FATALITIES DUE TO TRAFFIC

Many animals are killed on roads. Toads, hedgehogs, badgers and larger predators are among those most exposed. Accidents to elk, roe deer and reindeer have to some extent been prevented by setting up fences.

#### EFFECTS AT LANDSCAPE LEVEL

Local effects mainly describe the effects of a single road or rail project. An assessment of how the *infrastructure network* of roads and railways affects the landscape requires studies at landscape level over large areas and long periods. The most important effect at this level is *fragmentation*. Fragmentation of biotopes is caused by the loss and splitting up of habitats. The remaining environments deteriorate, and this causes stress for many species. The consequences are more difficult to localise, and they may also extend over long distances in the landscape. The ecological infrastructure in the landscape is weakened, and this may give rise to loss of biodiversity.

The effect of infrastructure fragmentation mainly depends on the size of the different fragments and the effectiveness of the barriers. For most of the larger animal species in Sweden, the smaller unfenced roads do not presumably pose any danger. On the other hand, the increasing network of fenced infrastructure installations may be significant with regard to the long term survival of animals.

The species which are particularly sensitive to the *fragmentation effects* of roads are those which have very special requirements on biotopes (specialists) and need large areas. Animals which are exposed to traffic fatalities and the barrier effect of roads are susceptible, as are those species which occur sparsely and have few young every year. Among the exposed species are predators such as wolves, lynx, badger and otter, hedgehogs, many amphibians and several forest birds.





## ANALYSIS OF THE ECOLOGICAL RELATIONSHIPS IN THE LANDSCAPE

Traditionally, nature conservation has concentrated on the preservation of individual natural elements, species or areas of limited size in the landscape which have high ecological qualities. However, the functions and processes which are important for the conservation of ecosystems and biotopes are not limited geographically to single areas, but take place in the entire landscape.

Not all well functioning ecosystems be very small; a reasonable ecological capacity demands e.g. a certain area. It is in addition necessary for all *functions* to be provided for, especially for animal species in the form of places for food, reproduction, rest and movement routes. The legal protection of certain biotopes in the Nature Conservancy Decree, and the sections of the Natural Resources

Act which deal with areas of special ecological sensitivity and large unaffected areas, are an expression of the fact that society has taken note of functional and capacity issues.

The criteria for ecological potential are as follows:

- QUALITY (biodiversity, rarity, etc)
- CAPACITY (ability to accommodate populations etc)
- FUNCTION (dispersal corridors, reproduction areas, etc)

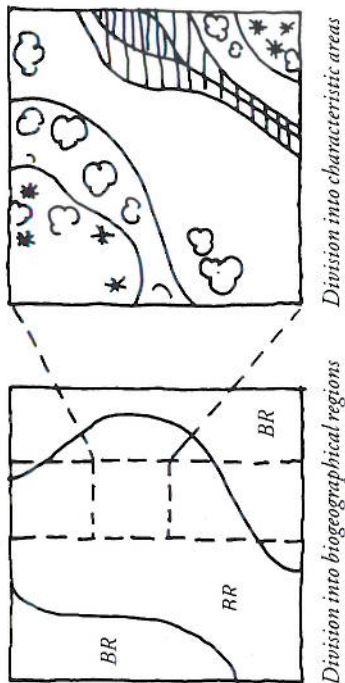
This publication takes special note of the impact on functions and capacity as an important basis for the assessment of damage and consequences in conjunction with the planning of roads and railways.

Assessment of the ecological infrastructure should form part of environmental impact assessments (EIA) in the *entire* planning process, ranging from a rough assessment of landscape structures in strategic planning and in the initial study, to accurate analyses of the structures of ecosystems in the road/railway feasibility study and during design.

Maps and existing knowledge base are mainly used in the initial study, while at the route location stage and during design field studies are necessary.

## SURVEY

A hierarchical approach is employed. The point of departure is the biogeographical region of the area (according to the classification of the Nordic Council of Ministers). The area is then divided into characteristic areas such as forest areas, mosaic areas, open ground, wetland or built-up areas.



The existing knowledge base is collected through maps and information from county administrative boards and municipalities. Local nature conservancy associations, game management associations or ornithological associations may have additional knowledge.

In order to arrive at the ecological infrastructure of the landscape, *functions and relationships* must also be studied. Where are breeding sites, nesting sites and important vegetation areas? What other areas in the landscape are these sites associated with? How do animals move about in the area? What is the water flow pattern? What changes in local climate may be expected due to encroachment in the landscape? The analysis of functions concentrates on finding those systems in the landscape which are needed in order that exchange of materials, species and genes may take place.

Using aerial photographs, a large proportion of vegetation and ground conditions can be interpreted. For instance, many deciduous tree species can be distinguished on infrared photographs. Lists of plant communities which are worthy or probably worthy of conservation are given in e.g. Publication No 1996:32 of the National Road Administration and 1996:2 of the National Rail Administration. After supplementary field studies, landscape units, ecosystems and biotopes can be defined.



### ANALYSIS AND ASSESSMENT OF EFFECTS

Ecological effects bring about important changes in ecological potential. It is appropriate to make a simplified assessment of ecological effects in this context by studying how the ecological infrastructure is affected by the road or rail installation.

In order to assess the effects, both a *biotope perspective* and a *species perspective* are needed.

### BIOTOPE PERSPECTIVE

The effects depend on the *function* of the biotopes in the landscape. The functions may have a greater significance in a landscape where the biotope is rare than where it is common. The assessment can thus vary depending on which geographical region the landscape is situated in.

Interpretation of relationships imposes demands on the experience of the surveyor as regards knowledge of the hydrology and local climate of the landscape and the way animals move about in the landscape, etc. Preliminary interpretation of relationships and functions in the landscape from maps and aerial photographs should be checked in the field.

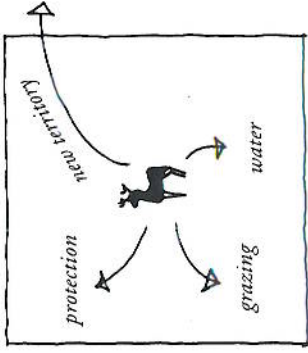
Linear elements such as bush and tree shelterbelts, watercourses, boundaries and sometimes also verges are important as biotopes and for the movement of animals, as are projecting fingers of woodland in the landscape, narrow areas of marshland, etc. For migrating birds, guidance features in the landscape such as coastlines or valleys are often of great value. Scattered biotopes such as clumps of trees in fields may be important for e.g. birds. In a mosaic landscape movements may be concentrated to such biotopes. The significance which these biotopes have depends on their size, shape, number, content and age, and the way they contrast with their surroundings.

### SPECIES PERSPECTIVE

A species perspective can be applied when representative or interesting species can be selected, and information is available or can be obtained regarding these. The effects on individual selected plant or animal species, and the way they react to the road/rail installation, are assessed from the species perspective.

Detailed knowledge is needed concerning the ecology of the various species and the demands they make on the environment. Factors which should be studied are reproduction, dispersal, population sizes, etc. Since these factors vary between species, it is difficult to lay down general rules as to how these studies should be made.

In order to limit the task, it may be appropriate to select some species; indicator species or species which are dependent on the functions of interest in the landscape (e.g. elk which are dependent on migration routes), or species which are desirable or worthy of conservation (e.g. threatened species). Fragmentation and stress effects can be assessed by studying species which are susceptible to such effects.



### EFFECTS IN DIFFERENT LANDSCAPE TYPES

The ecological functions in the landscape are affected in different ways in different landscape types. In a forest landscape it is mainly changes in microclimatic factors, new margins and verge biotopes with new alien species, which affect the ecosystem. In wetlands, chemical loading, noise and light can be spread over large areas. What is important is that hydrological conditions can be affected by the road or railway.

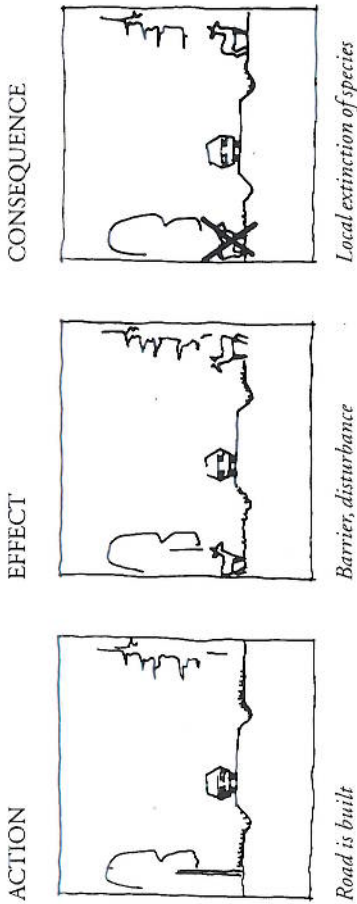
In an agricultural landscape, attention should be paid to particularly valuable meadow and pasture lands. These often shelter a large number of threatened species. As a rule, intensively cultivated areas in which arable land predominates contain few natural biotopes. These are however important for the fauna and flora which there is. In such areas roads and railways can be used to build up new structures, with bush and tree shelterbelts that can improve dispersal facilities between biotopes. Agricultural land can also be affected by barriers inasmuch as open land is cut off from the centre of cultivation and is therefore unprofitable to work, with overgrowth as a consequence.

### WHAT ARE THE CONSEQUENCES OF THE EFFECTS?

Broadly speaking, assessment of the consequences implies putting a value on the significance which the effects may have for an interest or societal target such as nature conservation or biodiversity.



Evaluation should be made for each case individually, and should be registered with the person in the county administrative board or municipality who represents this interest.



#### THE IMPACT ON DIFFERENT SPECIES

Depending on the perspective chosen, there is a lot of difference in the impact caused. A glade may for instance serve as the habitat for a whole population of ground living insects, while for badgers it is only a part of their feeding area. Construction of a road through a forest biotope probably has no major impact on the survival of insects even if the road is an absolute barrier, since the remaining biotopes are sufficiently large for the populations. For badgers, on the other hand, the increased risk of being killed and the reduction in the supply of food may threaten the local survival of the species.

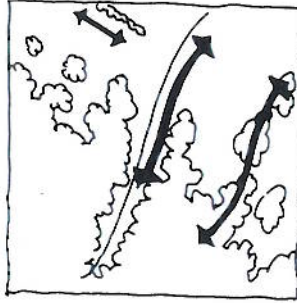
#### THE IMPACT IN DIFFERENT LANDSCAPE TYPES

It may at times be difficult to judge where the barrier effect will have the greatest impact. In a feasibility study, two railway or road alternatives will perhaps pass through two different landscape types. One goes through a mosaic landscape where the linear elements clearly show where the animal routes are located, while the other alternative passes through a fairly homogeneous forest terrain where the movements of animals may be assumed to be more diffuse and dispersed. In the former example, obvious and localised barrier effects can be discerned. In the second, the barrier effect appears less serious since there are no evident routes for the movement of animals. In reality, the barrier effect may

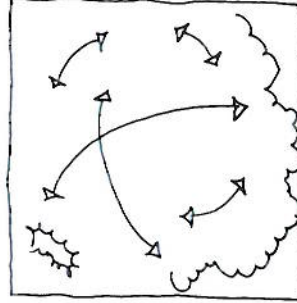
be equally pronounced in both landscapes.

In assessing the different cases, a species perspective may prove helpful. In studies of e.g. roe deer it is seen that these often move between open ground and woodland, graze in the fields and seek shelter in the forest. A railway which cuts the routes in two would therefore have a greater impact than one passing through the forest. Studies of gamebirds would perhaps give a different answer. In such a case evaluation of the conservation value of the different species, their frequencies in the area etc would govern the final assessments.

Even if the conclusion in an initial assessment is that the forest alternative is preferable, the feasibility of taking action may point towards the mosaic landscape - here it is easier to identify the animal routes and, in specific strategic positions, to locate the railway on a bridge instead of an embankment across the valley.



*In a mosaic landscape the movements of animals may be concentrated*



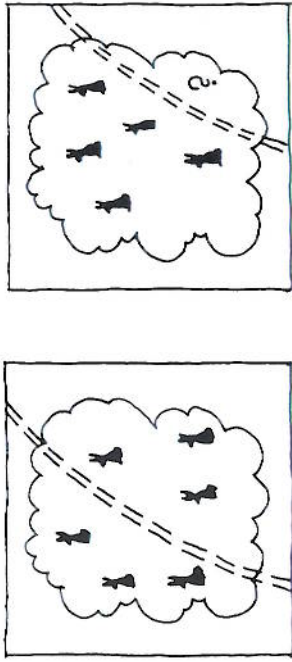
*While in a homogeneous landscape they may be more diffuse*

Even within the same landscape type such as woodland, the consequences due to the choice of location may vary, and these must be balanced against one another. Will the impact of the barrier and disturbance effects be greatest if a forest is cut into two equal parts, each of which can presumably support viable populations? Or is it wiser to leave most of the forest untouched and to 'sacrifice' a narrow strip along its edge where the fauna may perhaps be allowed to have worse living conditions? A species perspective may in this case also be helpful in showing the impact on different species.

### THE CONSEQUENCES OF DIFFERENT EFFECTS

The design chosen can also give rise to different effects. A road may act as a barrier for the flow of surface and groundwater which will affect vegetation.

One way of reducing this barrier is to raise the road so that water can flow through the embankment. But this increases the barrier effect for animals. The different effects and their impact must be weighed up against one another.



*The choice of route alters the living conditions for animals*

### HOW TO MANAGE UNCERTAINTIES?

The demand for certainty increases as planning proceeds. In the initial study or the strategic EIA it is possible to point out what are the risks and what should be investigated further. In choosing between alternatives and when measures are decided on, the greatest possible certainty is looked for. Is the impact going to be serious? Is a crossing needed?

Studies of different species may give answers which point in different directions. It may be possible to establish that there will be a barrier effect, but not the seriousness of its impact or how it will vary for different routes. These uncertainties must be pointed out in the analyses.

Methods of analysing functions in the landscape are under development. Monitoring of effects and measures will in time give rise to better methods which may in turn provide a better basis for decisions.

### WHO PERFORMS THE ANALYSIS AND HOW LONG DOES IT TAKE?

The survey and analysis should be carried out together with the other elements of a landscape analysis which contains aspects other than ecological ones. Assessment of effects and consequences requires a separate working stage.

The time taken, especially by a route feasibility study stage, depends on what existing information is available.

Assessment of the ecological infrastructure is necessary so that any damage to the natural environment may be predicted and prevented. The survey and analysis do not take longer than traditional nature survey, but they demand greater knowledge. A biologist/ecologist who has good knowledge of landscape and ecology should be attached to work on the environmental impact analysis in cases where the ecological effects are judged to be important.



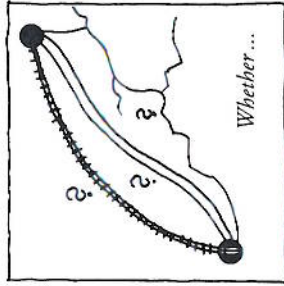
# ANALYSIS AT THREE LEVELS

## INITIAL STUDY\*

(whether the road/railway shall be built)

At this outline level, all the parties must form an idea of the conflicts that are associated with a possible project. The initial study will produce the terms of reference for work on the EIA. The goals for the landscape at national, regional or local level must be ascertained and applied in formulating the project-specific goals and in assessing the consequences.

The appropriate map scale depends on the scope of the project and its position in the country. It may vary between 1:100,000 and 1:10,000. Use must be made of the existing knowledge base such as nature conservancy plans, previous investigations/analyses, maps and aerial photographs. A preliminary subdivision is made into landscape types. A rough assessment of effects is made, in the first place at landscape level.



**The most important questions which must be answered are:**

- Can the landscape accommodate structures and functions which are particularly important for biodiversity?
- Are the functions susceptible to disturbance?
- How has previous development affected biodiversity?
- What development trends can be discerned in the landscape?
- How will a new installation affect these trends?
- Are conflicts to be expected if a road/railway is constructed?
- Can a new installation be compatible with the specified goals?
- May it be assumed that extensive measures will be needed to reduce the ecological impact?

At this level, it is especially important to identify conceivable barrier and fragmentation effects, since these can only be wholly prevented if the landscape is left completely untouched.

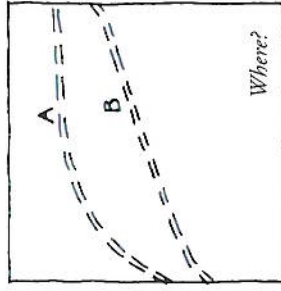
The initial study in road planning should result in indicating an area where the possible routes of the road must later be investigated and studied. Initial

studies for a railway will point to possible alternative routes. The results of the initial study must also indicate what is important and what the environmental impact assessment should concentrate on. In a predominantly agricultural landscape the existing ecological infrastructure may be relatively easy to chart. The analyses can then concentrate on e.g. how the ecological functions in the landscape can be improved. In a mosaic landscape with dispersed valuable biotopes it may be more difficult to identify e.g. dispersal corridors. In such a case extensive field surveys may be needed at a later stage to elucidate the functions of the landscape.

## ROAD/RAIL FEASIBILITY STUDY

(where shall the road/railway be located?)

The EIA at the route location stage must provide a basis for a decision regarding the route which must be designed. This work is based on the initial study which gave an indication of the size of the area which should be investigated. The actual influence area depends on the size of the area over which the effects extend. Depending on what the landscape is like, the fragmentation effects will be different in different areas. In open ground, for instance, noise and light pollution extend over a greater distance than in woodland. A road/rail route location survey can be made at different scales, 1:50,000, 1:10,000 or if necessary larger. The information provided by the initial study is supplemented by outline field studies.



**The following questions should be answered:**

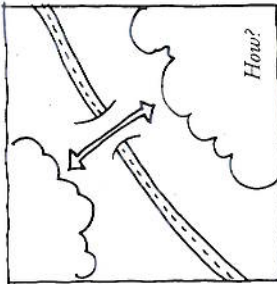
- What is the ecological infrastructure like?
- Which functions in the landscape are significant for biodiversity?
- Which functions are susceptible to disturbance?
- What is the ecological impact of the different alternatives?
- Can preventive/compensatory measures solve or mitigate the problems in the different alternatives? (e.g. animal crossings)

In this connection it is important to identify the effects which can be avoided by correct location of the road. These effects are mainly loss of, and changes to,



biotopes and disturbances. The barrier effect may have an impact on local populations and can at times be modified by the choice of route. In other cases the different options only shift the problem to another location.

In the road/rail route feasibility study attention must also be paid to the risk of ecological damage during construction, for instance if it takes place in sensitive water areas.



