Environmental Impact Assessment of Low-Volume Roads

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In Finland, development of a procedure for the environmental impact assessment of low-volume road projects started in 1991-1992 in connection with a road project in the region of North Karelia. A further project in North Karelia and a guideline project for the Turku region have contributed to formulating a general framework. The framework emphasizes the initial stages of project design. A common model can be given for project initiation, data gathering, interest group formation, project objective identification, and preliminary alternative design. The further process of assessment tends to vary as new facets of local interests and value show up during design.

Low-volume roads seldom give rise to major changes in traffic patterns, nor will their alignment demand massive reshaping of the landscape or removal of other land use. As a consequence, the environmental impacts of a low-volume road project are usually limited to local concerns.

However, in this local context, the impacts may be severe. For a village, the road may be a major factor for future land use, shaping the village in accordance with whether its alignment fragments land use or allows it to develop. A misplaced saving in costs may impair traffic safety as well as objects or areas of environmental importance. Choosing an inappropriate standard profile can cause damage to the landscape, to field drainage, or adjoining housing. Roads entering nature preserves or other hitherto untouched areas may give rise to fundamental changes in the possibilities to continue preserving the biological diversity of such areas.

For most of these impacts, the amounts of traffic are less important than the engineering choices made. The environmental aspect of developing low-volume road design centers on how the engineering choices can best be fitted to the actual environment and to serving the people concerned.

Environmental Impact Assessment Procedure

Globally, the environmental impact assessment (EIA) procedure is one of the most important tools for developing the environmental aspects of project design. Since its inception in the United States in the early 1970s, it has been adopted almost everywhere. In Europe, the European Economic Community 1985 directive on EIA was a significant step in implementing the procedure.

The Finnish EIA law was adopted in 1994. The law, as proposed in 1993, has been described elsewhere (*1*). Figure 1 shows how the stages stipulated in the law influence the design of roads. The decisions on application of EIA, an EIA schedule, and an EIA document are mandated by the law for motorways and semimotorways and such other projects of a similar scale that can cause severe environmental disturbance.

In developing EIAs, legal compliance is an important, but mainly formal, aspect. Environmentally responsible

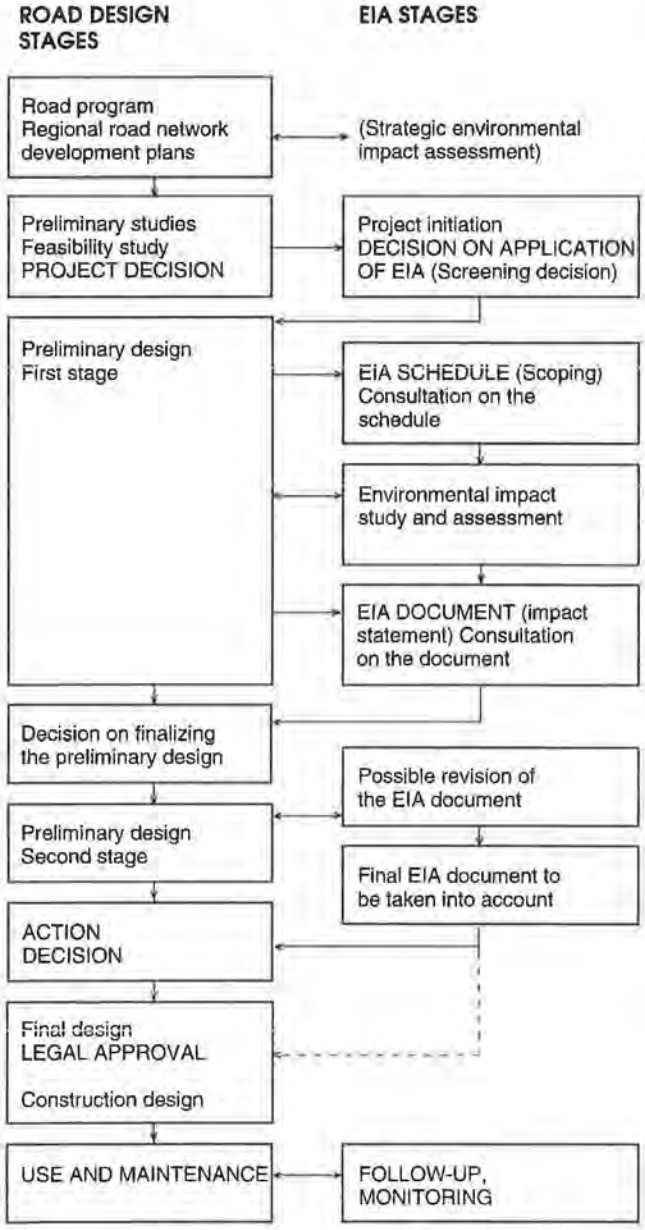

FIGURE 1 Road administration guidelines for environmental impact assessment of roads in Finland (*1*).

