Post-Project Analysis of Visual Impact Assessment: Implications for Visual Resource Management

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ABSTRACT

In development projects where visual concerns are identified, visual impact assessment (VIA) is an important and necessary part of environmental impact assessment. This study involved post-project analysis of three projects for which environmental impact assessment, including a visual impact component, was carried out. Post-project analysis has been identified as a way to improve environmental impact assessment by providing feedback about impact prediction, project effects and mitigation measures.

For each case, written documentation, photographs and computer-generated simulations were reviewed, and interviews with key people and site visits were conducted to collect relevant information. Using this information, each case was analyzed according to four criteria relating to the visual impact assessment methods and procedures used, the accuracy of visual predictions made, the effectiveness of visual mitigation measures implemented and the clarity and completeness of project documentation.

Based on this analysis, seven recommendations to improve the practice of visual impact assessment are presented. These deal with:

- the early identification of visual concerns in project planning
- the consideration of the long-term nature of visual impacts
- the use of suitable methods to gather visual information
- the application of visual assessment guidelines where they exist
- the clarity of documentation for undertaking post-project analysis
- the completeness of information for decision-making
- the documentation of information using visual and verbal formats

Effective visual impact assessment will ensure that visual quality factors are considered together with biophysical, economic and social factors in environmental decision-making.

RÉSUMÉ

Lors de L'application d'un projet où l'on se soucie de l'impact visuel, l'evaluation des incidences visuelles (EIV) devient un element fondamental de l'evaluation de incidences environmentales. La present etude comporte un analyse de trois projets où une evaluation des incidences environmentales fut entreprise tout en incluant une evaluation des incidences visuelles.

L'analyse entreprise a la suite d'un projet est une methode éprouvée pour ameiorer le processus de l'evaluation des incidences environmentales. Pour chacun des trois cas étudiés, l'auteur a revise toute documentation écrite, photographies et simulations à l'ordinateur. En plus, des information supplementaires furent recueillies a l'aide d'entrevues menées avec experts et de visites aux sites des projets.

Suivant le recueil et la revue des donnees, chaque cas fut analyse selon quatre criteres ayant rapport aux methodes et aux procedures utilisées en evaluation des incidences visuelles, l'exactitude des predictions visuelles, l'efficacite des mesures d'atténuation visuelle utelisees, ainsi que la clarté et le niveau d'achevement de la documentation du projet. Sept recommendations basées sur cette analyse sont présentées dans le but d'ameliorer la pratique de l'evaluation des incidences visuelles. Ces recommendations incluent:

- l'identification hâtive des impacts visuels lors de la planification du projet
- de reconnaître la caracteristique à long terms que peut avoir un impact visuel
- l'utilisation de methodes appropriees pour recueillir l'information visuelle
- l'application de recommendations en evaluation des incidences visuelles où elles existent
- l'enregistrement des donnees utilisant une methode visuelle ou orale
- l'état complet de l'information pour permettre une bonne decision
- la clarité de la documentation du projet

Une methode d'évaluation des incidences visuelles efficace assurera que les facteurs d'impact visuel seront consider& au même niveau que les facteurs biophysiques, sociaux et economiques lor des decisions affectant l'evaluation environmentale.

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EXECUTIVE SUMMARY

In development projects where visual concerns are identified, visual impact assessment (VIA) is an important and necessary part of environmental impact assessment. This study involved post-project analysis of three projects for which environmental impact assessment was carried out. In each project, visual concerns were deemed important, visual impact assessment was undertaken as part of a development proposal or environmental review, and the proposed development became operational. Post-project analysis has been identified as a way to improve environmental impact assessment by providing feedback about impact prediction, project effects and management and mitigation measures (Sadler and Davies 1988, Krawetz et al. 1987).

Data from each project was reviewed. Sources of information included written' documentation, photographs and computer-generated perspectives, interviews with key people and site visits. Following data collection and review, each case was analyzed according to the following criteria:

-the suitability and adequacy of the visual impact assessment methods and procedures used in the project
-the accuracy of the visual predictions made
-the effectiveness of the visual mitigation measures and management options implemented
-the clarity and completeness of project documentation.