#### DETAILED DESIGN

(how is the road/railway to be built)

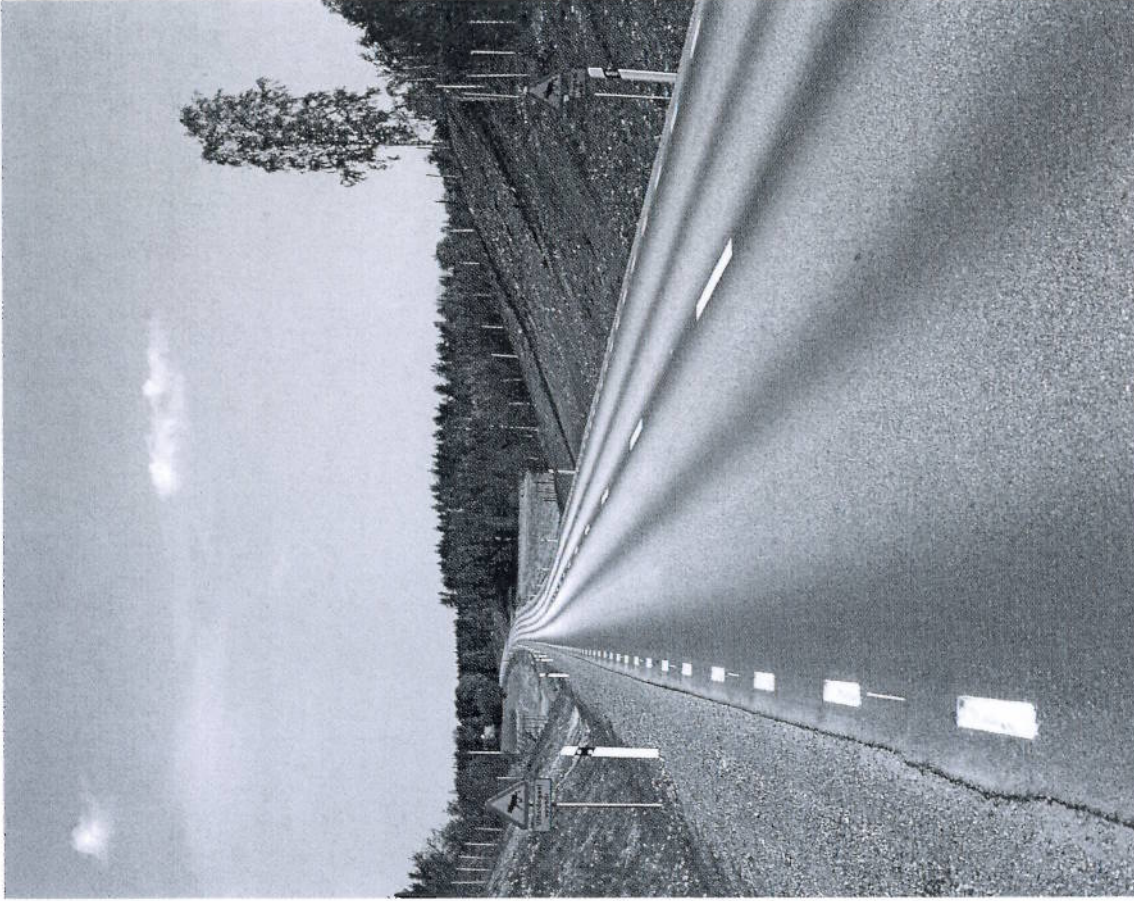
During design, the landscape analysis and the assessment of effects and consequences must form the basis for an *environmentally adapted design*. These measures must be seen as a complement to the judgments made in the earlier stages. They cannot therefore be used as compensation for e.g. a route that is unsatisfactory from the environmental point of view. In order that the measures should work and be effective, thorough knowledge of the affected biotopes is necessary.

The main questions are:

- Which effects should be mitigated?
- How can measures be taken to prevent damage to the environment? (e.g. fencing, special layout of verges and sections over watercourses)
- How can damage be limited, e.g. by providing animal crossings?
- How can damage be compensated for, e.g. by increasing the quality of the landscape along the road?
- What effect will the measures have? At what cost?

Animal crossings and other measures to reduce negative effects should be followed up in order to increase the knowledge base for future projects. In following up the project, it should be possible to use the information collected during work on the EIA.

\* The analysis may also correspond to ecological assessment in the EIA at strategic level.

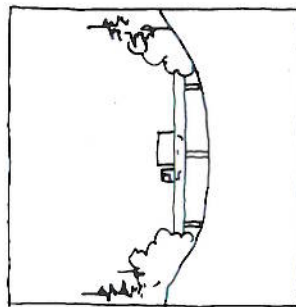




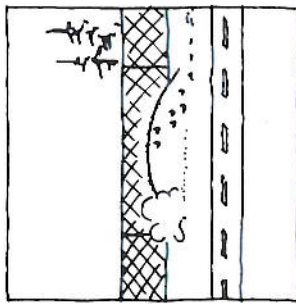
## MITIGATION MEASURES

By environmentally adapted design of the road/railway, damage can be prevented. Damage that arises during construction, for instance because a wildlife route is cut off, can be limited by building a wildlife crossing. Damage which has been caused can at times also be compensated for by e.g. creating new biotopes. Measures can also be taken in order to generally enrich the environment around the road.

Measures taken to reduce the barrier effect need not imply that separate installations are built only for animals. A valley can be bridged instead of the road being built on an embankment, and this will provide crossing facilities for both animals and people. Bridges over water can be made a little longer than what is necessary from the engineering standpoint to make crossing possible along the banks. Along fences put up to keep out game, mounds can e.g. be provided in places on the side near the road to enable animals which have somehow got into the road area to jump back over the fence.



*Bridge over a valley instead of an embankment*



*... and mounds for animals which have somehow got into the road area.*

overnight than in the surroundings. The verges can accommodate many plant communities. In uniform landscape types such as agricultural areas or forests, verges may be valuable both as biotopes, for instance for deciduous shrubs, and as dispersal corridors. Avenues are very valuable landscape elements which can provide shelter for a rich flora of mosses and lichens and many insects. Avenues should be protected and conserved, or replaced by new planting if they must be removed.

From the standpoint of traffic safety, however, it may be advantageous to make the verges as unattractive as possible for the fauna. A rich variety of small animals and insects will attract predators, especially birds of prey, which will increase the risk of collisions.

From the biological standpoint, a fence can be both harmful and useful. Where there are a lot of accidents involving game, a fence can reduce fatalities and thus benefit the populations. On the other hand, accidents to game probably indicate that a wildlife route is in the vicinity. A fence will then create a barrier in the ecological infrastructure. No Swedish investigations have been made to find when fencing is a preferable option from the ecological standpoint.

Speed limits can be applied to prevent damage during e.g. seasonal mass migrations of animals.

One important preventive measure is to limit damage to hydrological conditions. The road should be built so that the flow of groundwater is not impeded. Surface water from roads carrying high volumes of traffic should be collected and treated before being discharged to the surrounding ground.

### ANIMAL CROSSINGS

The function of crossings is to mitigate the barrier effects created by roads and railways in the landscape. Naturally, the entire intricate interplay in an untouched ecosystem can never be completely recreated or maintained by such measures.

Animal crossings may be bridges or underpasses through which the animals can cross without coming into contact with traffic. Different animals have different demands regarding width, layout, etc. The width required varies a lot depending on traffic density, the surrounding landscape, etc. Generally speaking, animal crossings should be made wide, of the order of 20-100 metres. Watercourses are important dispersal routes for both fishes and land animals. River systems should be preserved intact along their entire course. If bridges

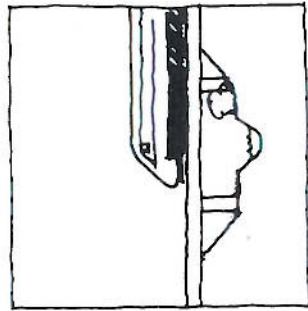
### NEW MARGINS, VERGES ETC

One way to prevent damage is environmental design of new margins and verges along the road or railway. This has great significance with regard to the impact which the installation will have on the ecology in the landscape. For many groups of animals, both the road/railway itself and its verges may have a certain attraction since, for instance, the temperature is higher there in the evening and

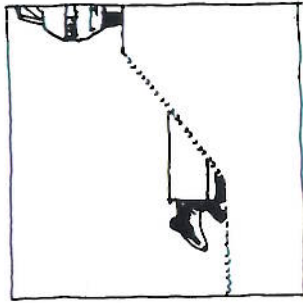


are built, it is essential not to disturb the water during construction in order to prevent destruction of the bottom strata. Culverts disturb the movements of fish, especially where there are differences in level.

If culverts must nevertheless be used, their invert should be lower than the bottom level of the adjacent watercourse, and they must be horizontal. The time for their construction should be such that damage is minimised, which is mostly when the water level is lowest.



*Long bridges over watercourses*



*Narrow pipes for badgers and foxes*

For deer, wide bridges or underpasses should be built, while for animals such as foxes which live in burrows narrow concrete pipes can be used as crossings. Many amphibians belong to those species which are often threatened by road construction since they undertake seasonal migrations. What underpasses for amphibians should look like has been relatively well investigated (see Publication No 1996:32 of the National Road Administration). If small mammals, reptiles and invertebrates such as insects and molluscs are to benefit, ecoducts are needed, i.e. bridges with a layer of vegetation that resembles the adjacent biotopes. These animals have no definite goals for their movements but use the crossings only if these can form part of their normal habitats.

Construction of animal crossings demands very good knowledge of the local fauna and its demands on the environment. Wrongly constructed crossings are underused.

#### **COMPENSATING AND ENVIRONMENT ENHANCING MEASURES**

The object of these measures is to replace functions that are lost in an ecosystem because of road construction. One example of such measures may be to

construct new ponds as spawning ground for amphibians. Measures are sometimes taken to increase the general quality of the biotopes affected by the road. Examples of such measures may be the planting of trees and vegetation in an unvarying arable landscape, or improvement of bridges and culverts along a river affected by the road.

#### **FEEDBACK**

In order to accumulate new knowledge, it is important to follow up the assessments of ecological effects. The need for follow-up must be assessed in conjunction with the analysis of environmental consequences. Follow-up is particularly important when a new method or measure is applied. Over the next few years, the National Road Administration will promote acquisition of knowledge regarding ecological effects by investigating a number of road projects to find what happens after construction.

On the following pages, examples will be given of functions and relationships which can be surveyed and analysed. The functions and effects are described as items which refer to the accompanying maps. In a complete landscape analysis, detailed descriptions of the results of survey and analysis are needed (see EIA Manual, Publication No 1995:30 of the National Road Administration).

#### **ANIMAL CROSSINGS:**

Animal overpass:

- Wildlife bridge
- Ecoduct
- Amphibian underpass
- Badger underpass
- Wildlife underpass, etc

Animal underpass:

By definition, crossings through road or rail tunnels, through underbridges, culverts, below bridges etc are not animal crossings, but they can serve as such.



# ANALYSIS OF A TYPICAL LANDSCAPE

## INITIAL STUDY\*

Construction of a road or railway which will improve communications between two towns is being discussed. The expected important effects/consequences are identified in an initial study. To provide a basis for this, it is necessary to make a preliminary analysis of the landscape with regard to e.g. the ecological infrastructure. For a description of initial studies, see Publications No 1995:30 and 1993:8 of the National Road Administration.

## THE CHARACTER OF THE LANDSCAPE

The area is situated in the rift valley terrain of Svealand in central Sweden. Rift valleys interspersed with plains of alluvial clay dominate the landscape. The surrounding hill and moraine districts are relatively low and rise less than 50 metres above the valleys. At the edges of the rift valleys there is a more variable landscape of mosaic character.

The composition of vegetation is relatively uniform in the whole district. On the highest outwashed areas of the hills there are pine forests, while in the slopes and depressions spruce forests dominate. There are wet areas with birch and alder. At the margins towards the arable fields there is greater species diversity. The area contains no natural landscapes listed by the county administrative board or the municipality.

The area is heavily modified by cultivation. Parts of the forest nearest the valleys have previously been grazing or open meadowland. The landscape is today characterised by rational agriculture. The valleys are cultivated. Trees and bushes are to be found only in clumps in arable fields, along watercourses and boundaries. Hydrology has been affected by agriculture through ditching and alteration of water quality in the watercourses.

No major changes are expected in the landscape. There is some tendency for trees to be planted in peripherally situated small fields.

## CONCLUSIONS

A road or railway in the area may give rise to fragmentation and disturbance effects with consequences for the fauna. The principal risk of conflicts with the ecological infrastructure occurs in the wetlands and the mosaic areas. In the

forest and arable landscape there will be fewer conflicts. The continuity of agricultural cultivation may also be affected, leading to overgrowth of open ground.

\* The analysis may also correspond to ecological assessment in the EIA at strategic level.

The rough division of the analysed area into landscape elements is as follows:

### LANDSCAPE UNITS

SENSITIVITY TO EXTERNAL ACTION

#### A

**MOSAIC LANDSCAPE. ENCLOSED PASTURES. SCATTERED RESIDUAL BIOTOPES IN FIELDS.**

**SENSITIVE TO LOSSES OF BIOTOPE AND FRAGMENTATION. GREAT NEED OF COMPENSATORY MEASURES.**

#### B

**BIOTOPES HAVE GREAT SIGNIFICANCE FOR FAUNA AND MOVEMENTS OF FAUNA IN THE AREA.**

**UNVARYING AGRICULTURAL LANDSCAPE. ISOLATED SPINNEYS.**

#### C

**HOMOGENEOUS CONIFEROUS FOREST LANDSCAPE. SCATTERED MARSHY AREAS.**

**BIOTOPE LOSSES MAY CAUSE LOCAL EFFECTS. FRAGMENTATION MAY IN THE LONGER TERM HAVE CONSEQUENCES. LAYOUT OF VERGES MAY ALLEVIATE EFFECTS ON E.G. THE LOCAL CLIMATE.**

#### D

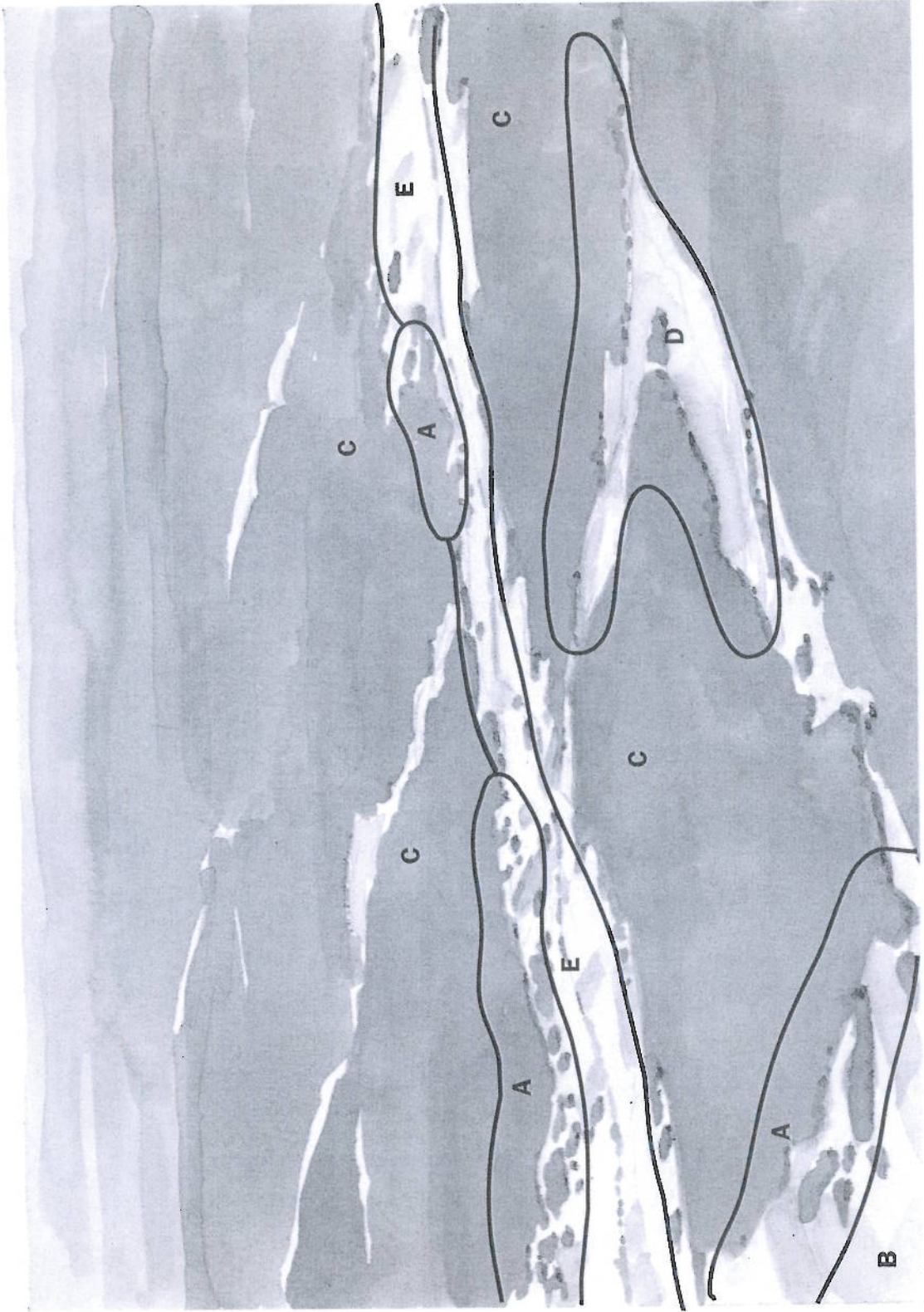
**WETLAND. RICH AVIAN FAUNA. ANIMAL ROUTES PROBABLE ALONG THE EDGES. AVIAN FAUNA HIGHLY WORTHY OF CONSERVATION.**

**THE FAUNA IS VERY SENSITIVE TO DISTURBANCES. RIVER IS SENSITIVE TO BARRIER EFFECTS. MEASURES NEEDED TO PROTECT THE WATER.**

#### E

**VALLEY SYSTEM WITH A RIVER. VALUABLE DECIDUOUS TREES AND SHRUBS IN AN OTHERWISE HOMOGENEOUS LANDSCAPE. ANIMAL ROUTE ALONG RIVER.**

**BIOTOPE LOSSES MAY HAVE SERIOUS CONSEQUENCES. SENSITIVE TO BARRIER EFFECTS. STRINGENT REQUIREMENTS REGARDING ROAD DESIGN.**





# ANALYSIS OF A TYPICAL LANDSCAPE

## ROAD/RAIL FEASIBILITY STUDY

Over part of the proposed route the effects of two alternative locations X and Y are studied. Earlier information from the initial study is supplemented with e.g. aerial photograph interpretation and field surveys. Assessment of the effects is followed by an assessment of the consequences, but this is not shown here.