design demands development in substance. For this reason, the Finnish National Road Administration (FinnRA) started the development of its own EIA procedure before legislation was proposed. This procedure includes all projects that may have significant environmental impacts, not only those mandated by the law (*2*).

Assessing Low-Volume Roads

The design process for a low-volume road project is simple. The design object is identified, design proceeds, and, as a final design emerges, it is proposed for legal approval. Considering the simple design process, one needs to ask whether it is necessary to include an assessment and, if so, how it can be organized without unduly complicating the process. Legal stipulations on EIA do not concern low-volume roads.

Although the impacts of low-volume roads may be minor from a national or regional point of view, they are extremely important for the people the road is intended to serve and for their environment. If a systematic assessment is not performed, the question of how these impacts will affect the future of the local environment and how the project will fulfill its objectives will be left to chance. A skilled designer will consider many of the impacts intuitively, but not all designers are skilled nor is it possible for any other party concerned to review the intuition of the designer.

A systematic assessment is a way to open up the design process to scrutiny, allowing all concerned parties to assist in reaching a good solution. An engineering assessment of the project and a review of its costs will take place regardless of whether it is identified as an assessment in the work schedule or not. That assessment is made by the designer, the designer's colleagues, and the authority deciding on approval of the project. Thus, stating that an assessment is necessary actually means that a system is needed for documenting the engineering and cost assessment and for including the environmental aspects.

Organizing the assessment is to make clear how and when the stages of assessment take place and what decision is made and by whom following the assessment. If one avoids too strict guidelines, allowing the procedure to be fitted to each project and environment in a flexible way, this will not complicate the design process.

North Karelia Regional Road Administration Development

Public Road 5053

The development of a low-volume road EIA was started by the North Karelia Regional Road Administration in 1991 in connection with the design of a stretch of Public Road 5053 in Eno municipality in eastern Finland (Table 1 and Figure 2). The technical standard and the alignment of the road needed to be improved. The major impacts would be caused by changes to 3 km of the road within the village of Ahveninen and to 5 km within a forest area west of the village.

A review of the assessment procedure is included in an earlier paper (*1*). The project was discussed at two village meetings and a series of interviews was performed. Villagers proposed several alternatives to the

TABLE 1 Public Road 5053 Project (*4*)

1. THE ROAD	
Public Road Nr 5053	Romppala-Ahveninen, in Eno Municipality, North Karelia Region in Southeastern Finland. The road is a connection to Main Road 18, serving especially Uimaharju and Ahveninen villages. Tourist traffic to the Koli nature park area.
Average Daily Traffic	Present: 240-350 vehicles, of which 10-20 trucks. Predicted: some 450 vehicles, of which 100 trucks (2010).
Standard	A winding, hilly road, difficult for trucks, especially in winter. Frequent frost heave damage. Traffic safety level acceptable.
2. THE PROJECT	
Project Description	Improving a 20 km stretch from Uimaharju village westwards, through Ahveninen village and the Paukkajanvaara-Kaltimonlahti forest area.
Project Objective	Improve traffic connections from Uimaharju to the main road network, especially considering truck transport for Enocell paper plant in Uimaharju.
Alternatives	- No action - Partial improvements on the existing alignment (do minimum) - Initial Road Administration realignment design - Several alternative alignments for Ahveninen village
3. MAIN AREAS OF IMPACT	
On Population	226 inhabitants in Ahveninen, for a 3 km stretch of the project.
On Natural Values	Paukkajanvaara-Kaltimonlahti forest area, for a 5 km stretch.
4. MAIN ENVIRONMENTAL IMPACTS	
No Action	Increased truck traffic disturbance (noise, vibration, risks) to population; some increase in accident risks.
Do Minimum	Increased traffic disturbance.
Initial Design	Major changes to village structure and landscape. Impediments to agriculture. Severe disturbance to the forest area immediately west of the village (13 objects destroyed or at risk).
Ahveninen Alternatives	Minor impacts on village structure and landscape.

projected alignment. New alternatives were included in the assessment, as were the "no-action" alternative and a "do-minimum" alternative that would not change road alignment.