Based on the post-project analysis, seven recommendations regarding the practice of visual impact assessment are put forth.

Recommendations

1. Ensure that visual concerns are identified early in the planning stages of a proposed project.

2. Establish programs for monitoring both impacts and mitigation measures that consider the long-term nature of visual impacts and mitigation measures.

3. The importance of recognizing the responses of observers to the visual aspects of various development features and mitigation options needs to be established through selecting and implementing appropriate simulation techniques and behavioural and humanistic assessment methods.

4. Ensure documentation associated with the project is clear and complete and outlines the visual assessment process used, including rationale for selecting the methods used. Where guidelines exist, the reasons for choosing not to include certain steps should bc documented.

5. Where visual assessment guidelines are part of visual resource management programs, the guidelines should be applied to relevant projects.

6. Visual impact assessment should be conducted and presented in a way to allow decision makers to consider visual concerns with other environmental concerns. If visual impact assessment is incomplete, this cannot occur.

7. Because the essence of visual impact assessment is the visual experience, every effort should be made to ensure that visual assessments contain visual information. This includes photographs and simulations which are representative, accurate, clear and defensible.

INTRODUCTION AND BACKGROUND

Visual impact assessment (VIA) is a tool used to ensure the recognition and consideration of the visual aesthetic qualities of the landscape in the process of environmental design and management. In development projects where visual concerns are raised, visual impact assessment is a suitable and necessary component of environmental impact assessment; VIA can provide decision makers with information concerning the impacts of proposed development activities and land use on the visual quality of the landscape. This information can be incorporated into the environmental assessment process so that visual quality factors are considered with biophysical, economic and social factors (Smardon et al. 1983). The ultimate goal of VIA is the "provision of systematic and objective information concerning the visual quality of landscapes and the visual impacts of land use activities pertinent to decision makers" (Feimer et al. 1979,287).

The inclusion of visual factors in environmental assessment is assumed to foster more effective decisions regarding the acceptability of a proposed project and to create more suitable and operative environmental management practices. More effective decisions and management will result, however, only if the evaluation of the visual resource and the prediction of impacts on it use systematic, accurate and reliable information and methods; "effective decisions are possible to the degree that the information upon which they are based is both accurate and appropriate to the issues at hand" (Feimer et al. 1979,287).

Purpose and Objectives

The present study reviews three projects in which visual impact assessment was an important component. The visual assessment component of two timber harvesting operations and one rail line expansion project are examined through post-project analysis (PPA). Post-project analysis has been identified as a way to improve environmental impact assessment by providing feedback about impact prediction, project effects and management and mitigation measures (Economic Commission for Europe

1990, Krawetz et al. 1987, Sadler and Davies 1988, Munro et al. 1986). PPA examines the effectiveness of impact prediction, mitigation measures and environmental management structures for a project by comparing what happened during construction of the project with what was expected during proposal and environmental assessment phases (Ross and Tench 1987).

The objectives of this study are:

1. to review briefly the literature on visual impact assessment and visual resource management;
2. to evaluate visual impact assessment using post-project analysis case studies;
3. to identify limitations and strengths of visual impact assessment from case study findings, with implications for visual resource management and visual quality evaluation techniques; and,
4. to suggest strategies for improving visual impact assessment and visual resource management.

STUDY APPROACH AND METHODS

The visual assessment components of three environmental impact assessments (EIA) or development proposals are examined through post-project analysis (PPA). Post-project analysis of the impacts of development and of the methodology of EIA is an important component of follow-up activities which are "necessary to build quality control and feedback links into the EIA process" (Sadler and Davies 1988, 1). The process of impact assessment should not be considered complete once impacts have been predicted and a decision has been made to proceed; follow-up studies or audits once construction has begun and continuing through to project completion and beyond are crucial to the assessment process (Ross and Tench 1987).

Post-project analysis (PPA)

PPA allows those reviewing and undertaking impact assessment to "gain a better understanding of project impacts, to improve the capability of prediction and mitigation methods and thereby to make future project design, environmental assessment and impact management more effective" (Sadler and Davies 1988,1). This is true also for the visual assessment component of an environmental assessment where PPA seeks specifically to provide feedback to improve-methods for visual evaluation and the prediction and management of visual impacts.