IMPORTANT ANIMAL ROUTES

AREA FUNCTION	EFFECTS (and possible measures). ALT X	EFFECTS (and possible measures). ALT Y
1 ARABLE LANDSCAPE OF SMALL SCALE CHARACTER, CLUMPS OF TREES, MARGINS. PROJECTING FINGERS OF WOODLAND. ANIMAL ROUTES.	BARRIER EFFECT, BIOTOPES DISAPPEAR AND DISTANCE BETWEEN THEM INCREASES WHICH LESSENS DISPERSAL FACILITIES. (ENLARGEMENT OF BIOTOPES, TUNNELLING THROUGH AREAS OF FOREST, ANIMAL CROSSINGS).	AREA IS ONLY MARGINALLY AFFECTED.
2 LARGE SCALE ARABLE LAND. INDIVIDUAL CLUMPS OF TREES IMPORTANT FOR WILDLIFE. RIVER WITH DECIDUOUS TREES AND SHRUBS. OLD AVENUE, IMPORTANT FOR INSECTS, BIRDS.	AVENUE IS CUT IN TWO. DISTURBANCE TO PARTS OF AVENUE AND ITS FAUNA. (PLANTING ALONG E.G. DITCH OF BIOTOPES).	LOSS OF INDIVIDUAL BIOTOPES. ROAD REINFORCES BARRIER TOWARDS RIVER (PLANTING OF NEW TREES).
3 WOODLAND IN SLOPING TERRAIN, IRRIGATED LAND.	BARRIER TO FLOW OF WATER (CAREFUL ROUTING OF ROAD).	AREA AFFECTED ONLY MARGINALLY.
4 STREAM, DECIDUOUS TREES AND SHRUBS, DISPERSAL CORRIDOR.	BARRIER EFFECT, LOSS OF BIOTOPES (LONG BRIDGE, WITH RIVER LEFT UNTOUCHED).	BARRIER EFFECT, LOSS OF BIOTOPES (LONG BRIDGE, WITH RIVER LEFT UNTOUCHED).
5 ARABLE LANDSCAPE OF SMALL SCALE CHARACTER, CLUMPS OF TREES, MARGINS. RICH BIOTOPES.	AFFECTED ONLY MARGINALLY.	BARRIER EFFECT, BIOTOPES DISAPPEAR AND DISTANCE BETWEEN THEM INCREASES. DISPERSAL FACILITIES WORSE. (ENLARGEMENT OF BIOTOPES).





# ANALYSIS OF A TYPICAL LANDSCAPE

## DESIGN

Alternative X shall be designed. The measures taken in the part which passes through the zone between woodland and arable land, and the woodland on sloping terrain, are described here. After field studies and interviews with local experts, it was found that the sections in the projecting fingers of woodland and

along the river are very important for the ecological infrastructure and should be conserved. In view of topographical conditions, tunnels through hills and/or bridges over valley systems are discussed.

## LANDSCAPE ELEMENT FUNCTION AND EFFECT

### A

**ZONE BETWEEN WOODLAND AND ARABLE LAND. PROJECTING SECTIONS OF FOREST. THESE ARE USED BY ELK, ROE DEER, FOXES ETC. THE ROAD WOULD BE A SERIOUS BARRIER FOR THESE ANIMALS. ONE OF THE HILLS IS HIGH ABOVE THE SURROUNDING GROUND.**

## POSSIBLE TYPES OF MEASURES

- ROAD IN TUNNEL THROUGH THE HILLY AREA. DISTURBANCES AT TUNNEL OPENINGS REDUCED BY DENSE PLANTING AROUND THESE.
- LONG BRIDGES OVER THE VALLEYS.
- ANIMAL CROSSINGS IN THE FORM OF OVER OR UNDERPASSES.

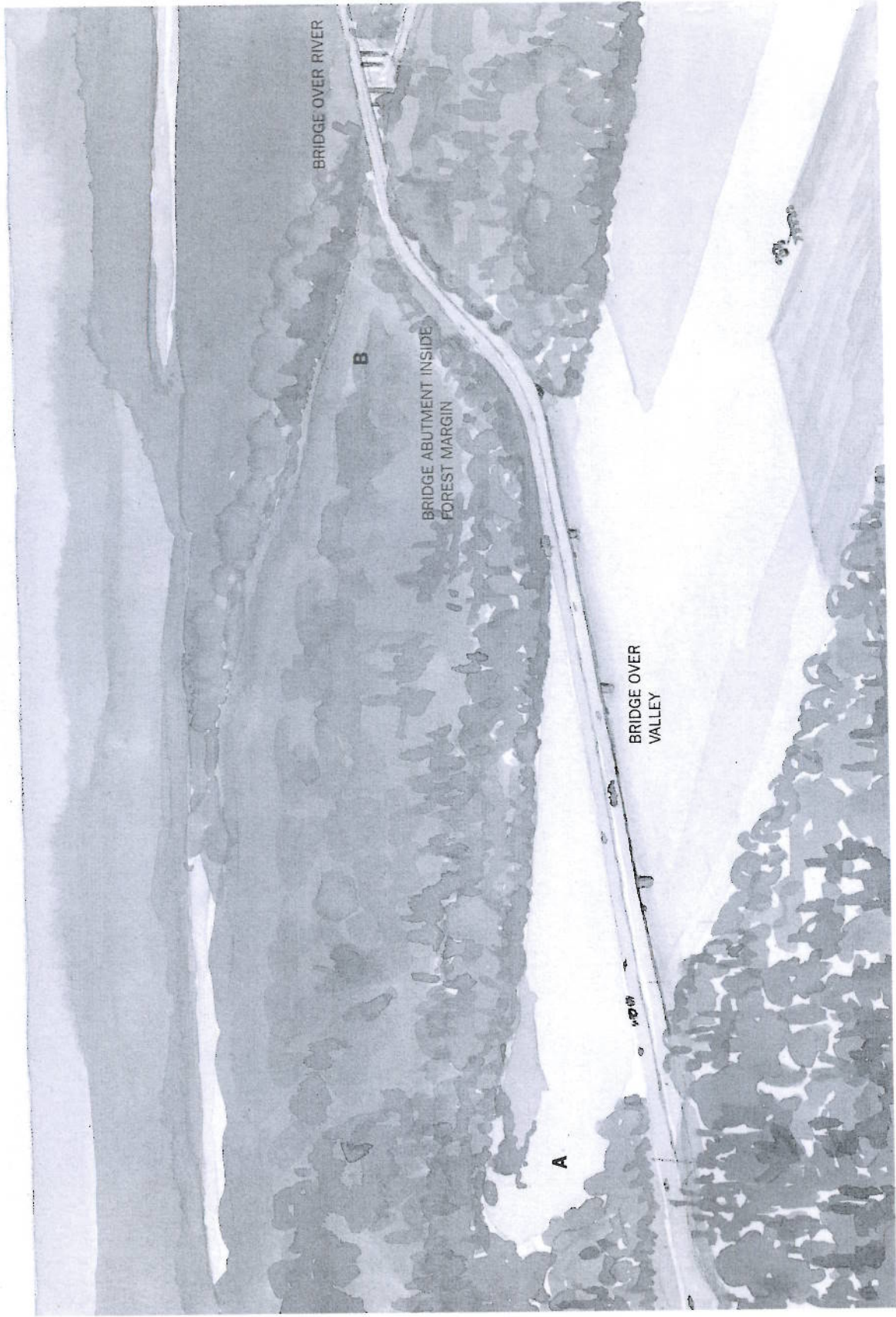
### B

**WOODLAND IN SLOPING TERRAIN. FLOWS OF WATER IN AND ON THE SLOPE CUT OFF BY THE ROAD.**

**CLOSELY SPACED CULVERTS ASSIST FLOW OF WATER TO SOME EXTENT. HOWEVER, BARRIER EFFECT FOR SURFACE AND GROUND WATER IS ONLY MARGINALLY REDUCED.**

**RIVER WITH ITS BANK VEGETATION IS IMPORTANT FOR MOVEMENTS OF ANIMALS. THERE ARE SPawning FISHES. CONSTRUCTION IN WATERCOURSE AND ON ITS BANKS WOULD DISTURB FAUNA AND FLORA.**

**ROAD CONSTRUCTED ON A LONG BRIDGE OVER THE RIVER. RIVER PROTECTED DURING CONSTRUCTION PERIOD SO THAT WHOLE RIVER IS LEFT UNTOUCHED, INCLUDING BOTTOM AND BANK VEGETATION.**





# EXAMPLES OF ANALYSES - TRIAL APPLICATION OF METHOD

**New European Route E4 and new railway between Söderhamn and Hudiksvall**  
By commission of the National Road Administration, a trial was made in applying the method to the assessment of environmental effects on the section between Söderhamn and Hudiksvall in the north of Sweden. The sections under discussion are shown in a generalised form on the maps, as examples of how a connecting link between E4 and the East Coast Line (ECL) could be located. The work was carried out by Schibbye Landskap AB, Bengt Schibbye.

**MAP 1** shows the natural geographic districts in accordance with the classification of the Nordic Council of Ministers, and the character of nature. The sources are map studies and earlier field studies during work on the EIA.

**MAP 2** shows linear structures. These are mainly streams and rivers, but also include the present E4 and wider road networks, as well as sensitive biotopes. The sources are map studies, previous surveys, and the land use and nature conservancy plans of the municipalities.

**MAP 3** shows parts of the fauna surveys made by various local game conservancy circles. It shows the migration routes of elk, the nesting sites of birds of prey, and the display grounds of gamebirds. Part of this map is shown on p. 25.

## The survey highlights some central issues:

It is evident that the barrier effect of the road/railway is significant for the local wildlife, but what does it mean on a larger scale? Can this be judged without considering development in the region as a whole? If the whole section is fenced, elk between E4 and the east coast line will be considerably more isolated than at present. Is this a serious impact?

The study covers the whole 10 km wide strip along the sea - the zone where a new E4/ECL is likely to be located. The landscape between Söderhamn and Hudiksvall consists of four characteristic areas. One of them, the Skåssan area, is described in the following. The text has been shortened to a certain extent.

## THE SKÅSSAN AREA: MARSHY, FLAT RAISED BEACH

Flat wooded blocky moraine areas, extensively outwashed. The rock is

oligotrophic. Moist and wet spruce forests in the depressions and pine forests on the heights. High proportion of marshy ground. Marshes occur in several development stages, all oligotrophic (not all surveyed). The whole central bog and marsh complex is classified as of national interest, chiefly for its hydrology. The area is almost completely without buildings, apart from some shelters for livestock and holiday houses. There will be no major change in land use. Most of the forest is under very rational management.

## ASSESSMENT OF ECOLOGICAL EFFECTS

The road/railway reduces the width of the untouched area between the sea and E4 from the present 6-8 km to 4-6 km. It is however uncertain whether this will cause difficulties for any species. This is one of the few areas along the Hälsinge coast which has direct connection between coast and hinterland without any intervening road. The highest marshy areas will be cut off. Hydrology may be modified. The effect will be fragmentation, and there is great contrast with the surrounding landscape.

## POSSIBLE MEASURES

Is it possible to route the new road nearer the existing E4? The road can be located so that there is minimum interference with hydrological conditions, i.e. so high that unobstructed flow of water through the road embankment is possible. In order that the embankment itself should not act as a drain, it may be necessary to make the sides of the embankment watertight.

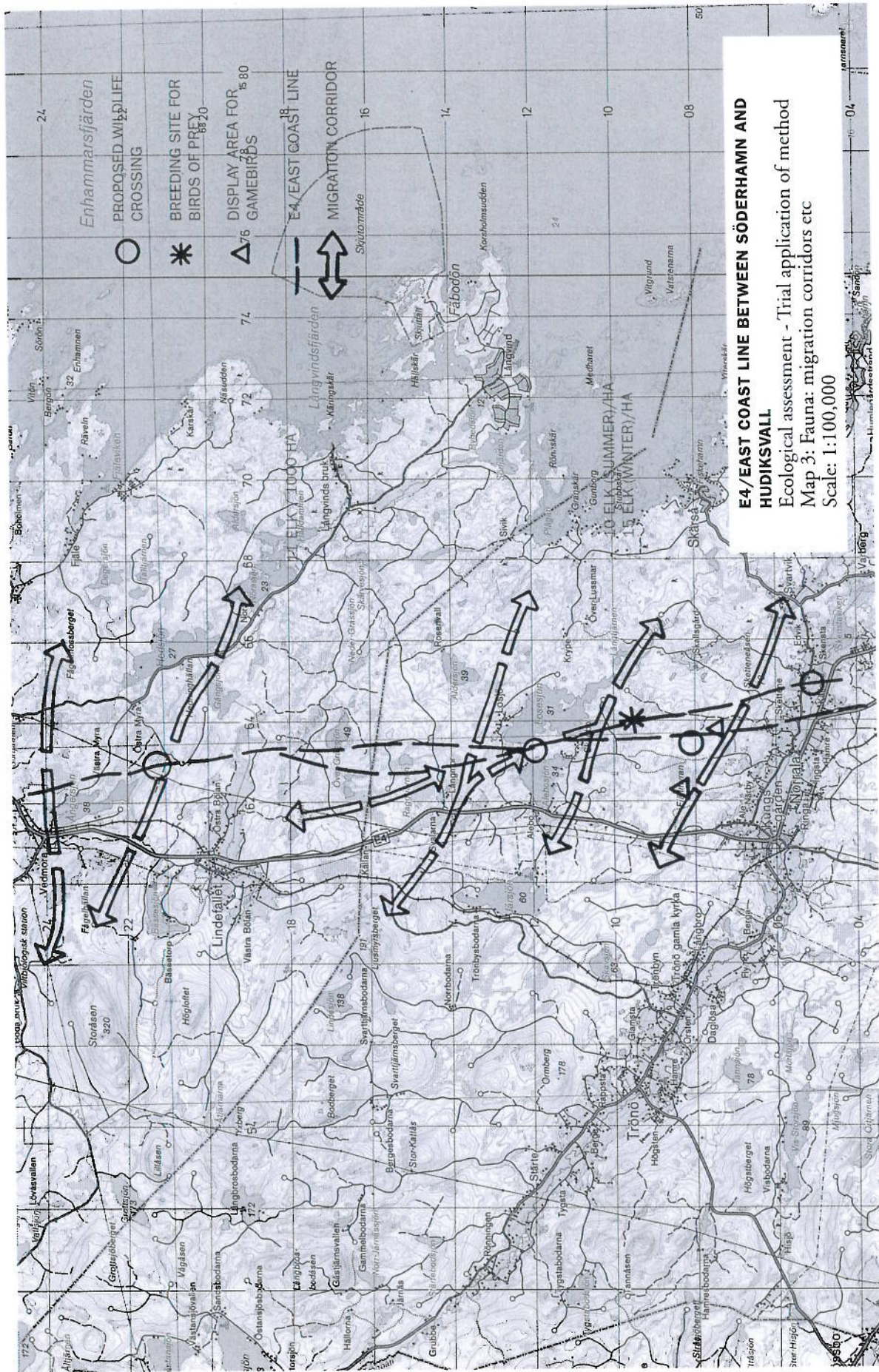
## LINEAR STRUCTURES, ASSESSMENT

The rivers Höljån and Myrabäcken-Långvind drain relatively small areas dominated by forest, with a large proportion of marshy ground. The banks are mostly flat and access to them is difficult. A new road/railway across the structures will cut the forest terrain in two. It is however uncertain whether the proposed routes will be a greater barrier than the present E4.

## SENSITIVE BIOTOPES, ASSESSMENT, MEASURES

The narrow isthmus between lakes Alebo and Lose is of importance for the movement of the fauna. Wild rosemary marshes along the banks of the lakes. The stream between the lakes is an important route for animals. The road should not encroach on the isthmus. Skåssan, Raggjärn with the marsh complexes are key areas in the area of national interest. The road may cut off and affect hydrology. A route to the side of the area should be chosen.





**E4/EAST COAST LINE BETWEEN SÖDERHAMN AND HUDIKSVALL**  
 Ecological assessment - Trial application of method  
 Map 3: Fauna: migration corridors etc  
 Scale: 1:100,000



# EXAMPLES OF ANALYSES - ROAD LOCATION STUDY

## ROAD 108 BÖKEBERG BYPASS

The National Road Administration and Svedala Municipality have jointly surveyed a future route of Road 108 near Svedala, between Bökeberg in the north and Aggarp in the south. Three routes were studied, one of which consists of upgrading the existing road. As part of the survey, the Administration tested a new method for assessing ecological effects. The test was performed by VBB Samhällsbyggnad, Göran Loman.

### SURVEY OF THE LANDSCAPE

Siting in the natural geographic region forms the basis for the analysis. The area is part of the sedimentary and horst regions of Skåne in the south of Sweden. The landscape is a small scale kettled outwash plain which contains several sub-biotopes: small lakes, marshy areas, watercourses, deciduous forest, deciduous marshland forest, meadowland, etc. These variable environments and the relationships between them are important for the fauna.

Special study was made of two groups of animals: deer and amphibians.

### Deer

In the area there are elk, red deer, fallow deer and roe deer. The movement patterns of these animals are described. Roe deer move a lot between open ground where they graze and the forest where they seek shelter. The number of accidents involving game along the existing road is given. Statistics show where the most frequently used wildlife routes are located.

### Amphibians and reptiles

There are different species of amphibians and reptiles (e.g. common frog, moor frog, tree frog, salamander etc). Some of these migrate with the seasons. The tree frog is vulnerable in the national perspective, and grass snake, edible frogs and salamander also demand consideration. Edible frogs occur almost exclusively in south-west Skåne, and the region around Bökeberg is the central area for these populations.

### THREATS

Deer often cross the road and may be involved in accidents. Amphibians like to come into the road area, for instance to seek food, and may be run over. The survey finds that traffic fatalities do not usually have much significance for the survival of a population, but that in some cases they may be an evident risk factor.

### ANALYSIS

The area surveyed has a unique assemblage of several different sub-biotopes over a small surface area. Species composition is special in character.

A new road would mean that the areas of the biotopes are reduced and relationships between these disrupted. Construction of a new road and simultaneous retention of the old road increases the risk to amphibians since they would then have two roads to go to. In the case of amphibians, traffic density is of little significance. Two roads with a lower traffic density are thus worse than one road with more traffic.