On the basis of the discussions, the assessment took the form of a description of the impacts of the alternatives on the village. For the forest area, alternatives were formulated and assessed by the North Karelia Board of Waters and the Environment. The main impacts of the project alternatives are given in Table 1.

When the assessment started, the road administration had already decided on an alignment proposal. The decision eventually made resulted in only minor changes to that initial alignment, even though other feasible alternatives had been identified with less severe environmental impacts. To that extent, introducing the EIA did not fully succeed. The villagers appreciated that the road administration took the initiative to explain and discuss its project, but in the end, they felt that their own efforts were ignored. A main reason for the limited success of this process was that the EIA was introduced at a very late stage. This was a pilot project and initially no specific impact assessment had been foreseen. The procedure was fitted into a summer break to avoid lengthening the timetable.

Mönni Ferry

In 1993 the North Karelia Regional Road Administration decided to apply the assessment procedure in connection with a proposal to replace a road ferry by a

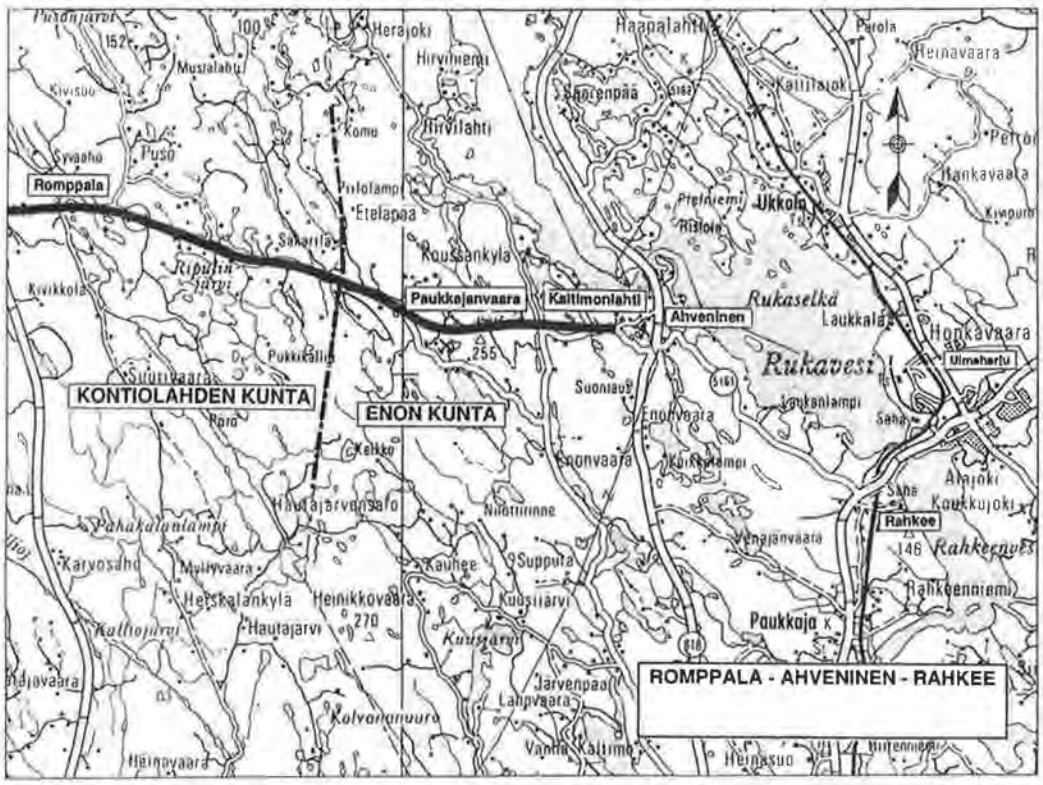

FIGURE 2 Location of Public Road 5053 (3).

bridge (3). The Mönni ferry carries some 320 cars a day over a 210-m-wide stretch of the Pielisjoki River. Replacing the ferry by a bridge would shorten car journeys, but one of the main motivations for replacement proposals was the cost of maintaining the ferry service. Figure 3 shows the location of the ferry, and Table 2 presents additional information on the project.