Post-project analysis of the visual resource is analogous to monitoring any other environmental condition. Smardon et al. (1986) and Palmer (1983) point out that such post-project analyses have been conducted most often as separate research projects rather than as "integrated follow-up" (Palmer 1983, 266) to development decisions. In an analysis of over 30 major projects for which detailed visual impact studies were done, Smardon et al. (1986) found that the frequency of undertaking subsequent PPA was "minimal". In order to improve visual impact assessment methods and techniques so that VIA is undertaken in more and various project settings and applied appropriately, post-project analysis must become a part of follow-up for visual assessments. One major problem in the field is the dearth of information on the evaluation of visual impacts after development has occurred -- the literature deals with visual landscape analysis, setting visual objectives before development occurs, and predicting visual impacts of proposed development, and little with monitoring impacts after development occurs to ensure that objectives have been met and predictions are accurate.

Selection of Cases for Study

Three development projects were selected for post-project analysis. In each project, visual concerns were deemed important, visual impact assessment was undertaken as part of a development proposal or environmental review, and the proposed development became operational.

The first case is a forestry operation involving the clear-cutting of 199 hectares of lodgepole pine forest in 1990 at Cox Hill in Kananaskis Country, Alberta, 60 km west of Calgary. Visual impacts of the timber cutting were identified as a major concern because of Kananaskis Country's importance as a recreation area and the proximity of the proposed cutting to recreational access corridors.

The second case is also a forestry operation. The operation involved the clear-cutting of 227 hectares of forest at Warspite Creek, in the Rocky Mountain Trench of British Columbia, 300 km west of Calgary. Visual impacts became a concern because the harvested area would be visible from a heavily travelled highway and from several rest areas and picnic grounds in this major regional tourist and recreation area.

Application of visual resource management and visual impact assessment has occurred extensively in forestry in North America. It was one of the first major and systematic applications of visual impact assessment and visual resource management systems (Litton, 1968; USDA Forest Service, 1974; Hough, Stansbury and Associates, Ltd., 1973).

Another major application of visual impact assessment techniques is within the Canadian national park system, and the third case is from this jurisdiction. The construction of a second rail line by CP Rail through Glacier National Park in British Columbia involved the construction of 17 km of tunnel and 17 km of surface track, along with a number of associated structures. Within national parks visual concerns and other aesthetic values are very significant; "the aesthetic effects of existing and proposed land use planning must be evaluated and action taken to minimize those that are negative and to enhance those that are positive" (Parks Canada 1986, 19).

The cases analyzed are used as examples and are not necessarily representative of the projects for which VIA is undertaken. Because this research is specifically concerned with visual impact assessment and visual resource management, these cases are works where impacts to the visual resource are a major concern (although not the only major concern) and are dealt with in a substantial way. There are many other assessments where important visual concerns are not dealt with in a significant way and where minor visual concerns are dealt with in a minor way.

Data collection

Information for each case was gathered from a number of sources, including written documentation, photographs and computer-generated perspectives, interviews with key people, and site visits. Written documentation consisted of reports, planning documents, minutes of meetings and letters obtained from the proponent and the initiating government agencies. Other general policy or guideline documents that related to the project were also consulted. For example, for the Warspite Creek timber harvesting project, the British Columbia Ministry of Forestry's ***Forest Landscape Handbook (198*** 1) served as the basis for comparing the visual assessment process that did occur with what is outlined as Ministry of Forests policy in the ***Handbook.***

Photographs and computer generated perspectives were collected for each project; pre-development and post-development photographs, and the simulations of proposed landscape changes were obtained. For the Rogers Pass project, these materials were included in the VIA report (MacLaren Plansearch and Lavalin 1983). For the two forestry case studies, photos and computer perspectives were not part of a report or plan, but were included as part of the general project files by the proponent forest companies.

Interviews with key people involved in each project were conducted. These people included staff with the initiating government department, employees with the proponent companies, and ***others*** not associated with either group but who had a major interest or involvement with the project.

Several open-ended questions were asked, allowing respondents to elaborate on and explain their views. Questions dealt with project planning procedures and with the respondents' opinions and interpretations of the proposals, the visual assessment component and the outcome of the development. The questions varied for each case and for each person interviewed because of the varying information requirements at the time, the person's role in the project and the individual responses provided by each respondent.