Since the residual population of certain amphibian species is small in the area, the loss of every pond is a threat.

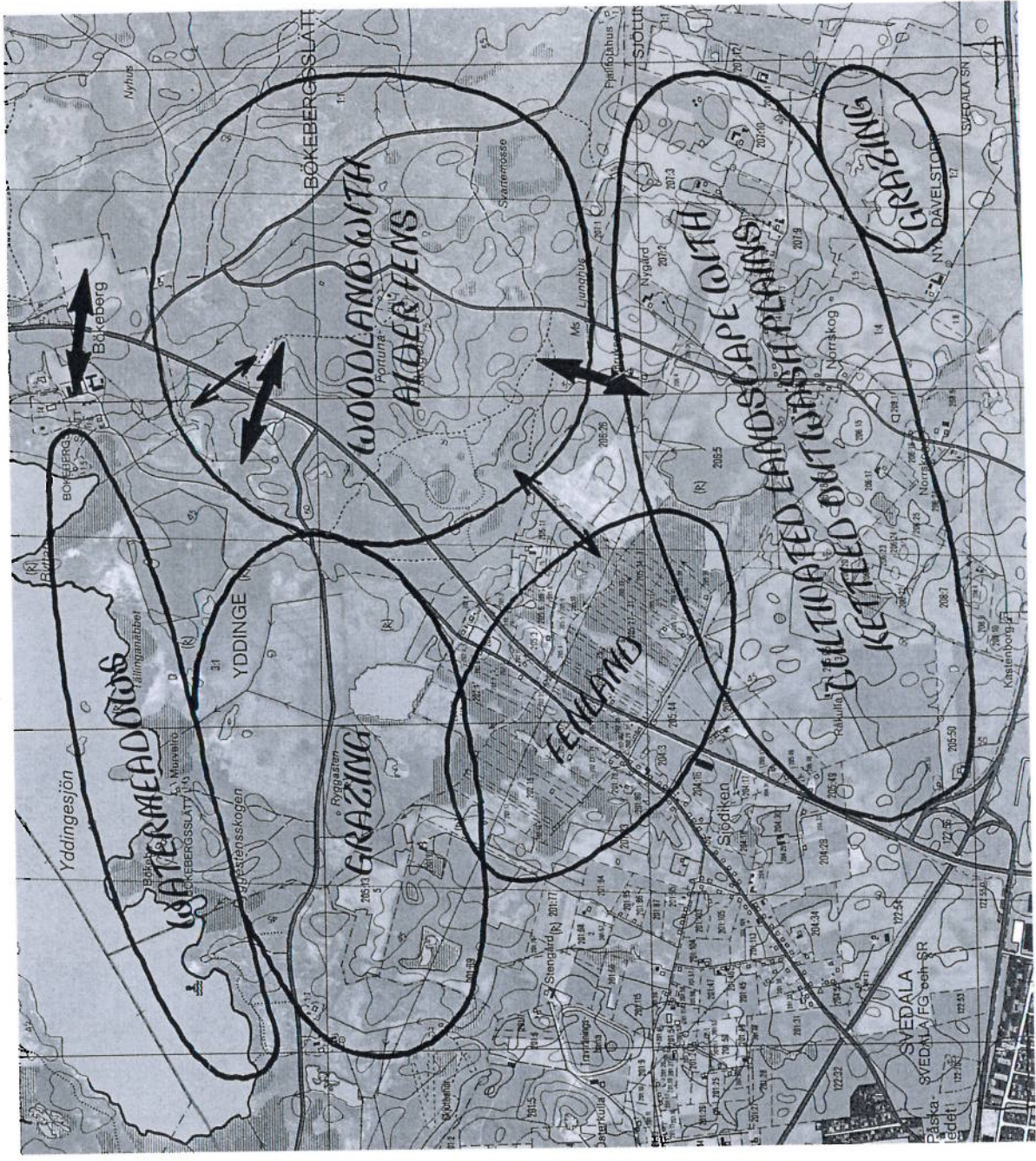
### CONCLUSIONS

The survey finds that upgrading of the existing section will cause the least disturbance.

Fencing restricts the freedom of movement of deer. On the other hand, the risk of accidents is reduced. Low fine-meshed fencing can be erected to prevent amphibians going on the road. These may however be trampled down by larger animals.

One possible measure is to construct animal crossings. These can also be built for amphibians. In order that these should work, it is essential that they are designed properly and sited in the correct positions.





Wide arrows = deer  
 Narrow arrows = amphibians  
 Summary of the ecological analysis.  
 Dominant sub-biotopes and routes.



# EXAMPLE OF ANALYSES - ROAD LOCATION STUDY

## E4 BETWEEN STORA ÅBY AND VÄDERSTAD

An improvement of the standard of European Route E4 through Östergötland in the south of Sweden has long been discussed. This road survey studies alternative new routes for E4 between Stora Åby and Väderstad. Widening of the existing E4 to motorway standard was excluded at an early stage since this would have a serious impact on existing building development along the road. The work was done by VBB, Michael Porath.

The survey is primarily an example of how outline classification into landscape types can be used as a basis for assessing the effects of alternative routes. The three natural geographic landscape types in the area are:

1. Hälaveden, the northern part of the forest district in Östergötland. The area is characterised by large comparatively uniform coniferous forest areas with large and small lakes and some building development, mostly in the form of single houses with farmyards and small arable/grazing fields. There are few marginal zones and they are short. The terrain has many rock outcrops which are in places quite dramatic.
  2. The open landscape of Östergötland, a mainly very large scale and flat agricultural landscape. Buildings are mostly in small groups or in small villages. Open spaces are very large, and the few marginal zones are long.
  3. The small scale agricultural and forestry area in the transitional zone between Hälaveden and the open Östergötland landscape. The area is characterised by a small scale mosaic of woodland, agricultural land and buildings - both single and in groups. Open spaces and marginal zones are small and short, but in great numbers.
- The southern alternative route of the road mainly passes through the forest areas in Hälaveden, the existing E4 passes through the southern part of the open landscape of Östergötland, and the northern route mostly passes through the small scale transitional landscape.

## ECOLOGICAL ASPECTS

From the ecological standpoint, the open Östergötland landscape and Hälaveden are landscape types with comparatively little variation and few marginal zones. The small scale agricultural and forestry landscape in the transitional zone between the open landscape and Hälaveden, with its many marginal zones and small biotopes, offers a broader spectrum of habitats.

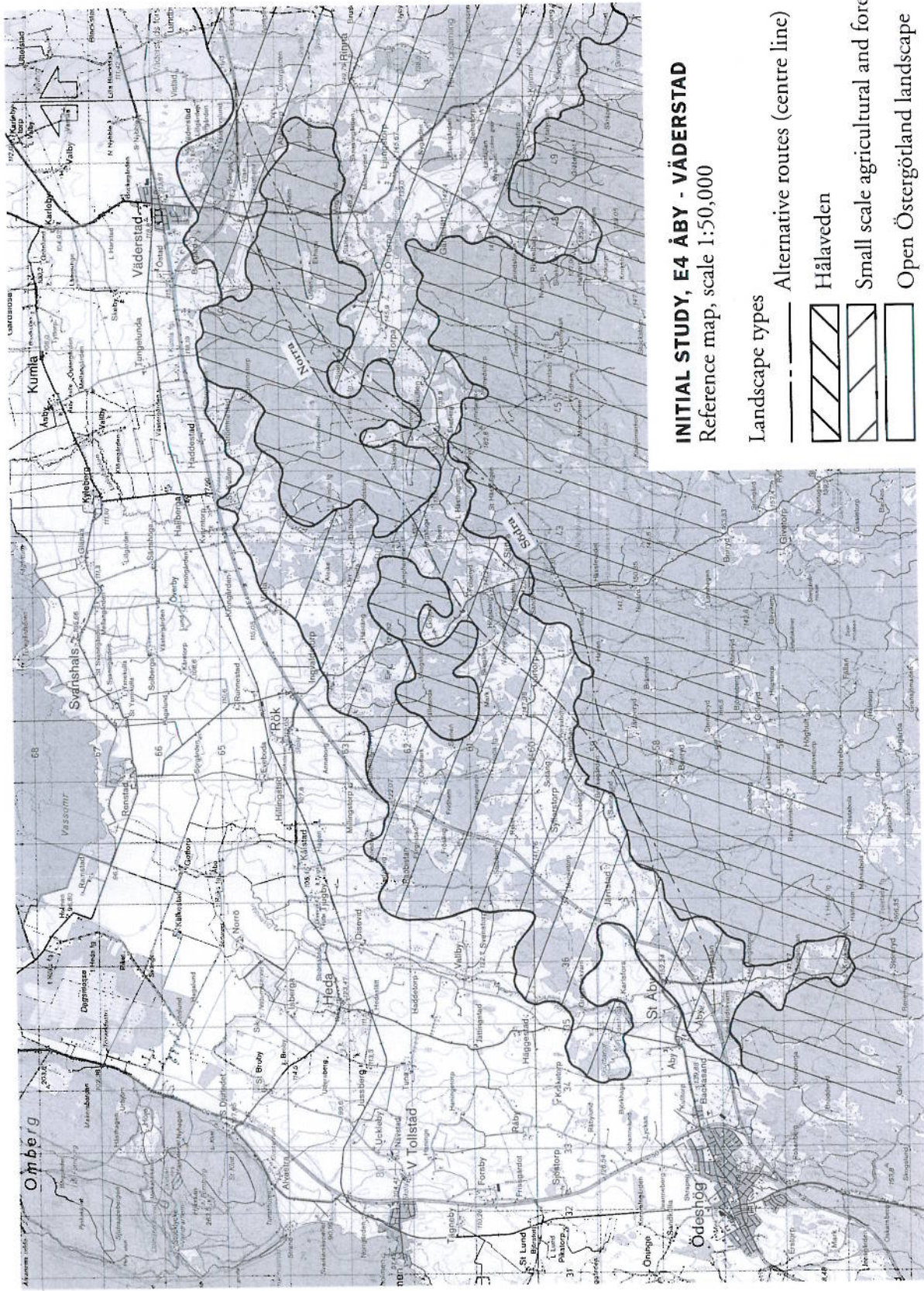
All three landscape types, with the exception of the southern part of the open landscape of Östergötland, may be described as large uncultivated areas according to Chapter 2 Section 2 of the Natural Resources Act. According to the NRA, such large uncultivated areas shall as far as possible be protected from evident damage. A number of smaller areas, mostly situated in the small scale agricultural and forestry area, may be said to come under the category ecologically specially sensitive areas according to Chapter 2 Section 3 of NRA.

## CONSEQUENCES OF THE ALTERNATIVE ROUTES




The northern alternative route through the small scale and ecologically more sensitive transitional landscape will affect a greater number of valuable areas than the southern route. A number of meadows and woodland pastures will be fully or partially destroyed. A bog and nature reserve at Sättra will be affected. The southern alternative route will be mostly constructed through forest. Fewer valuable areas will be affected. However, the planned route passes near, and will affect, several rich biotopes of small size.

The map on the next page shows the classification into landscape types.





**INITIAL STUDY, E4 ÅBY - VÄDERSTAD**  
 Reference map, scale 1:50,000

- Landscape types
- — — Alternative routes (centre line)
  -  Hålevåden
  -  Small scale agricultural and forestry landscape
  -  Open Östergötland landscape



## EXAMPLE OF ANALYSES - MITIGATION MEASURES

### E4 TO THE NORTH OF HÄRNÖSAND

The measures taken for environmental adaptation of the new E4 to the north of Härnösand are examples of the measures which have the aim of mitigating the effects on the environment from several aspects; to reduce the visual disturbances to the landscape and the natural environment, and at the same time to facilitate the movements of animals.

The road passes through undulating coastal landscape. The terrain has a mosaic character which makes for diversity in vegetation. Many slopes, stream ravines and beaches accommodate an interesting flora. The meadows and groves of the cultivated landscape contrast with the barren coniferous forests higher up on the slopes.

Design of the new E4 on the High Coast was preceded by careful route location studies and assessments of the measures needed. Special study was made of the fauna. Information on wildlife that can be hunted: elk, roe deer, small game especially hare and gamebirds, was taken from various hunting parties. Information on the nesting sites of birds of prey was provided by the various hunting parties and the project Eagle Owl North. The grazing grounds of elk and roe deer, areas rich in small game and the migration routes of elk across the road are described in the Environmental Impact Assessment.

In several places, there are bridges over water (the best known is the High Coast Bridge). When these are constructed, there is a risk of disturbance to spawning and migrating fish.

The flora has been surveyed. However, the road zone does not affect the areas listed as having valuable flora.

### MITIGATION MEASURES

In several places, the road is carried on bridges instead of embankments. These bridges fill several functions; they reduce disturbance to the landscape, provide panoramic views for road users, and reduce the barrier effects for animals and people. There is also less encroachment on arable land.

The bridges pass over valleys, i.e. where the terrain creates good conditions, and not over animal routes which are mainly in the forest. The bridges have

however been designed so that they facilitate the movements of animals, by placing the abutments inside the forest margins. This also gives a more slender impression and the belt of vegetation can be maintained unbroken in front of the abutment. The bridges over water also have their abutments further back, so that there is room along the banks for animals to pass.

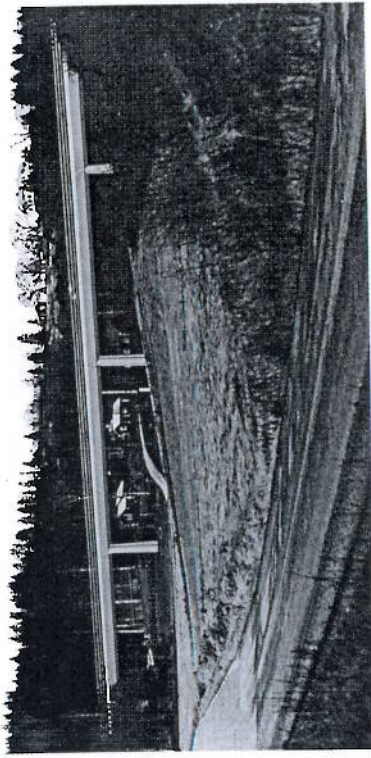
In one place where the road cuts off several animal routes, an underpass was built merely to serve the animals.

The slopes of the road have been adapted to the surrounding nature. The excavated spoil has been put back, and local seeds have been sown.

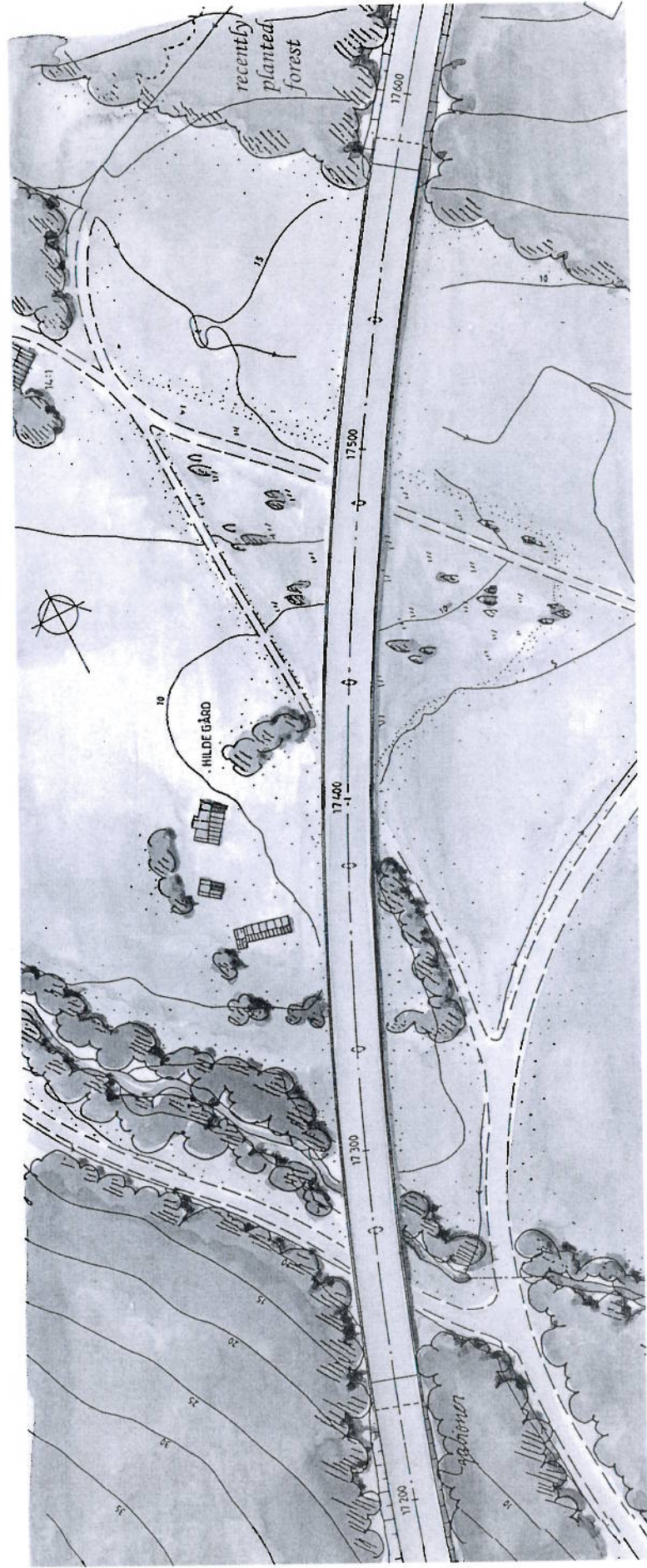
Since a lot of damage to the environment occurs during construction, all those engaged on the project were given environmental training.

The environmental impact assessment on which the measures have been based was carried out by Schibbye & Blomkvist AB, Bengt Schibbye. The bridges over the valleys were designed by Söderblom & Palm, Inger Berglund.





**Bridge at Utvik**  
A long bridge over the valley facilitates the movement of animals.  
Design: Inger Berglund, Söderblom & Palm. Photomontage.