Three preliminary alternatives had been identified in February 1993: keeping the ferry, replacing it with a bridge just south of the ferry, and replacing it with a bridge 2 km south of the ferry. These alternatives were studied by the regional road administration in cooperation with the villagers concerned, regional and local authorities, the environmental and land-use planners of Kontiolahti municipality, a researcher from the regional board of planning and experts from Joensuu University. Table 3 presents an outline of the Mönni ferry project's design and its assessment.

The work was overseen by the North Karelia regional authorities' environmental cooperation group. Groups of this type were introduced in all Finnish regions in 1991 to improve cooperation between the road administrations and other authorities. The villages were represented by the village councils, a traditional form of local association still active in many rural areas. The project was publicized in the local papers. Village meetings were also held. A questionnaire was used to survey people's opinions.

As a conclusion of the assessment, the regional road administration decided to proceed with design of a bridge just south of the ferry. Of two variants assessed —a three-span bridge with fairly long embankments and a five-span bridge with short embankments—the five-span bridge was chosen as being better fitted to the landscape. The solution chosen mirrored the opinion of the villagers that a bridge would do if it was attractive (3). The assessment showed that the environmental disturbance or risks caused by this alternative were minor.

In this case, the EIA was integrated into the design from the start. Conflicts were avoided probably partly as a result of favorable initial conditions because the project had the support of general opinion. But the taking of all aspects and impacts into consideration from the beginning, and the cooperation with the public, did ensure that support continued.

The duration of this stage of the design process was 10 months, some 4 months more than if the EIA procedure had not been involved. However, including the feasibility study and the subsequent final engineering, the process would have extended from 1991 to 1994 in any case.

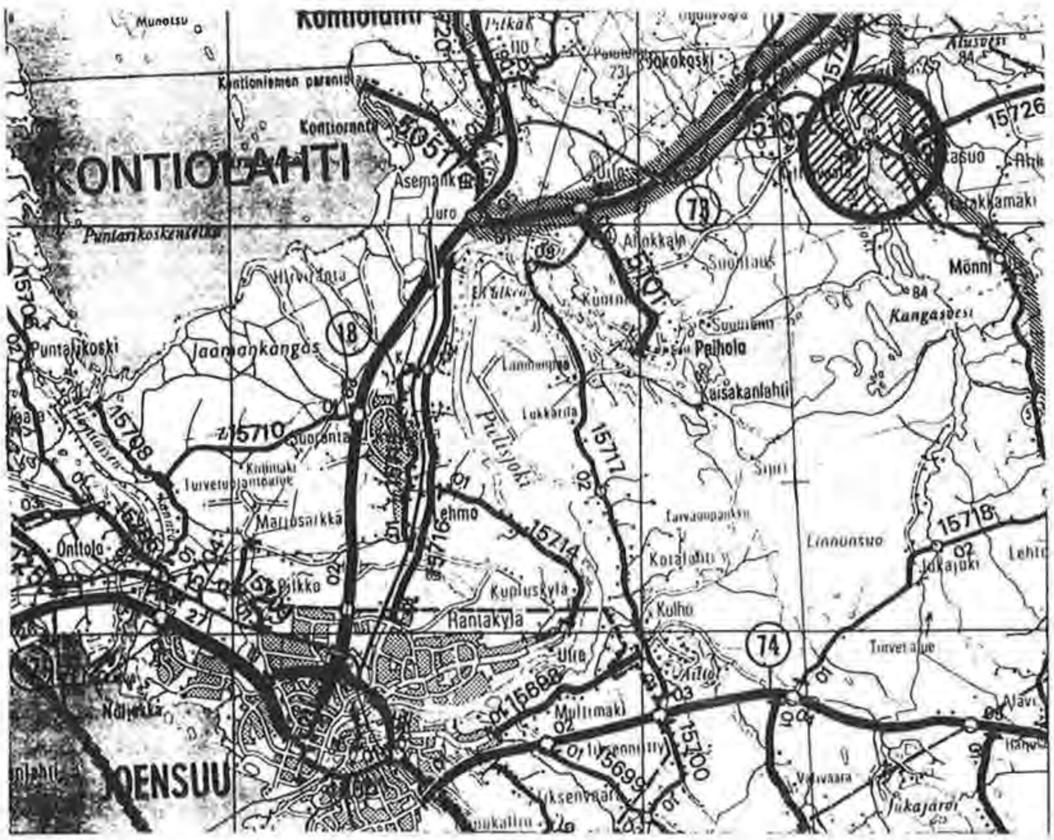

FIGURE 3 Location of Public Road 510 and Mönni Ferry (*4*).