## BIBLIOGRAPHY

- European Council Directive No 92/43/EEC. Conservation of natural habitats, wild flora and fauna.
- European Council Directive No 79/409/EEC. Conservation of wild birds.
- Swedish Council for Planning and Coordination of Research. FRN Report No 96:1, 1996. Landscape Analysis in the Nordic Countries.
- National Environmental Protection Agency. General advisory notes. 1995:4. Protection of biotopes. (In Swedish).
- National Environmental Protection Agency 1994. Monitor 14. Biodiversity in Sweden. (In Swedish).
- Nordic Council of Ministers 1984. Pålsson L (ed). Natural geographic regional classification of the Nordic countries. (In Swedish).
- Nordic Council of Ministers, Copenhagen. Vegetation types in the Nordic countries. Tema Nord 1994:665. (In Swedish).
- Nordic Council of Ministers, Parts 1 and 2. Environmental Report No 1987:3. Natural and cultivated landscapes in physical planning. (In Danish).
- National Road Administration. Publication No 1993:8. Initial studies in road design. (In Swedish).
- National Road Administration. Publication No 1996:32. National Rail Administration. Publication No 1996:2. Folkesson L., Nilsson S., Seiler A., Skage O.R., Wallentinus H-G. Ecological assessment in planning roads and railways. (In Swedish).
- National Road Administration. Publication No 1995:30E. Environmental impact assessment for roads. Manual.
- National Road Administration. Publication No 1995:40. Fact sheets for EIA for road planning. (In Swedish).
- National Norwegian Road Administration. No 177. Roads and nature. (In Norwegian).

# **National Environmental Programme 2002 – 2005**

of the

## **Swedish National Road Administration**

Strategic Planning, Sectoral Responsibilities, National Road Management,  
Exercise of Public Authority and Common Tasks

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## Summary

This is the second National Environmental Programme drawn up by the Swedish National Road Administration (SNRA). It applies throughout the entire SNRA organisation, except for the Profit Centres. The programme establishes general and detailed environmental goals, measures that lead to goal fulfilment, follow-up principles and environmental indicators for the period 2002 through 2005. The programme is the basis for the SNRA's long-term and short-term planning.

Today's road transport system is not sustainable in a long-term perspective. Despite advances in technology, roads still have a major impact on the environment. The importance of environmentally-sound road traffic is pointed out in both international and national contexts. The crucial environment issues that are both difficult as well as essential to resolve, and thus central to all environmental endeavours in the SNRA, are as follows:

- energy consumption and carbon dioxide emissions
- the impact on health of air pollution and noise
- the impact of roads on environments of natural and cultural value in urban and rural areas.

The environmental goals that are established in the programme comply with Parliament's environmental quality goals and the Government's sub-goals for a sustainable environment as stipulated in national policy for both the environment and transports. The SNRA's overall environmental goals during the period are based primarily on crucial environmental issues within the road transport system. The goals are:

1. By 2005, the SNRA's combined measures during the programme period are to contribute to a reduction in carbon dioxide emissions of 130 000 tonnes, as compared to not having implemented these measures.
2. Environmental quality standards for air along the state road network are to be met from the year they are stipulated in legislation and regulations.
3. Properties along the state road network where the noise level exceeds 65dBA outdoors are to have a maximum 30dBA equivalent indoor level.
4. By 2005, goals and strategies are to be drawn up to meet the criteria concerning natural and cultural environments along state roads.

During the programme period the SNRA will give priority to their environmental endeavours in the following areas:

1. A market for environmentally-sound transport.  
The SNRA is to help develop a market for environmentally-sound, energy-efficient and safe transportation.
2. An energy-efficient style of driving.  
The SNRA is to promote an economical driving style for motorists.
3. Change-over to the fuels of tomorrow.  
The SNRA is to help develop a national strategy for non-fossil fuels.
4. Co-operation in the road transport sector at the local level.  
SNRA is to develop and implement measures in consultation with regional and local players.
5. A strategy to solve health problems.  
SNRA, in co-operation with other players, is to describe and test a strategy of measures for solving health problems resulting from bad air quality caused by road traffic.

6. Adaptation to environments of natural and cultural value.

SNRA is to develop goals and indicators, and undertake measures to safeguard environments of natural and cultural value in urban and rural areas.

7. Environmental management in construction, operation and maintenance.

SNRA is to develop environmental management in construction and operation mainly by continuing the development of procurement and reimbursement models within national road management, but also by reviewing the civil works code and monitor adherence to it.

8. Noise-abatement inside dwellings.

SNRA is to prioritise noise reduction programmes that achieve the targeted 30dBA maximum equivalent level indoors in dwellings.

9. Promote walking, cycling and public transport.

SNRA is to improve the basic conditions for environmentally-sound ways of transportation: walking, cycling and public transport.

These areas of focus form the basis for prioritising the measures described in five action plans; i.e., for strategic planning, sectoral responsibilities, road management, the exercise of public authority, and common tasks. In these action plans, detailed environmental goals are developed. The 74 measures proposed to achieve the goals do not inherently conflict with other transport policy goals.

The cost for implementing the environmental programme is estimated to be just under SEK 300 million per year. This can be compared to the actual costs of SEK 100 million in 2000 for measures within a similar scope and to SEK 455 million per year, which is the corresponding level in the current long-term national and regional plans. The amount and character of the measures give the programme a major economic dynamism. The SNRA is of the opinion that the measures in the programme can be implemented during the programme period provided funding is available. Nonetheless, the proposed measures are not sufficient for attaining society's long-term environmental goals. Funding on the same level as for the year 2000 means that the overall environmental goals will not be attained.

Apart from the follow-up of the environmental goals in the programme, the SNRA will also define 24 environmental indicators to monitor developments within the SNRA and the road transport system respectively. The indicators will be chosen to correspond with international reporting routines and be used to monitor both long-term and short-term developments.



## Background

*“The design and functioning of the transport system shall comply with demands for a healthy and sustainable environment for everyone, where environments of natural and cultural value are protected and preserved. Good management of land, water, energy and other natural resources shall be promoted.”*

Environmental goal for the transport system extracted from Government Bill 1997/98:56.

Why do we need an environmental programme?

There are at least three answers to this question:

- United, forceful action is required from the SNRA in order to contribute to the Government's environmental goals for the transport system.
- The environmental programme, in which environmental goals and follow-up routines are stipulated, forms part of the environmental management system.
- The measures in the environmental programme form the basis for the SNRA's annual activity plans.

### How does road traffic affect the environment?

Today's transport system is not sustainable in a long-term perspective. Car and lorry transports are increasing substantially, whereas the contribution from more environmentally-sound transport modes, like walking, cycling, public transport and railway are decreasing. The negative effects of this development are particularly noticeable in cities. Expressed in terms of environmental goals, carbon dioxide emissions are increasing, the number of people exposed to noise is not being reduced fast enough, the air quality in certain urban areas is unsatisfactory and environments of natural and cultural value are being endangered.

In spite of this, the development of the road transport system has been successful with regard to exhaust emission control. Emissions of air pollutants are decreasing and the interim goals for nitric oxides, volatile organic compounds and carcinogens are likely to be met. The interim goal for sulphur dioxide has already been met.

The SNRA considers it very doubtful whether the interim goal for carbon dioxide will be met. Even if it is, much remains to be done in order to achieve a sustainable level of carbon dioxide emissions. If traffic increases as predicted, the carbon dioxide problem will remain substantial in the future as well.

The air pollutant level that affects health has been reduced in most respects, but in some urban areas the level is still high. Today it is mainly nitrogen dioxide, benzene, particulate matter and ground level ozone that can be found in levels high enough to impair health.

The noise abatement goals for new or major re-construction projects are being met in most cases. The goal for reducing the number of people exposed to noise in existing residential areas will not be met at the present rate.

Governing guidelines and concrete goals are lacking for environments of natural and cultural value. Concrete proposals for goals, models and strategies are being drawn up. A knowledge bank is being built up through taking inventory of avenues and cultural heritage roads.

Internal goals for recycling and reduced consumption of finite natural resources have been met. There are still problems relating to springs, watercourses and municipal water catchment areas damaged by salt.

## Environmental issues nothing new for the SNRA

In a broader sense, the SNRA has always taken environmental issues into consideration. This became more systematised in 1988 when the environment became a so-called “focus area”. At that time, the SNRA built up its expertise primarily with respect to the environmental impact of road management works. In 1992 the SNRA took over the tasks of the Swedish National Road Traffic Safety Office, when for the first time, the SNRA’s letter of appropriation stipulated that “the promotion of an environmentally-sound road transport system and an environmentally-sound vehicle fleet” was one of the main goals of the operations. This was ratified in the Government Bill (95/96:131) concerning the SNRA’s sectoral responsibility for the road transport system. Beyond the traditional road management role, sectoral responsibility implies supporting and encouraging other players in the road transport sector in order to attain the goals in national transport policy.

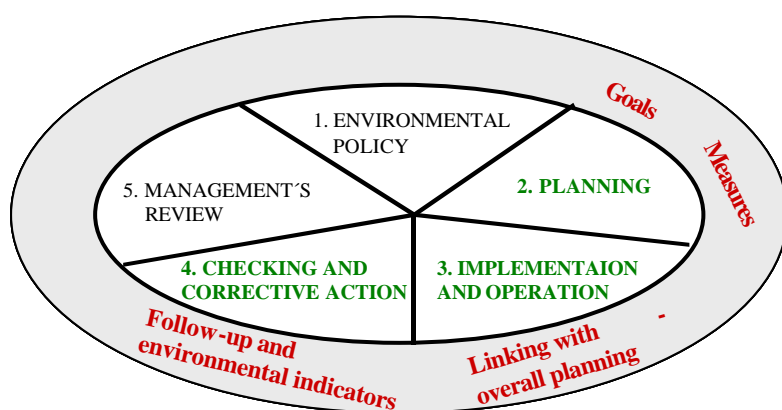
## The first environmental programmes

In 1996, the first national environmental programme was ready. It was characterised by the MaTs co-operation<sup>1</sup> and SNRA’s mandate to develop a special plan for the environment and road safety goals. The sectoral issues – to support other players so that they contribute to the environmental goals – were strongly emphasised in the programme. Since then seven regional environmental programmes have been drawn up.

During this period the SNRA improved its environmental resources. Persons with environmental expertise were recruited, and all employees attended a basic course to stimulate environmental awareness. The responsibility for strategic environmental endeavours was raised to management level with an environmental department being set up directly under the Director-General. The following years saw many environmental initiatives being taken at the SNRA.

## Environment management systems are being introduced

The SNRA is working on introducing an environmental management system. The environmental programme is part of this. The environmental management system implies, in part, that environmental endeavours are developed in a systematic way and integrated into all activities. This entails steady improvement and enables management to ensure that laws and regulations are being complied with throughout the organisation.



*Five main elements are described in the environmental management system ISO 14001. The environmental programme is concerned with parts of three of these (2 – 4). Within “Planning” the programme sets environmental goals and describes measures. Within “Implementation and Operation” goals and measures are linked with overall planning. A follow-up system is included in “Checking and Corrective Action”.*

<sup>1</sup> Co-operation between the Swedish Environment Protection Agency, the traffic authorities, the National Board of Housing, the Swedish Transport and Communications Research Board (KFB), the Swedish Business Development Agency (Nutek), Swedish Institute for Transport and Communication Analysis (SIKA), the Car Industry Association and the Swedish Petroleum Institute. The aim was to describe how an environmentally-sound and sustainable transport system could be developed.

### **A strategy for the environment and safety on roads**

A basic conception of the environmental problems we are facing has gained a foothold within public institutions, the business sector and the academic world. During 1998/99 the SNRA, together with the National Environment Protection Board, the Swedish Association of Local Authorities and the National Swedish Police Board, developed a strategy for “the environment and safety on roads” (the MöTs- strategy). The strategy was drawn up on a broad front in consultation with local authorities, the business sector and stakeholder organisations. In the present environmental programme, the SNRA intends to respond to this strategy and the demands placed on us by the outside world. Today the SNRA is much better equipped for taking strong action in the environmental field than it was five years ago.

## **Content, scope and implementation**

The SNRA's environmental programme describes the common ambitions at the national level in the work aimed at the fulfilment of its own environmental goals as well as those of the Government. The programme forms part of SNRA's environmental management system and is based on current legislation and governmental policy. It describes environmental goals for the SNRA, measures for attaining the goals, areas of follow-up and indicators for environmental improvements.

The programme applies to three of the SNRA's main tasks: sectoral responsibility, the exercise of public authority and national road management. The programme also concerns strategic planning measures and common measures within the organisation not linked to any specific main task. The programme does not apply to the SNRA's Profit Centres.

The goals that are set up can be met through action taken by the SNRA itself or by other players as a direct result of SNRA initiative. Consequently the goals are not formulated for the road transport system in its entirety but only for those parts where the SNRA considers that it has sufficient resources to exert an influence— directly or indirectly.<sup>2</sup>

The environmental programme is intended primarily for SNRA employees. It expresses the common ambitions of the SNRA and is to be a source of guidance and inspiration in carrying out environmental improvements.

The programme forms the basis for SNRA's long-term and short-term planning. In the annual planning process it is decided what must be done and who is to do it.

### **Other environmental programmes within the SNRA**

In addition to the national environmental programme at hand, there are seven regional environmental programmes, which describe relevant regional goals and action plans. This can entail measures to solve regional problems, or those that contribute to the national goals but where the solutions depend on regional conditions, and are thus specific for that region. The regional environmental programmes, together with the national one, form the basis for regional activity plans. To facilitate co-ordination and follow-up, the regional and national environmental programmes are to be closely correlated. Therefore, when the regional programmes are being up-dated they are to be supplemented with a description of how the national programme is taken into consideration.

The SNRA has been instructed by the Government to introduce environmental management systems by the year 2003. This means that there must be an environmental programme for each SNRA Profit Centre as well. These Profit Centres are integral to the SNRA as a public authority, but are run on competitive market terms. Three out of the four Profit Centres – Construction and Maintenance, Ferry Operations and Consulting Services - have already drawn up their own environmental programmes. The Training and Development Centre is still to develop one.

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<sup>2</sup> In the report "Measures and incentives for attaining the environmental goals" 1999:134, the SNRA describes what can be done by society as a whole to attain long-term environmental goals.

### **Closely related strategies, programmes and plans**

There are also a number of closely related programmes and action plans, which in various ways describe measures that contribute to environmental improvements. The SNRA's three-year R&D plans are two such examples. The focus of the research into environmental issues and how this is organised is described in an overview on page 29.

On a Government mandate, the SNRA has developed a quality programme for road architecture (publications 1997:88 and 1999:102). This programme will be concluded in 2001. Subsequent to an evaluation, the SNRA will take a stand on how to proceed with the work. This means that the environmental programme does not comprise explicit goals and measures with respect to road architecture and aesthetics.

Several national strategies, programmes and indicative plans describe what is to be done in various areas – commercial traffic, cycling, public transport, ITS (Intelligent Transport Systems), community planning, ground and water etc. Many of the measures proposed contribute to the fulfilment of environmental goals. Some of the measures are emphasised in this programme. There are also some “environmental action plans” that describe our work in the field of noise pollution, biodiversity, in-house environmental endeavours, etc. Besides these plans there are regulations and manuals for how to consider environmental issues when planning and designing the road transport system and roads; e.g. the manuals for strategic environment assessment and environmental impact assessment.

### **Implementation of the programme**

The basic input for the action plans presented further on in this programme has been developed in task groups comprising representatives from both Head Office and the seven regional road administrations. These actions plans in turn form the basis for the SNRA's annual activity plans, where the SNRA stipulates what is to be done to the goals set up, including environmental goals. All departments and divisions are required to draw up an environmental action plan as part of their annual planning process. This plan is to show what will be done in order to contribute to the SNRA's national and, if applicable, regional environmental goals.

The action plans have different implications for the departments and divisions at Head Office. Below is an overview of the division of responsibility.

	Strategic planning	Sectoral responsibilities	National road management	Exercise of public authority	Common tasks
Division/dept responsible for the implementation of the environmental action plans in the organisation's activity plans	PV	M SM PV TS	SV PV	SM PV	PER I E M

*PV = Road Transport System Planning Department, M = Environmental Department, SM = Sectoral and official services Division, TS = Traffic Safety Department, SV = National Road Management Department, PER = Personnel and Human Resources Department, I = Information Department, E = Finance Department.*

The Finance Department is responsible for ensuring that the environmental programme is included in the annual activity plans, and for making sure that it is followed-up. Further, it has a mandate from top management to conduct the environmental audit in co-operation with the Environmental Department.

It is the responsibility of the Environmental Department to provide guidance and support to the other departments in their activities planning. The Environmental Department is also responsible for the administration of the programme and for judging whether it needs updating during the programme period.

## **International and national environmental goals**

There are environmental goals at both the national and international level that have significance on the road transport system and SNRA's operations.

### **EU's environmental goals**

EU's overall environmental goal is formulated as the principle of sustainable development: the politics conducted by the EU to satisfy today's needs are not to harm future generations. EU's sixth environmental action programme was launched in 2001 and covers the period until 2010. This programme states the political ambitions of the member states. Long-term goals are put forward in the programme – a kind of ideal scenario in terms of certain environmental problems. The programme also proposes goals and measures of action up to the year 2010. Some of these concern road traffic, and primarily refer to climatic impact, air pollution, noise and water resources. The programme is not legally binding.

#### EU directives

EU directives are binding on each member state. However, it is up to each individual state to incorporate the directives into national laws and regulations. There are primarily two directives concerning environmental issues that are of significance to the SNRA during the programme period.

The air directive stipulates a minimum standard of air quality as regards the levels of sulphur dioxide, nitrogen dioxide, lead and particulate matter (PM 10). These standards are to be incorporated into each country's legislation and regulations, and are to be met in each member state. Each country can set higher standards than the EU directive. Sweden has environmental quality standards for nitrogen dioxide, sulphur dioxide, and lead in line with SFS 1998:897. Proposals for new quality standards for benzene, carbon monoxide and PM 10 are being drawn up. Each player is required to check whether the environmental quality standards are being exceeded and take measures to prevent this.

In summer 2001 the EU integrated the standards concerning water issues into a water directive. This directive is to be implemented into the legislation of the member states within three years. Among other things this directive implies that the supervision responsibility is administered at the outflow point. This could facilitate the work on removing obstacles impeding migration in the water systems. Amongst the stipulations in the directive is a general ground water protection clause, which will have an impact on road management. The directive also stipulates official protection of water catchment areas that yield more than 10 cubic metres per 24 hours, or serve more than 50 people.

### **Parliament's environmental quality goals and the Government's proposal for sub-goals**



The Swedish Parliament has adopted 15 national environmental quality goals, expressed as ideal situations in specific environments and types of landscape. The goals are set as generation goals – they are to be attained within 25 years. They are to be governing for public administrations and a guideline for society at large.

The environmental quality goals that have the greatest implication for the SNRA are:

Limited climatic impact

Fresh air

Only natural acidification

No eutrophication

Living lakes and waterways

Swarming wetlands

Good quality ground water

A rich agricultural landscape

Good environment in built-up areas

The goal for limited climatic impact will be broken down into sub-goals in a forthcoming bill. The Environmental Bill (no 200/01:130) divides the environmental quality goals into some 60 sub-goals. Most of these aim at the year 2010, and thus are outside the scope of this environmental programme. However, some still concern SNRA's operations, and the measures in the environmental programme contribute in some cases to the sub-goals. None of SNRA's environmental goals conflict with those set by the Government. On the other hand, only a few tangibly support SNRA's environmental endeavours.

#### Fresh air, Only natural acidification and No eutrophication

Emissions have been reduced and air quality has been improved primarily through the development of more technologically sophisticated engines and exhaust systems. The government considers that the following measures are needed in order to achieve the sub-goals: road taxes must be reviewed; the environmental classification system for plant and equipment must be up-dated; procurement requirements for plant, equipment and heavy vehicles must be further developed; local authorities should be granted the option of introducing road pricing; the system for nitric oxide fees must be reviewed; goods transports must be co-ordinated and made efficient and more drivers should be taught eco-driving. The SNRA is of the opinion that it could be difficult to meet the future environmental quality standards for air in some of the busiest traffic areas.

#### Living lakes and watercourses, Good quality groundwater

Emissions from road traffic find their way to waterways and the ground water. Not least of all, road salt is a problem for drinking water catchment areas. The government proposes that by the year 2010 water catchment areas that pump more than 10 cubic metres per day or supply more than 50 people are to meet the national Swedish standards for drinking water. Local authorities are expected to make an inventory of individual water catchments areas that have the above capacity. SNRA's goal as contained in the environmental programme is that by 2005 no water catchment area of this capacity will be sub-standard in this respect as a result of road salt – i.e. contain more than 100 mg chloride ions per litre water.

#### A rich agricultural landscape

The Government's view is that the SNRA should continue the work on protecting biodiversity in roadside areas.

#### Good environment in built-up areas

The Government proposes a 5% reduction in the number of people exposed to noise levels exceeding the noise guidelines recommended Parliament by the year 2010 as compared to 1998. This goal lies outside of the programme period but clearly indicates that indoor noise in dwellings is the most prioritised area for noise-abatement during the programme period.

It has been proposed that the Geological Survey of Sweden (SGU) be commissioned to develop agreements on division of responsibility in order to fulfil the goal of a maximum total consumption of natural gravel at 12 million tonnes per year by 2010.<sup>3</sup>

### **The Government's interim goals for the transport sector**

The Government has already formulated interim goals for noise and emissions in the transport sector. Work is in progress on formulating transport policy interim goals for health, environments of natural and cultural value and ecocycle adaptation. These are formulated to reflect the national environmental quality goals. The current interim goals for transport have not been broken down for roads specifically, but apply to the transport sector as a whole. They cover five areas.

#### Emissions of air pollutants and climate gases:

- Emissions of carbon dioxide from transports in Sweden should have stabilised at the 1990 level by 2010.
- Emissions of nitric oxides from transports in Sweden should have been reduced by at least 40% by 2005, with 1995 as the baseline.
- Emissions of sulphur from transports in Sweden should have been reduced by at least 15% by 2005, with 1995 as the baseline.
- Emissions of volatile organic compounds (VOC) from transports in Sweden should have been reduced by 60% by 2005, with 1995 as the baseline.

#### Noise:

The Government has defined guidelines for residential areas and schools and hospitals:

- 30 dB(A) equivalent level indoors
- 45 dB(A) maximum level indoors at night
- 55 dB(A) equivalent level outdoors at façades
- 70 dB(A) maximum level outdoors near permanent residences

The guidelines are expressions of an acceptable level for average or typical circumstances in areas where noise can normally be expected. In a first stage – Stage 1 – measures are to be taken for the most exposed residential areas with noise levels exceeding 65dB(A) equivalent levels outdoors. The measures are primarily intended to limit indoor levels that exceed the guideline for acceptable levels. In compliance with the bill on “Transport Policy for Sustain-

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<sup>3</sup> The SNRA consumed 3.1 Million tonnes of natural gravel in 2000. That was a reduction by 28% as compared to 1999.

able Development” 1997/98:56, the interim goal is to be met by 2007, although no later than 2003 for the state road network.

#### Impact of air pollutants on health:

The Government has set interim goals for reaching current limits for nitrogen dioxide by 2000 and halving emissions of carcinogens by the year 2005 as compared to 1998. These goals apply regardless of the source. There is no breakdown within the road transport sector or for the transport sector as a whole.

#### Ecocycle adaptation:

Government bill 1996/97:53 on the focus of infrastructure for transports in the future contains three interim goals:

- Environmentally hazardous materials are not to be introduced into the infrastructure.
- The use of non-renewable natural resources is to be minimised.
- Materials used in the infrastructure are to be recycled and reused and tipping / landfill must basically cease.

The Government also states that the use of fossil fuels in a long-term perspective must be phased out at a rate that leads to the attainment of the carbon dioxide goal.

#### Natural and cultural environments:

Government bill 1996/97:53 on the focus of infrastructure for transports in the future contains a few ambitions as concerns new transport facilities:

- New transport facilities should be located so that they function in harmony with the surrounding environment and be designed with regard to regional and local environments of natural and cultural value.
- The possibility of developing existing infrastructure should always be considered before deciding on new infrastructure.
- Analyses of how new infrastructure will affect the landscape should be conducted at an early stage.

## SNRA's environmental goals

One environmental goal at the SNRA is linked to status changes in the SNRA management process model. Environmental impact, achievements and even desirable characteristics can be described in terms of goals. The SNRA sets the environmental goals in the programme period at two levels: as overall goals for the entire organisation and detailed goals related to the SNRA's main tasks and those working on them. The detailed goals are to be found in the action plans for strategic planning, sectoral responsibility, national road management, the exercise of public authority and common tasks. The SNRA estimates that it is possible to attain the following overall environmental goals provided measures for around SEK 300 million are funded each year during the programme period.

- I. By 2005, the SNRA's combined measures during the programme period are to contribute to a reduction in carbon dioxide emissions of 130 000 tonnes, as compared to not having implemented these measures.

Road traffic accounts for around 25% of the carbon dioxide emissions in Sweden, just short of 18 000 000 tonnes in 2000. In accordance with the goal set by Parliament, carbon dioxide emissions from road transports in Sweden should not exceed 1990 year's level – around 17 000 000 tonnes – by 2010. The targeted reduction is expected to result primarily from improved energy efficient driving, quality assured transports and better compliance with current speed limits.

- II. Environmental quality standards for air along the state road network are to be met from the year they are stipulated in legislation and regulations.

In accordance with the EU air directive, environmental quality standards for ambient air are being introduced in Swedish legislation on a continuous basis. From 2006 the quality standards concern levels of nitrogen dioxide and particulate matter (PM 10) for the protection of human health.

- III. Properties along the state road network where the noise level exceeds 65dBA outdoors are to have maximum 30dBA equivalent indoor level.

Whether this environmental goal can be attained is determined through the interaction between regional self-governing bodies, county administrative boards and the SNRA. At the current rate, this goal cannot be fulfilled before 2005. This means that the Government's targeted 2003 will be difficult to realise.

- IV. By 2005 goals and strategies are to be drawn up to meet the criteria concerning natural and cultural environments along state roads.

As more is learned about where the road network fails to meet the criteria during the programme period, measures are to be taken to adapt roads to environments of natural and cultural value.

### **Environmental problems within the road transport system and important environmental aspects**

The environmental impact of the road transport system and important environmental aspects have been analysed a number of times and by a number of different environmental committees in Sweden. The conclusion is that the road transport system affects the environment in many ways. The greatest problems that demand change are:

- energy consumption and carbon dioxide emissions.
- the impact on health of air pollution and noise

- the impact of roads on environments of natural and cultural value in rural and urban areas.

The problems apply to the entire SNRA organisation. The overall environmental goals stipulated above are based primarily on these problems. The solution to the problems depends on developments in

- vehicles and fuels
- the infrastructure
- traffic and road-users

These areas comprise the key environmental aspects within the road transport system to be taken into consideration. Detailed environmental aspects are described for road management, the exercise of public authority and common tasks.

## Areas of focus for attaining the environmental goals

We know the problems fairly well. We know roughly which direction to take. In the common strategy, "The Environment and Safety on Roads" from 1999, some areas where change is needed are highlighted:

- Demand and conduct safe and environmentally-sound transports.
- Actively promote developments on the international scene regarding vehicles and fuels.
- Develop roads so that they can cope with more stringent safety and environmental requirements.
- Improve road safety and the environment in urban areas and make walking, cycling and public transport more competitive modes of transportation.
- Co-operation between the government and industry for the development of new technology
- Increased knowledge on a wider front and working in consultation with others.
- Economic incentives support development.

Measures that are undertaken within these areas lead towards the goals. The environmental programme contains measures within all of these areas. Below is a description of the nine most important areas of focus in this environmental programme. These have been developed from the strategy presented in the foregoing and form the basis of priority for the action plans presented in the programme.

The problem regarding emissions into the air consists of two parts– regulated exhausts and carbon dioxide emissions. It appears that the former is being solved, while the latter is extremely difficult to resolve.

As regards quantifiable goals for emissions of regulated exhausts (nitric oxides, sulphur dioxide, and hydrocarbons) available forecasts and analyses indicate that they will be met through the action already decided upon and current prognoses on traffic trends. Thus, a specific focus during the programme period is not needed. This picture will change if current goals are made more stringent or the prognoses prove to be unreliable.

As to carbon dioxide emissions, analyses show that the goals are not likely to be attained given the measures decided upon and current prognoses on traffic trends. The goal could however be achieved through significant economic incentives or through a combination of several interacting measures.<sup>4</sup>

During the programme period, the work at the SNRA will concentrate on the following areas.

### 1. A MARKET FOR ENVIRONMENTALLY-SOUND TRANSPORT

The SNRA is to contribute to the development of a market for environmentally-sound, energy efficient, safe transport. Within its sectoral responsibility, the SNRA directs its support towards the business sector and public organisations in their procurement, implementation and follow-up of transport services. In its road management endeavours, the SNRA develops specifications and forms of reimbursement for the procurement of construction and maintenance contracts. In-house, the SNRA has adopted a policy concerning work-related travel.

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<sup>4</sup> In the report "Measures and incentives to attain the environmental goals" (1999:134), the SNRA has estimated the total public funding required to meet the carbon dioxide goal at just under SEK 2 billion per year.



## 2. ENERGY-EFFICIENT STYLE OF DRIVING

The SNRA is to promote an energy-efficient driving style. Within sectoral activities, the SNRA develops and applies economical driving in co-operation with driving schools, for example, and encourages its application within private and public organisations. The SNRA and other authorities set speed limits and work on their being complied with. Speed adaptation has a major impact on fuel consumption. Within its exercise of public authority, the SNRA teaches driving test officials to assess candidates according to their driving style skills. In its in-house environmental endeavours, the SNRA organises courses for employees who drive a lot on the job.

## 3. CHANGE-OVER TO THE FUELS OF TOMORROW

The SNRA is to contribute to the development of a national strategy for non-fossil fuels. Is it ethanol, methanol, biogas, hydrogen gas or electricity that is going to replace fossil fuels? Both international and Swedish regulations are lacking, partly or totally, for new engine systems and fuels. The absence of regulations and a common view of the future impedes progress. A number of new concepts are being developed. A shared viewpoint would significantly facilitate the development and introduction of new technology, e.g. hybrid cars and cars run on hydrogen gas.

## 4. CO-OPERATION IN THE ROAD TRANSPORT SECTOR AT THE LOCAL LEVEL

The SNRA is to develop and implement measures in consultation with regional and local players. Even if the national measures are expected to have a great impact they do not on their own lead to the goals. Measures depending on regional conditions will also be needed during the programme period in order to attain the goals. Environmental networks within public administration, industry and stakeholder organisations are important forums. That is where local initiatives can be picked up.

## 5. A STRATEGY TO SOLVE HEALTH PROBLEMS

The SNRA in co-operation with other players is to describe and test a strategy of measures to solve health problems caused by bad air quality due to road traffic. In spite of the ongoing reduction of regulated exhausts there are still environments where exhaust levels are too high. These high levels together with other traffic related air pollutants impair health. It is estimated that the impact on health is almost the same as that of traffic accidents. The inquiry into environmental health estimates that between 100 and 1000 persons every year contract cancer as a result of air pollution. Many more, above all allergy sufferers and persons prone to bronchitis are affected by air pollution. A total number of between 20 000 and 100 000 days of hospital care per year are estimated to be related to air pollution.

A joint strategy to handle this problem and meet the goal on health is lacking today. The SNRA undertakes many different measures aimed at attaining this goal; transport quality assurance, procurement specifications, traffic management, promoting public transport, cycling, etc. To compile the experience gained in this area, formulate a focus area and test it are important tasks during the programme period. Co-operation should be sought with the Swedish Association of Local Authorities, the Swedish Environmental Protection Agency, County Administration Boards and regional self-governing bodies.

## 6. ADAPTATION TO ENVIRONMENTS OF NATURAL AND CULTURAL VALUE

The SNRA is to draw up goals, define indicators and carry out measures to protect and preserve environments of natural and cultural value in urban and rural areas. The impact of roads on natural and cultural environments is enormous. Since 1998, the SNRA has been working together with authorities for the protection of natural and cultural environments to develop quality standards and criteria for road harmonisation within these environments. Comprehensive work to ascertain the need for measures in relation to the criteria is to be carried out. Goals for the proportion of the state road network that is to meet the quality standards will be formulated as the shortcomings in relation to the standards become known.

At the same time improvements are being made on stretches of road where the need for measures is known. During the programme period the SNRA aims to put the quality standards into practice in maintenance and operation works, road improvements and in new construction. Concrete goals for valuable natural and cultural environments are to be formulated and met for new road projects. The work on road harmonisation with its surroundings is supported by extensive information campaigns and courses.

## 7. ENVIRONMENTAL MANAGEMENT IN CONSTRUCTION, OPERATION AND MAINTENANCE

The SNRA is to develop an environmental management system for construction and maintenance, primarily by continuing to develop procurement and reimbursement models within national road management, but also by reviewing technical specifications and ensuring that they are complied with. Several of the environmental aspects to consider within the road transport system are linked to the construction, operation and maintenance of the road infrastructure, water issues, use of chemicals, salt, choice of materials and use of natural gravel. The approach is twofold:

- stop toxic and hazardous substances from spreading in the environment
- preserve natural resources through economical production and recycling.

The prime tools here are the development of environmental requirements when procuring road construction and maintenance contracts and the development of technical specifications that regulate road works. The development of expertise in ecocycle matters, economising on natural resources and disseminating knowledge within the subject area are all vital elements if the SNRA is to achieve its environmental goals.

## 8. NOISE-ABATEMENT INSIDE DWELLINGS

The SNRA is to give priority to noise-abatement programmes that achieve the targeted 30dBA maximum equivalent level inside dwellings. The feasibility of meeting this goal depends on the interaction between the SNRA, the county administration boards and regional self-governing bodies, where the economic resources for noise-reduction programmes are allocated. Goal achievement for noise reduction along state roads varies throughout the country, depending on the measures taken. However, given the current resources and rate of progress it is impossible to meet the targeted maximum 30dBA indoors in dwellings along state roads where the outdoor noise exceeds 65dBA.

By giving priority to façade measures it is possible to achieve the goal by 2005. During the programme period the SNRA is to focus noise-abating measures on dwellings that are exposed to traffic noise outdoors above 65dBA, or above 55dBA maximum indoors at night. Noise protection shields can be used where they are economically advantageous, for instance when several properties can be protected simultaneously. The building of quiet places outdoors is given less priority. This complies with the sub-goals for noise in the environmental bill.

The focus proposed for stage II – to reduce the sources of noise – presumes extensive development and investigation work. Among other things it is important to develop knowledge concerning measures and incentives for greater use of low noise level tyres. As far as the SNRA is concerned, developments during the programme period will focus on road management measures and a review of the technical specifications regarding recommendations and standards for road surfacing. Also speed limits and other traffic regulations will be tested to a greater extent, primarily in order to reduce noise at night.

#### 9. PROMOTE WALKING, CYCLING AND PUBLIC TRANSPORT

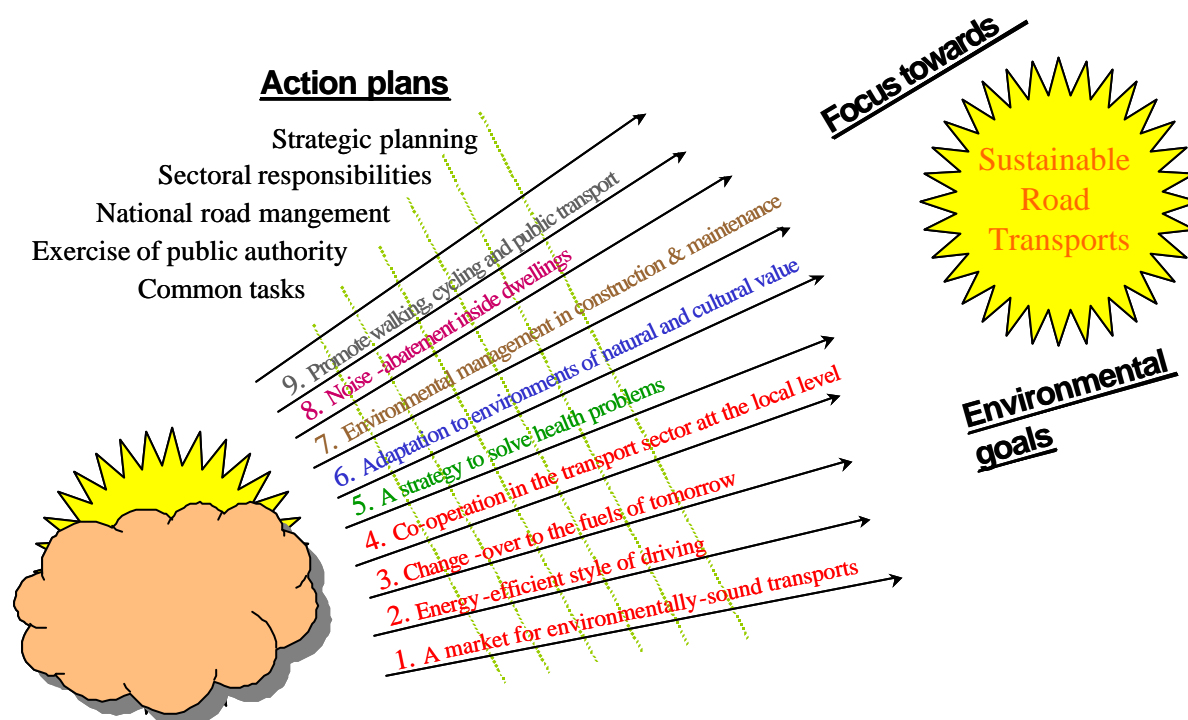
The SNRA is to develop the prerequisites for environmentally-sound transportation – walking, cycling and public transport. In spite of the impressive engineering developments within the road transport system, it will be difficult to attain many of the goals– including those related to road safety and accessibility. Measures are therefore needed that aim at promoting walking, cycling and public transport and to improve interaction with other modes of transport. The SNRA can already contribute to this by planning for and promoting transportation that we know is good for the environment and which belongs in a sustainable transport system. Together with the development of vehicles and fuels, improved community and traffic planning, fair pricing and support to sound market forces we will come closer to attaining the goal.