Evolving Framework

A follow-up report on the Public Road 5053 project was prepared by the Central Road Administration (*4*). Table 4 shows the procedure for design and assessment of low-volume road projects proposed in the report. Of the decisions given in Table 4, only the decision on approval is legally mandated. The other decisions are based on FinnRA guidelines. The proposal emphasizes the early involvement of interest groups, that is, local authorities, organizations, and people concerned with the project.

The interest-group concept implies that consultation need not be between the road administration as an organization on the one hand and individuals on the other. Those who find that they have a common interest regarding the project can form a group. If necessary, the road administration should assist in interest-group formation, arranging preliminary meetings in which people will hear about the project and at the same time be able to identify others who have interests similar to theirs. Often, groups already exist in the form of local associations.

Table 3 shows an outline of the Mönni design and assessment procedure. This procedure corresponds to the stages indicated in Table 4, from project initiation to choosing an alternative. The actual process is not divided into such clearcut stages as those proposed in Table 4. Instead, exchange of information and discussion have been continuous, whereas interest-group formation and decision stages were less important in this case. The need for specific interest groups will depend on whether the project is seen as controversial.

In addition, the environmental consultant noted that discussions with Mönni village council members, other interested parties, villagers encountered during field studies, people visiting the road administration offices, and others were included in all stages of the work (*5*).

Two points emphasized by the outline in Table 3 are as follows:

- The prominent role of local and regional environmental authorities and researchers and
- The need for an independent review of the EIA in cases in which it is mandated by law.

In Finland, there is a profusion of regional authorities covering administration, waters and the environment, forestry, agriculture, navigation, planning, road administration, and others. Some of these are being amalga-

TABLE 2 Mönni Ferry Project (3)

1. THE ROAD	
Public Road Nr 510	Alavi-Jakokoski, in Kontionlahti Municipality, North Karelia Region. The road is a connection to Trunk Road 73, serving villages along the Pielisjoki river. The river crossing is by ferry.
Average Daily Traffic	Present: 320 vehicles, of which 5-10% trucks. Predicted: 390 vehicles (2010).
Standard	The ferry distance is 210 m (6 minutes). The present ferry can carry 44 metric tons. The annual cost for the ferry is 2 Million FIM (0.4 Million USD).
2. THE PROJECT	
Project Description	To improve or replace the ferry connection.
Project Objectives	Avoid delays expected due to capacity problems. Reduce costs.
Alternatives	- Retain the ferry, in which case a new ferry is needed by 2005 - Replace the ferry with a bridge 2 km south of the ferry; bridge length 100 m and new road alignment 3.2 km - Replace with a bridge 0.4 km south of the ferry (bridge 250 m, new road 1.6 km). Two bridge variants: 3 and 5 spans.
3. MAIN AREAS OF IMPACT	
On Population	556 persons in surrounding villages.
On Natural Values	The Pielisjoki river, the river landscape, valuable wetlands and areas of vegetation along the river.
4. MAIN ENVIRONMENTAL IMPACTS	
Retaining Ferry	Ferry noise (riverside L_{Aeq}47dB, L_{Amax}70dB) and exhausts (sulphur, nitrogen oxides).
Bridge 2 km South	Embankments disturb wetlands. The new road cuts through two ecologically valuable forest areas. Some increase in housing east of the river (2-3 families / year) and possible changes in housing and service patterns. Some risk to present tourist services viability (situated at the ferry).
Bridge 0.4 km South	For a 3 span bridge, an embankment of 150 m length and 10 m height will impair river flow and landscape. For a 5 span bridge, such an embankment is not needed. Some increase in housing.

mated. Although they undoubtedly make for some administrative confusion, they are most important as regional centers of data and know-how. Together with local expertise, in this case exemplified by the researchers of the University of Joensuu in the capital of North Karelia, they provide essential input to environmental studies and assessment.