## What we want to do – action plans

In this national environmental programme five action plans, containing detailed environmental goals and measures for attaining them are presented: for strategic planning, for three of the SNRA's main tasks: sectoral responsibility, road management and the exercise of public authority, and for common tasks throughout the SNRA organisation.

The action plans express the SNRA's ambition within these tasks – the goals we want to attain, the measures we want to implement. The plans are based on environmental inquiries of various character and status. They all point out key areas of significance for the results attained in the SNRA's different fields of operation.

The presentation of the action plans follows a common structure. First there is a description of what each task implies – the scope involved. Then areas of key environmental consideration are described, followed by the detailed environmental goals for each individual action plan. The action plans conclude with a list of the measures that lead towards goal fulfilment and that have been proposed for the programme period. The measures are more or less parts of the nine ways to attain the environmental goals described in the previous section.



### *How are the action plans related to the focus on the goals?*

*The nine areas of strategic focus for attaining the environmental goals and the five action plans interact to form a matrix of measures. Within each area of focus, measures in the various action plans support each other. Those measures in the action plans that fall into the 9 areas of focus are given priority..*

The economic framework for implementing the measures is set in the long-term national plan for the road transport system and in the SNRA's annual activities plan. The measures that will be implemented and when this will occur is decided in the annual planning of the operations, where the economic premises are given and the goals and measures are balanced within the economic framework.

## Action plan for strategic planning

Part of the planning stands apart from the choice of individual measures. That part of the planning aims at deciding what kind of measure would be suitable to solve a problem or satisfy a need. Do we need a road or a railway? Should we reduce the speed limit or should the standard of the roads be improved?

This type of consideration in the planning process is strategic. It concerns both road management, the sectoral responsibility and the exercise of public authority. In this planning, measures that do not entail a road as a solution are also regarded, e.g. measures that can have an impact on the demand for transport, the choice of mode of transport as well as measures that lead to a more efficient use of the existing road network. This can concern information, control or regulations. In this respect the strategic planning is part of the system for Mobility Management<sup>5</sup>, which has been developed in several EU projects.

Future demand for transport is also affected by the physical planning. This mainly takes place within the municipal authorities in compliance with the Planning and Building Act. The interaction between municipal planning and the development of the road network by the national government must be carried out keeping in mind the environmental problems caused by increased motor vehicle traffic. This interaction is also part of strategic planning.

### Key environmental considerations

Areas of key environmental consideration within strategic planning are the same as for the entire road transport system:

- vehicles and fuels
- the infrastructure
- traffic and road-users

Focus is on the major environmental problems within the road transport system;

- energy consumption and carbon dioxide emissions
- the impact on health of air pollution and noise
- the impact of roads on environments of natural and cultural value in rural and urban areas

### Goals

Goals for the strategic planning during the programme period are:

- A strategic environmental assessment is to form an active element in future long-term action plans.
- Input for determining interim goals within the following target areas is to be developed during the programme period.

Natural and cultural environments

Health

Ecocycle and consumption of natural resources

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<sup>5</sup> Mobility Management is primarily an approach to change the demand for passenger and goods transports. It builds on co-operation and partnership and a set of tools for supporting and encouraging changes in attitudes and behaviour towards sustainable transports in the long-term.

- The input referred to county administrative boards or regional self-governing bodies for decision and implementation through regional transport infrastructure plans must at least include natural and cultural environments, aesthetics, emissions into air, impact on health, noise and water protection.

### **Measures targeting goals and environmental aspects of consideration**

- M1. Development and implementation of methods for a strategic environmental assessment.
- M2. Development and implementation of the so-called four-stage model to quality assure the design of measures aimed at environmental goals, amongst other things.
- M3. Charting items of decision within and outside of the SNRA for the entire process of planning and constructing the road transport system.
- M4. Develop support for decisions in the planning process, among other things an analysis of the direction to take.
- M5. Develop input for the county administrative boards and the regional self-governing bodies for regional transport infrastructure plans.
- M6. Develop and apply traffic survey methods based on general plans and road plans.
- M7. Map out quiet areas in co-operation with such players as the county administrative boards, regional self-governing bodies and the Association of Local Authorities.
- M8. Further development of goals and indicators for environments of natural and cultural value in connection with long-term planning, new road projects, existing roads, follow-up activities and information and training.
- M9. Further develop input for interim goals on health and ecocycle adaptation.

### **Action plan for sectoral responsibility**

Sectoral responsibility aims at leading, supporting and stimulating other players within the sector. The task includes co-operation and co-ordination, and actively promoting the development of the road transport system in a results-oriented way through reaching agreements, offering support, procuring services, providing basic data and initiating research and development.

### **Key environmental considerations**

The work in this field is aimed at areas within the road transport system of key significance:

- vehicles and fuels
- the infrastructure
- traffic and road-users

Attention is focused on the major environmental problems:

- energy consumption and carbon dioxide emissions
- the impact on health of air pollution and noise
- the impact of roads on environments of natural and cultural value in urban and rural areas

### **Goals**

The goals during the programme period are:



- By 2005, the measures undertaken within sectoral responsibility during the programme period are to contribute to a reduction in carbon dioxide emissions of 115 000 tonnes as compared to not having implemented the measures.
- By 2004, a strategy containing action plans to reduce the detrimental effect of roads on health is to be formulated in consultation with other players.
- The number of people exposed to noise in the road transport system is to be reduced during the programme period.
- Cooperation within the road transport sector is to be extended to include natural and cultural environment aspects during the programme period.
- The SNRA is to develop its role as the Government's advisor. It is to do so by analysing trends and suggesting how laws as well as administrative and economic incentives can be used in Sweden and the EU to attain the long-term environmental goals.

### **Measures targeting goals and environmental aspects of consideration**

The proposed measures are divided into three groups. They correspond to a process that has been developed through the environmental endeavours undertaken within the sectoral responsibility task. The metaphor of a greenhouse can be applicable. First one thinks about which plants to cultivate (strategy and analysis). A limited number of these are then cultivated (demonstration project). If it turns out that the plant is hardy and productive, it will be cultivated for production (national project). Using this allegory, regional road sector projects, which are not described here, can be compared to trial cultivation. They can also, however, be cultivated for production in a regional perspective.

#### National projects

The basic condition for these projects is that they are concrete to a high degree – we know what is to be done, how to do it and what effects it will have.

The national SNRA projects during the period are:

- M10. Assuring the quality of transports. The purpose of the project is to develop a market for quality assured transports from an environmental and road safety perspective. The environmental part of the project is focused on lower energy consumption and reducing air pollution.
- M11. Economical driving (SPARK). The aim of the project is to reduce fuel consumption through a better style of driving. Methods for this are being developed and are used by both passenger cars and heavy traffic.
- M12. Better compliance with speed limits. The work on speed issues was primarily initiated for road safety reasons, but it also contributes considerably the attainment of the environmental goals. The work includes further development of automatic speed surveillance on dangerous road stretches, further development of models and systems for automatic and dynamic speed adaptation and public opinion campaigns.
- M13. Road drainage. Remove wildlife migration barriers: The SNRA, in co-operation with other relevant players, is to make an inventory and rectify incorrectly placed culverts and other wildlife migration barriers in the road reserve. In many cases this is a necessity for attaining the goal concerning biodiversity in watercourses.

#### Demonstration projects.

This is a collection of projects to test methods and assess the effects on a large scale in one or more regions. These projects can turn into national projects during the period.

- M14. Targeted information on environmental characteristics of cars.
- M15. Develop environmental and road safety activities in municipalities along the strategy of “Environment and safety on the road – an investment for the future”.
- M16. Smarter commuting for reduced environmental impact.
- M17. Car sharing for reduced environmental impact and increased accessibility to the road transport system.
- M18. Promote cycling – for reduced use of cars.
- M19. Co-ordinate community funded transports.

#### Studies and strategic development projects of national interest

- M20. National strategy for alternatives to fossil fuels.
- M21. Catalogue of measures for reduced noise.
- M22. Influencing attitudes to increase the proportion of travel by public transport.
- M23. Traffic control and IT measures to meet the environmental quality standards.
- M24. Easily accessible information on choices of travel in a concrete travel situation.
- M25. Improved accessibility for pedestrians and cyclists.
- M26. Easily accessible consumer information on the environmental characteristics of cars.
- M27. Spread information of commendable environmental measures undertaken in national road management.
- M28. As a sectoral authority and official referral body, the SNRA is also to demand that general plans, detailed plans and road plans have an impact on the possibility of creating a long-term sustainable road transport system.

### **Action plan for national road management**

National road management entails developing and managing the state road network. Part of the responsibility is to balance the different transport policy goals: accessible transport systems, high transport quality, safe roads, good environment and a positive regional development. The aim is that “everybody can choose safe journeys and transports in a sustainable and efficient road transport system which satisfies growing needs for mobility” (quote from the SNRA vision).

In practice, the work entails planning the state road network, and procurements involving the design and construction of new roads as well as maintenance and improvement works on existing roads. Important tools for achieving this include the governing and advisory regulations that other road managers also apply.

#### **Key environmental considerations**

An environmental review for national road management has been developed. It is defined for the impact of construction, maintenance and operations works on the environment. The following main groups of key environmental consideration have been identified:

- handling/use of chemicals

- consumption of diesel (transports and plant and equipment)
- choice and use of materials
- waste (origin and management)
- consumption of finite natural resources
- impact of activities and measures (noise, vibration, etc.)

These groups are not weighted in relation to each other.

The environmental impact assessments for each new and/or reconstructed road highlight the key environmental aspects to consider when planning and designing roads. The collected experiences from conducting environmental impact assessments indicate the following key environmental aspects to consider in planning and design:

- Barriers for people and animals
- The harmonisation of roads with their natural, cultural and physical surroundings
- Noise along state roads
- High levels of exhaust emissions along state roads

### **Goals**

- Follow-up systems for handling chemicals are to be in operation by 2003.
- A continuous reduction in the amount of salt per kilometre road treated and normal winter is to take place in the programme period.
- No drinking water catchment areas pumping more than 10 cubic metres per day or supplying more than 50 people are to have chloride ion levels exceeding 100 mg/litre because of road salt.
- By 2005, the combined measures undertaken through state road management during the programme period is to contribute to a reduction in carbon dioxide emissions of 5 000 tonnes as compared to not having implemented the measures.
- The environmental impact of the new specifications in procurement contracts<sup>6</sup> (2001) is to be assessed in a report by 2004 for the next edition of the requirements.
- Properties along the state road network with more than 65dBA outdoors are to have maximum 30dBA equivalent level indoors.
- A strategy of goals and indicators for water issues is to be drawn up by 2003.
- The proportion of natural gravel in ballast materials is to be reduced during the programme period with consideration to regional conditions.
- Regional maintenance plans for roadsides, tree-lined roads and cultural landmarks are to be developed and applied during the programme period in all regions.
- Plans for handling of waste, noise, vibrations and water pollution are to be presented to all contractors in accordance with the "SNRA's Environment Standards for Contractors".

### **Measures targeting goals and environmental aspects of consideration**

#### Measures within the field of planning

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<sup>6</sup> SNRA publication 1998:105, which will be published in a new edition by 2002.

- M29. Course for planning and design engineers on the new environmental impact assessment directives.
- M30. Follow up and assess environmental measures in connection with the construction and maintenance of roads.

#### Measures within construction, operation and maintenance

- M31. Develop routines for better environmental consideration at minor improvement works.
- M32. Further develop environmental management and contract specifications for construction works.
- M33. Implement the manual on environmental considerations during the construction phase.
- M34. Procure environmentally compatible electricity, so-called green electricity.
- M35. Review the environment standards in major bodies of regulations for civil works.
- M36. Implement the follow-up systems for handling of chemicals in road management.
- M37. Further develop environmental management and contract specifications for operation and maintenance activities.
- M38. Develop and implement maintenance plans for roadside areas.
- M39. Utilise roadside vegetation – “Road hay”.
- M40. Implement physical measures to make use of the cultural value of roads.
- M41. Investigate impact on water catchment areas and receptacles near roads.

#### Targeted physical environmental measures

- M42. Develop proposals for action plans along the state road network where it is expected that environmental quality standards will be transgressed.
- M43. Reduce the barrier effects for mammals, batrachians and fish.
- M44. Take protective measures in water catchment areas where needed.
- M45. Improve know-how concerning low noise level surfacing.
- M46. Conduct demonstration projects with low noise level surfacing.
- M47. Renovate worn and ugly city accesses and thoroughfares.
- M48. Encourage environmentally-sound transports by more and improved cycle paths and measures that promote car-pooling and public transport.

#### Development of goals and indicators for water issues:

- M49. Develop a strategy for surface and ground water protection.

### **Action plan for the exercise of public authority**

The exercise of public authority refers to the directives and regulations issued by the SNRA and applied along with ordinances in a way that affects the general public. As concerns the SNRA this means developing and applying regulations for vehicles, driving licences, the road environment and commercial traffic. Other tasks include reviewing applications for exemptions, the approval of final design plans for road construction projects and the administration

of state subsidies. When the SNRA makes decisions within these areas, it is essential to take into consideration the provisions in the second chapter of the Environmental Code.

### **Key environmental considerations**

The environmental review for the exercise of public authority is based on the 15 environmental quality goals adopted by Parliament. The environmental impact of the operations has been assessed with regard to these goals. In light of this, the areas of key environmental consideration within the exercise of public authority can be described as follows:

- Consumption of fossil fuels
- The composition of the vehicle fleet and its environmental characteristics
- Driver skills and expertise
- The distribution of vehicle mileage between the different means of transportation
- Environmental adaptation of roads

### **Goals**

- By 2005, the measures undertaken within the exercise of public authority during the programme period are to contribute to a reduction in carbon dioxide emissions of 10 000 tonnes, as compared to not having implemented the measures.
- Final design plans are to be of such a quality that they are not blocked on the grounds of insufficient environmental adaptation or shortcomings in the basic input for decision-making.
- During the programme period regulations that imply environmental impact are to be made explicit in terms of their importance for the environment.

### **Measures targeting goals and environmental aspects of consideration**

The exercise of public authority indicates the framework for other players. In this way, authority decisions create the basic prerequisites for the sectoral responsibility, although exactly how is not completely understood. This is true for SNRA's decisions as well as those of other authorities. The SNRA needs to improve its knowledge in this area.

- M50. Summarise current know-how and indicate the speed limits that contribute most to the environmental goal.
- M51. Review road signing and describe the possibilities for economising on fuel and use this as a basis for formulating concrete measures.
- M52. Investigate how economic incentives affect the potential for attaining the environmental goals today and in the future.
- M53. Facilitate the trial of alternative fuels.
- M54. Reduce the number of environmentally deficient vehicles in traffic.
- M55. Describe commercial traffic's share in environmental problems.
- M56. Incorporate environmental aspects in both the theory and practical driving test.
- M57. Supplement the driving test with a certificate of competency in environmental issues.
- M58. Simplify the final design plan process when constructing cycle paths and bus stops.
- M59. Review the regulations for cycles and cycling.

M60. Continue supporting environmental undertakings in private road management.

### **Action plan for common tasks**

Just like at other places of work, SNRA premises need heating, cleaning and lighting. Employees must travel to and often through their work. They require materials, information and knowledge in order to carry out their work. This is true anywhere. The goals and measures described here are not linked to any particular task of the SNRA, but apply to the organisation as a whole. An integrated environmental review for these tasks does not exist. The SNRA is to introduce one by 2003.

### **Key environmental considerations**

The reviews that have been made, both within and outside the SNRA, on environmental impact at a place of work, show that energy consumption is the key aspect. The choice of materials and use of chemicals is also of obvious significance. SNRA's environmental achievements within these and other areas are to a large extent a result of employee competency: knowledge, skills, ambitions and attitudes. Access to information concerning the environmental situation and management's ambitions within the environmental field is also crucial to environmental achievement. Hence, key environmental considerations are:

- Energy consumption (electricity, heating, travel)
- Choice of material and use of chemicals
- Competence of the staff
- External and internal communication

### **Goals**

- An environmental review for common tasks at the SNRA is to be completed by 2003.
- Follow-up systems for the use of natural resources with regard to work-related trips and work premises are to be introduced by 2002.
- Each regional administration and the head office are to reduce their own energy consumption per employee during the programme period.
- All employees who drive more than 5000 kilometres through their work every year, or who need to know more about economical driving for their work shall have received such training by 2003.
- A programme for developing environmental awareness in employees is to be ready by 2002.
- Relevant and easily accessible information on the environmental impact of road traffic is to be available on SNRA's homepage by 2003.
- Administrators working on procurement cases and in-house environmental endeavours are to receive support by the development of routines, opportunities to improve their skills and expertise, and networks that function by 2002 at the latest.

### **Measures targeting goals and environmental aspects of consideration**

The internal environmental work began to take shape during the former environmental programme. However, since this is not a designated area of responsibility in its own right and is seldom a matter of priority for either management or employees, it is often relegated to sec-



ond place. There are some brilliant exceptions. The development of SNRA's travel policy has been vital for SNRA's image in environment issues as well as for the development of travel policies in other organisations.