An independent EIA review corresponds to the procedure mandated for projects subject to the EIA law, in which the regional board of administration gives its review in a final statement on the assessment, summing up the statements of all other parties. A similar practice for smaller-scale projects seems justified. It introduces a final consideration of EIA validity, clearing up any mistakes or misunderstandings that may have arisen.

The stages and procedures shown indicate an evolving framework for low-volume road EIAs. There are differences between the procedures, mainly as a result of differences in the projects at hand. However, it can be seen that as work progresses, the importance of the initial stages of design is emphasized.

Turku Regional Road Administration Development

The Turku Regional Road Administration in southwestern Finland started the development of low-volume road EIAs in 1993. The objective was to test the application of the EIA on a small road project and to

TABLE 3 Outline of Mönni Ferry Project Design and Assessment Procedure (*5*)

DATE	STAGE	PARTICIPANTS
1991	Feasibility study	North Karelia Regional Road Administration (NKRA)
February, 1993	**Project initiation decision**	Central Road Administration (published locally)
April, 1993	Project presentation	Mönni village council, NKRA, local paper
May, 1993	Discussion on objectives	Regional authorities' environmental cooperation group, village development project, local paper
June, 1993	EIA contract and **EIA schedule**	NKRA, consultant, discussions with regional and local authorities
July, 1993	EIA inventory, map and field studies, other published data, opinion survey	NKRA, consultant, the Regional Boards of Waters and the Environment, Navigation, and Forestry, Mönni and Selkie village councils and Jakokoski village council chairman, interviewees
	Village meetings	NKRA, consultant, Mönni and Selkie villages, local paper
August, 1993	Impact studies	NKRA, consultant, environmental and land use authorities, local researchers, the Regional Boards of Planning, and Waters and the Environment
	Discussion on impacts	NKRA, consultant, Selkie, Heinävaara, Mönni, Pohja and Jakokoski village meetings, local paper
September, 1993	Evaluation of alternatives	NKRA, consultant, local researchers
October, 1993	Alternatives finalized	NKRA, consultant (environmental aspects, landscaping, mitigation)
	EIA report	NKRA, consultant. The document is distributed to all concerned parties.
December, 1993	EIA review	The regional authorities' environmental cooperation group
	Project decision	NKRA (on choice of alternative)

produce a low-volume road assessment guide. In the test, road design groups were asked for proposals on how to implement the EIA in the Lappi-Hinnerjoki road project. The proposals were taken into account when guide material was developed, the aim of which (*6*) is to assist the road designer in identifying the initial considerations essential to programming a low-volume road project EIA. These considerations are shown in Table *5*.

The role of the programming stage is emphasized. It represents a thorough spelling out of what the project is about and what impacts it may have. On the basis of this program it is possible to decide to

- Continue with an assessment, the scale of which depends on the diversity of impacts and interest groups identified, or
- End the process having clarified the reasons for the lack of need for an assessment.

To obtain the basic data and delineate studies needed, the guide recommends discussions with road administration personnel and other experts, local representatives and regional researchers, as well as regional authorities' environmental cooperation groups. A checklist on possible impacts is appended to the guide, and the discussions will aid in deciding which impacts may be relevant for the project concerned.

Another appended checklist concerns possible interest groups. For a given region, it is useful to list the regional and local authorities, public interest groups, and other active organizations or groups known, as well as examples of organizations representing local interests. This procedure simplifies the first contact by tele-

TABLE 4 Proposed Design and Environmental Assessment Procedure for Low-Volume Road (*4*)

DESIGN PROCEDURE	ASSESSMENT AND DECISIONS
1.Project initiation - project objectives - task list	Interest groups are informed, the need for EIA is determined and a preliminary EIA schedule is defined.
2.Design program - focusing the design task - work program	A project group is formed, with interest group representatives. Decisions to be made, and the needs for public consultation, are defined. The **EIA schedule** is included in the work program.
3.Basic inventory traffic/engineering/environment	Environmental inventory, consultation with the interest groups on design objectives.
4.Final design objectives - traffic - economy - environment	Preparing a decision on design objectives and documentation of the decision material. **Decision** on design objectives. Interest groups informed.
5.Alternatives and their impacts - road network - land use - alignment - engineering - environment - costs	Public consultation on forming and assessing alternatives. Preparing a decision on alternatives and documentation of the decision material. **EIA report**. Interest group statements on alternatives.
6.Choosing an alternative	**Decision** on choice of an alternative. Interest groups informed.
7.Preparing the final design - engineering design - final impact studies	Consulting the people concerned on design details, defining mitigation measures where needed, deciding on the need for and methods of follow-up. Final design published. Final statements of interest groups, local authorities and other concerned parties.
8.Legal approval	**Decision** on approval. Legal appeals possible.

TABLE 5 Initial Considerations for Low-Volume Road EIA (*6*)

1.	BASIC ENVIRONMENTAL DATA
	- what basic data are needed?
	- from where and how are they obtained?
2.	ENVIRONMENTAL IMPACTS AND AFFECTED AREA
	- what environmental impacts does the project have?
	- what is the affected area?
	- what studies are needed?
	- who will do them?
3.	PUBLIC INVOLVEMENT
	- what are the interest groups concerned by the project?
	- how are the groups to be reached?
	- how will contacts be maintained?
4.	PROJECT OBJECTIVES AND PRELIMINARY ALTERNATIVES
	- what are the objectives of the project?
	- does the project have specific environmental objectives?
	- what are the preliminary alternatives?

phone, letter, leaflet, or other means; the responses will identify the further contacts in a specific project. In most projects, a general mailing list is maintained.

The forms of public involvement during design may vary. Local representatives, the local authority, and the road designer can form a working group; the local population can form a group of its own; or discussions may be arranged at village meetings. The regional authorities' environmental cooperation groups are not expected to be involved in stages other than the first discussions and the review stage, as their main concerns are directed toward large-scale projects.

Project objectives are formulated on the basis of the discussions. Technical and economical objectives need to be formulated with the same care as environmental objectives. It is to be expected that some of the objectives will conflict, for instance, the need for as short an alignment as possible as opposed to avoiding the fragmentation of fields or forests. Some objectives form a mutually supporting group, for instance, retaining village structure and using existing roadbeds where possible. The preliminary alternatives are designed to correspond to each group of objectives, expressing the conflicts as choices among possible solutions.

It will not be possible to express some objectives in the form of, say, an alignment alternative, but it is important to discuss these objectives and their implications thoroughly, too. Unanimous solutions are seldom possible, but by discussing each objective and interest, a better understanding can be reached. These discussions will reduce conflicts at the decision stage.

The guide notes that the success of this procedure demands the full commitment of road administration personnel. Especially in projects of this scale, a lack of understanding expressed even as a half-serious comment such as "well, we put the road where we wanted it, anyway" may severely impair public trust.

Objectives of EIA and Low-Volume Road Design

The EIA is not an end in itself. It is a tool to implement objectives such as the following (2):

- Improve decisions by basing them on a systematic assessment of actual alternatives and their impacts,
- Present the concerns of the environment to the decision makers at the same time as and on the same level as other aspects,
- Improve the exchange of information and cooperation with the public, giving the people concerned a real chance to influence projects,
- Clarify the responsibilities of public and private authorities, agencies, and interests and develop cooperation among them, and
- Define how environmental disturbances or damage can be avoided or mitigated and how damage arising after implementation of the project can be identified and mitigated.

Present development shows that these objectives can be met by a simple procedure if it is carefully thought out. The main concern has been in improving the exchange of information and including environmental aspects in project considerations. These improvements will in their turn ensure a better basis for decision making, as well as clearer responsibilities for all parties involved, especially the division of responsibilities among the road administration, local authorities, and environmental authorities.

In the cases presented, the questions of avoiding or mitigating environmental damage have not been studied in depth. In general, a low-volume road project will not require extensive mitigation of environmental disturbances if, in the choice of alignment, the environmental aspects have been taken into account.

Conclusion

The usefulness of the EIA methodology is not limited to large-scale projects. For low-volume roads, the EIA can serve as the basic structure of the design process. In Finnish development to date, cooperation and public involvement are emphasized. Compared with previous design procedures, involving a wide range of professions and interests in design demands a larger effort and takes a longer time, but the increase in demand on resources is moderate when set against the whole duration of design and construction. What is gained is a more thorough understanding of the project, its alternatives, and their impacts; a better fit to the environment; and the avoidance or mitigation of conflicts.

Public involvement does not automatically guarantee public support, but an early and continuous involvement will ensure that the public is aware of the motivation for the project and for any subsequent decisions.

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