- M61. Implement a complete environmental inquiry into the tasks shared in common at the SNRA.
- M62. Reduce the consumption of natural resources on SNRA premises.
- M63. Develop good and simple routines for the compliance with and follow-up of the travel policy.
- M64. Facilitate walking, cycling and use of public transport for work and in work-related travelling.
- M65. Use environmentally compatible, so-called green electricity for heating and in offices.
- M66. Set environmental standards for conference centres.
- M67. Educate new employees in environment issues.
- M68. Develop the management's competence within the environment area.
- M69. Reinforce and develop the organisation and the expertise of those who work with internal environment issues.
- M70. Reinforce and develop the organisation and the expertise of those working with procurements and contracts outside the road management task.
- M71. Balance the information targeted outside the organisation so that all transport policy goals are taken into consideration.
- M72. Improve environmental information by conducting user studies.
- M73. Offer media courses to those working with environmental issues.
- M74. Make SNRA's environmental work known to the public.

## **SNRA's environmentally targeted research and development**

Research and development is an important means of support for attaining the goals in the national transport and environmental policies. The SNRA's Board of Directors has adopted a ten-year indicative programme with defined areas of research for the period 2000 – 2009. The research areas that primarily contribute to the achievement of the "good environment" goal in transport policy and hence the goals in environmental policy are:

- Sustainable conservation of resources within road and street management.
- Urban transport systems.
- Design, choice and use of vehicles and fuels for an ecologically sustainable development.
- Effective measures to reduce ground and water pollution.
- Design of roads and streets in natural and cultural environments.

The first three measures are project areas of high priority.

The indicative programme forms the basis for the three-year R&D plans that are updated every year and where research for around SEK 250 million is carried out every year. There are at present 15 framework projects (i.e. problem descriptions) in the R&D plan, which entirely or largely concern environmental issues.

### Overall framework projects on environmental issues

Nature, culture and design – development of goals, indicators and assessment methods.

Environmental impact assessment.

Reduction of the detrimental effect of roads on health and reduced carbon dioxide emissions – increased knowledge for better measures and control mechanisms.

Influence the choice of transport and vehicles for industry and individuals.

Methods of measurement and follow-up for traffic -related problems: air pollution, ground pollution, noise.

Urban transport systems.

Framework projects for vehicle issues:

Patterns of driving, emissions and fuel consumption for road plant and equipment.

Environmental impact of vehicles with alternative drive and fuel systems.

Noise as a result of driving patterns and tyres.

Framework projects for road management issues:

Environmentally-sound bridges.

Environmentally-sound tunnels

Environmental impact of stormwater.

Environmentally sound winter roads.

Recycling of materials used in road works.

Environmental impact of roads and traffic.

There are also framework projects for community development and transport needs as well as transport and community planning, both of which can concern research of significance for environmental impact in the future.

The actual R&D projects conducted in these and other environment-related framework projects is determined through proposals submitted by research institutes and the SNRA's priorities.

## Cost and impact of the programme

It will cost just under SEK 300 million per year to implement this entire environmental programme. This can be compared to the cost in 2000 to implement measures within a corresponding scope – about SEK 100 million. Is SEK 300 million then considered a lot or a little? And is it sufficient to enable the SNRA to live up to the ambitions and expectations of Parliament and the Government?

### SNRA's costs for environmental adaptations

Let us first look at what is not included in the programme's SEK 300 million/year, because the SNRA also carries out activities that lead to an improved environment but which are not mentioned in the programme.

The following costs are not included in the programme:

- Some regional measures based on agreements with regional or local players. At present these costs amount to SEK 15 million per year.
- Costs to avoid environmental problems when new roads or bridges are constructed or old ones re-built. These costs cannot be shown separately but are part of the road or bridge standard and consequently included in the works costs. The same applies for operation and maintenance costs.
- Research and development within the environment area – at present about SEK 35 million per year.
- Administrative support – contact with the general public, international undertakings, “business” intelligence, development of the environmental management system, etc. At present, this cost amounts to at least SEK15 million per year.

Consequently, it is not possible to describe SNRA's total costs for the environment for the period 2002 – 2005, but 300 million per year would form a substantial part of it.

### Is the programme sufficient to attain long-term goals?

The action plans and the proposed undertakings in the programme are based on optimistic but reasonable expectations on future resources. They imply a substantial increase as compared to today's actual level, but they also imply nearly as substantial a decrease compared to current long-term plans (regional road management plans + national plan for the road transport system = SEK 455 million per year). But is this enough money to attain the long-term goals?

A sustainable and environmentally-sound road transport system cannot be achieved by the work of the SNRA only. Contributions from many different players are needed for this to happen. Consequently it is difficult to put a price tag on an environmentally-sound transport system. Besides, efforts to attain other goals in society contribute to a better environment as well. Therefore it is difficult to attribute costs to a specific goal.

In spite of the great uncertainty, the SNRA has tried to put a price on the national costs for attaining the long-term environmental goals for the road transport sector. In the so-called “Goal adjustment project” this cost was estimated at between SEK 35 and 105 billion,<sup>7</sup> which amounts to SEK 1.4 - 4.4 billion per year. The SNRA's contribution was estimated at between SEK 17 and 20 billion - around SEK 750 million per year.

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<sup>7</sup> This refers to the total amount for all players for 25 years. The uncertainty is due to the varying calculation models used in the input – primarily to attain the goal for carbon dioxide.

One can compare this with the SEK 300 million per year, which is the cost of this programme and with the SEK 100 million for the corresponding measures in 2000. The conclusion to be drawn is that the SNRA does not at present have, or thinks it will have, the required resources to implement "its part" in attaining the long-term environmental goals during the programme period.

### **What would more money mean?**

What would happen if the SNRA were to receive more funds for environmental measures, like the corresponding sum of the current national and regional long-term plans, an annual amount of some SEK 450 million?

Many of the measures proposed are of such a character that they can be carried out at a higher or lower pace and intensity. This means that the programme can manage both a higher and a lower allocation of funds.

The environmental goals in the programme that would profit the most from increased financing are the carbon dioxide goal, the noise goal and possibly the goal on environmental quality standards for air.

The measures in the environmental programme are those that we consider will be possible to implement. More resources would primarily mean that the proposed measures could be implemented at a faster rate. Measures aiming at reducing carbon dioxide emissions could be speeded up. Consequently the probability of attaining the carbon dioxide goal in the programme would increase.

The probability of attaining the noise goal in the programme would also increase substantially. It could be possible to attain the goal as soon as by 2003, in line with the ambition of Parliament, if the better part of the extra resources were to be used for noise measures.

Also a number of the measures in the programme are of type: "Study and test measures of type X to see the effect on environment problem Y." The cost of conducting this kind of measure is calculated in the programme. Consequently, it can be assumed that given increased resources also new measures could be implemented during the programme period.

In order to attain the goals for the environmental quality standards in the programme, an analysis must be conducted of what has been learned from measures that have been implemented. Increased funding would allow systems for traffic control to be tested on a full scale. Nevertheless it could still be difficult to attain the goal. Today we do not know the scope of the problems nor how they actually are to be solved.

### **What would less money mean?**

A continued funding for environment measures on the level of year 2000 – around SEK 100 million per year – would imply significant limitations. It would mean that all of the overall environmental goals in the programme probably would not be attained.

In order to fulfil the goal for carbon dioxide in the programme, intensified co-operation within the sector is needed. Current projects need to be reinforced and new ones started. Given today's focus and rate of action during the programme period would mean only reaching half way at most.

The cost for attaining the goal on noise in the programme has been estimated at nearly SEK 500 million. In 2000, just under SEK 40 million was spent on noise measures. Given a similar funding the goal on noise will not be met during the programme period.

Also the environmental quality standards for air would be jeopardised. Traffic control systems along the highways in urban areas need to be developed and tested together with relevant lo-

cal authorities. A limited budget for the environmental programme would not allow investments in necessary demonstration projects.

The goal for environments of natural and cultural value in the programme implies setting a goal for the proportion of the road network that will meet the criteria for good natural and cultural adaptation. A comprehensive inventory of shortcomings in the road network in relation to the criteria is needed. Already known shortcomings also need to be remedied and methods for this tested. These measures work in conjunction to form the basis for setting the goals. A continued low allocation of funds would jeopardise this approach, and thereby the goal.

A cut down in resources would also mean that projects within areas that are not expressed in terms of an environmental goal are not going to take place at all. This concerns for instance systematic water protection measures.

Finally it needs to be emphasised that regardless of the level of funding the SNRA is going to get, this is not the crucial issue for attaining the overall, long-term goals. To do this, we need the contribution of many more players.

### **How are other transport policy goals affected?**

The measures proposed in the environmental programme are developed to contribute to our various environmental goals. However, they are also assessed in relation to other transport policy goals. Do the measures contribute to or conflict with other transport policy goals?

Since the measures in the programme include so many different parts of SNRA activities, they also have a very varying degree of impact on other goals. Some measures have a clearly positive impact on other goals, others, undeniably, a negative one. This cannot be totally avoided. However, in cases where the proposed measures have a contra-functional effect on other goals this will obviously influence the priority of the measure. To make such assessments of choice and implementation of measures is an area where the SNRA has long-standing experience.

### Road safety

Several of the measures contribute to the road safety goals, especially measures aiming at reducing speed or reducing car traffic. Such measures lead to fewer situations of conflict with pedestrians and cyclists, and thus reduced injuries. Reducing traffic with environmentally unsuitable cars should also promote road safety, since these cars are likely to be unsuitable with regard to road safety as well. Also measures encouraging an increased proportion of public transport will promote road safety.

There are proposed measures that neither contribute to, nor conflict with the road safety goal. When they are implemented they can still interact with road safety and have positive synergistic effects. This concerns various information measures and measures within community planning. Consumer information on environment characteristics of cars can for instance be supplemented with road safety aspects.

There are some measures where conflicts could arise if road safety is not given enough attention when implemented. This primarily concerns measures aiming at an increased proportion of pedestrian and cycle traffic. However, in the environmental programme there are also measures that support the protection of these road-users directly. An example of this is "simplified final design plans for the construction of cycle paths and bus stops".

A measure contested as to its conflicting impact on road safety is the reduction of road salt used in skid control.

Preserving natural and cultural environments and landmarks, like botanically prolific roadside areas, precious avenues and bridges of historical value, places demands as to how road safety

enhancement measures are carried out along roads. The conflict is not impossible to solve but wants respect paid to both environmental and road safety goals and an increased consideration and cautious approach from both sides. None of the proposed measures within the sectoral responsibility task or through the exercise of public authority directly conflict with road safety.

#### Accessibility

Accessibility means how we can reach activities and services in society through using the road transport system. There are measures that imply limited accessibility for cars but at the same time increase accessibility for pedestrians and cyclists. Generally speaking, accessibility for cars is considerably better than for pedestrians and cyclists. The proposed measures only have a marginal effect on accessibility for car users. However, there are also measures that imply increased accessibility to the road transport system, such as car-sharing, which makes cars available to new groups in a simple and economically beneficial way.

Measures to reduce noise and to meet the environmental quality standards for air can lead to limitations for road traffic along roads in residential areas.

#### Transport quality and regional development

The programme measures do not affect these goals considerably, except for measures within community planning. These could of course play an important part in supporting regional development, which could contribute to the development of an attractive region of positive environmental value.



## Follow-ups and reports

The follow-up of SNRA's four overall environmental goals and the detailed environmental goals in the action plans is aimed directly at verification of these goals. The goals are expressed in terms of a defined state that must be achieved at a certain point in time during the programme period.

In addition to this follow-up of goals, the SNRA will develop a system of indicators intended to describe how the SNRA and the road transport system are developing as concerns the environment. These indicators will be used to follow up developments as soon as relevant measurements are developed for them. A report will be presented in the annual environmental report.

### Today's environmental reports

Today's environmental reports covers traffic emissions, health effects, how the road transport system is used, its impact on our natural and cultural heritage, developments in road aesthetics, the use of materials, development of know-how and expertise, attitudes of various players, implemented activities, and much more.

All of this cannot be reported in full. Much of the environmental ambitions in the road transport sector and at the SNRA and what they lead to is described annually in SNRA's environment report. This is based on the statistics collected, surveys in the road transport system and on the SNRA's annual follow-up of activities.<sup>8</sup>

The Government's letter of appropriation stipulates the specific areas that must be reported. These can vary over time. Within the areas that have interim goals, these are assumed to be stable and are included in the proposed indicators below. Other feed-back occurs through a specific process.

### The need for environmental indicators

The environmentally related interim goals that the SNRA is to work towards either already exist, or are under development, for emissions into air, noise, health, natural and cultural environments, energy consumption and ecocycle adaptation. Even when the list of interim goals is made complete, a follow-up will only give a rough picture of the environmental improvements. Therefore indicators are needed that provide information on how the road transport system as a whole is developing and how SNRA is adapting its own activities to take the environment into consideration.

Both nationally and internationally there is a need to describe developments in environmental issues in society. One example is the TERM report issued by the European Environment Administration (EEA): Transport and Environment Reporting Mechanism. Indicators must be chosen and designed also with this function in mind.

The indicators chosen represent separate levels in the SNRA's management process model;

- how the SNRA's resources are used
- the processes implemented by the SNRA and other players.
- achievements that change products and services of the SNRA and other players.
- changes in the state of use of the road transport system

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<sup>8</sup> Some of the basic parameters are important for more than just the environmental result. This concerns for instance the distribution of vehicle mileage per mode of transport and speeds. These parameters are not described here.

- Environmental effects.

The fact that there are indicators in the overall management process model makes it easier to follow environmental trends over time. Changes in the use of resources and processes can be noticed at an early stage while changes in the state of use and environmental effects come later.

As more is learned, for example new environmental analyses, the list of indicators may need updating. To develop these indicators, measurement methods and reporting routines is in itself a major undertaking during the programme period.

Apart from the indicators chosen, each department or division at the SNRA is to follow up other key environmental considerations as needed in order to describe their environmental achievements and communicate this to others.

## **Environmental indicators for SNRA activities and areas of responsibility**

### Environmental effects

- Δ The number of people along the state roads exposed to noise above the guidelines.  
“Status”: Included in present-day environmental reports. The Government’s demand for feedback and specifications as stipulated in the Environmental Code.
- Δ The number of people along the state roads exposed to air pollution above current target values, guidelines, environmental quality standards, etc.  
“Status”: Method needs to be developed. Requirement on in-house control as stipulated in the Environmental Code.
- Δ The number of water catchment areas along the state road network pumping more than 10 cubic metres/day or supplying more than 50 people with drinking water and containing levels of chloride ions above 100 mg/litre because of road salt.  
“Status”: Implies a minor change in the indicator “number of polluted water supplies”, which is included in the present environmental reporting.

### SNRA’s products and services:

- Δ Proportion of the state road network adapted to natural and cultural environments.  
“Status”: Measures and methods drawn up by 2003 through the project that is involved in determining goals and indicators for environments of natural and cultural value.

### SNRA’s processes and achievements

- Δ Reduced emissions of carbon dioxide as a result of SNRA’s total operations.  
“Status”: Requirements in compliance with the Government’s letter of appropriation.
- Δ Use of chemicals and environmentally hazardous materials within the SNRA.  
“Status”: Follow-up method needs to be developed. Work conducted in a governmental commission.
- Δ The amount of used road salt per kilometre of road treated with salt and normal winter in the state road network.  
“Status”: Implies a change of the indicator “amount of road salt used on the state road network”, which is included in the present environment report process and is the Government’s demand for feedback.
- Δ The amount of natural gravel used on the state road network.

“Status”: Proposal by the Environmental Targets Committee. Included in the present reporting process. Governmental demand for feedback.

#### SNRA's resources

- Δ SNRA's investments in the pedestrian and cycle path network and subsidies to networks managed by other players.  
“Status”: Proposed in the EU project TERM. Gives a good picture of the intensity of the Government commission to increase the relative proportion of pedestrian and cycling traffic. The Environmental Targets Committee's proposal as an indicator. Accessibility indicator for bicycles still lacking.
- Δ SNRA's own investments in public transport facilities and SNRA's subsidies to other public transport facilities.  
“Status”: Proposed in the EU project TERM. Gives a good picture of the intensity of the Government commission to increase the relative proportion of public transport. The Environmental Targets Committee's proposal as an indicator. Accessibility indicators for public transport still lacking.
- Δ SNRA's targeted investments in the environment and subsidies to the targeted investments in the environment by other players.  
“Status”: Part of today's environment reporting process. Proposed in the EU project, TERM.
- Δ SNRA's funding of road sector environmental endeavours.  
“Status”: Gives a picture of the level of ambition of the Government and the SNRA .

### **Environmental indicators for the road transport system**

#### Environmental effects

- Δ Emissions of carbon dioxide, nitric oxides, sulphur dioxide, hydrocarbons, particulate matter (PM10) and carcinogens in the road transport sector.  
“Status”: Included in today's environment reporting process. Government demand for feedback.
- Δ Number of people exposed to noise above current guidelines and target values.  
“Status”: Included in present reporting process. Proposal by the Environmental Targets Committee.
- Δ Number of people exposed to air pollution above current guidelines, target values, environmental quality standards, etc.  
“Status”: There is a requirement that each road manager is to conduct its own control as regards environmental quality standards. Method needs to be developed during 2001. The SNRA will compile the whole picture.

#### State of use for the road transport system

- Δ Number of cars in traffic primarily run on non-fossil fuels.  
“Status”: Calculation method needs to be developed during 2001. Significant for the follow-up of carbon dioxide emissions. Gives a good picture of the rate in the phasing out of fossil fuels.
- Δ Number of cars in traffic without catalytic converters.  
“Status”: Part of SNRA's present environmental reporting.
- Δ Load factors in goods traffic.

“Status”: Statistics are available (SCB/SIKA) but need revising for “driving without a load”. Proposed in TERM’s follow-up. The indicator describes improved efficiency in goods transports.

- Δ Extent of use by passenger car traffic measured as number of people/ vehicle kilometre.  
“Status”: Statistics are available in RVU. Proposed in TERM’s follow-up. Significant area of follow-up linked to the sectoral endeavours aimed at environmental improvement.
- Δ Amount of fuel delivered (diesel and petrol).  
“Status”: Included in SNRA’s present environmental reporting.
- Δ Road-users’ appreciation of environmental adaptation (measured as an index).  
“Status”: Indicators that have been developed by the SNRA. Proposed in TERM’s follow-up.
- Δ Access to alternative transportation.  
“Status”: Indicators need to be developed. Proposed in TERM’s follow-up. Proposal as an indicator by the Environmental Targets Committee. Can be measured as distance to public transport or as average part of a journey to work or school undertaken by walking, cycling or public transport.

#### The players’ products, achievements and services

- Δ Specific fuel consumption in new cars.  
“Status”: Indicator available. Proposed in TERM’s follow-up.
- Δ Amount of natural gravel used for road purposes.  
“Status”: Proposal by the Environmental Targets Committee. Indicators and statistics at the SGU. Governmental requirement on feedback transferred to system level.