Field analysis of each of the three sites was undertaken to view the post-development landscape. Photographs were taken of the landscape changes, from the key observation points used in the pre-development visual assessments. An attempt was made to replicate the perspective of the photographs used in simulations and of computer generated perspective plots in order to make comparisons.

Analysis

Once data were collected, each case was analyzed. Various researchers have identified components for study in post-project analysis (e.g. Ross and Tench 1987, Sadler and Davies 1988) and developed guidelines for carrying out PPA, monitoring and auditing activities (e.g. Sadler and Davies 1988, Munro et al. 1986). Others have identified criteria by which environmental impact reports can be evaluated (e.g. Ross 1987). These criteria and guidelines have been considered in developing analysis criteria for the present study.

Each case is examined according to the following criteria:

1. the suitability and adequacy of the visual impact assessment methods and procedures used for the particular project;
2. the accuracy of the visual predictions made;
3. the effectiveness of the visual mitigation measures and management options implemented; and
4. the clarity and completeness of project documentation.

1. Assessment methods

The suitability and adequacy of the visual assessment methods and procedures used were evaluated by considering if inventory, analysis and prediction phases were undertaken, if visual concerns were identified, and if the techniques and procedures satisfied project requirements. For the Warspite Creek and Cox Hill forestry cases, the relevant visual landscape assessment documents, ***Forest Landscape***

Handbook (B.C. Ministry of Forests 1981) and ***Forest Landscape Management Strategies for Alberta (Alberta*** Forestry, Lands and Wildlife 1988), served as the basis for comparing the methods that were undertaken with what is recommended in these guiding documents.

2. Predictions

To determine if the predictions made accurately reflected the changes that actually occurred, the simulations of the proposed development created during the planning stages were compared with the pictures taken after development was complete.

3. Mitigation measures

The effectiveness of the mitigation measures was determined by evaluating if the measures employed actually reduced the visual impact as they were intended to, and where applicable, met the visual quality objectives established.

4. Documentation

The clarity and completeness of the project documentation was evaluated by considering the explicitness of identification of visual impacts and mitigation measures, the inclusion of VIA procedures employed, and the rationale for such methods.

LITERATURE REVIEW

History of visual impact assessment

The visual aesthetic qualities of landscapes have been the subject of many works of art and many written pieces for centuries (Litton 1979), but the incorporation of visual values in interdisciplinary environmental planning and decision making on a broad scale begins much later (Priestly 1983). Visual resource analysis and management as a component of environmental planning began in about 1968

(Priestly 1983; Zube 1986), with the publication of several seminal works in the field in both North America and Great Britain: Litton's ***Forest Landscape Description and Inventory;*** Linton's "The Assessment of Scenery as a Natural Resource"; and Fines' "Landscape Evaluation: a Research Project in East Sussex".

The following year in the United States, a landmark piece of legislation, the National Environment Policy Act (NEPA) "ushered in an era of interdisciplinary environmental planning in which visual values could be included in the planning and design decision-making process" (Zube 1986,13). NEPA called for all agencies of the Federal government to:

> ... Identify and develop methods and procedures . . . which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic and technical consideration (Specht 1983, 78).

The lack of valid and reliable methods and procedures for identifying visual values and visual impacts of proposed developments soon became apparent (Zube 1986). While policy and legislation made it clear that visual values were important, little mention was made about just how to undertake their evaluation.

The development of manuals and guidelines for use in identifying and managing landscape visual resources and scenic quality, and for assessing visual impacts of development occurred without the benefit of related theoretical research (Zube et al. 1982). There was "remarkably little within previous works" (Dearden and Sadler 1989, 6) to guide researchers in developing techniques to assess visual quality; what theory existed, primarily in landscape design and art history focussing on aesthetics, offered little upon which to develop ***practical*** methods.

The pragmatic concerns of environmental management and planning created by legislation such as NEPA, led to the development of methods that centre on the landscape, with the main concern being the identification of intrinsic aesthetic qualities or elements of the landscape that can be stated objectively for use in decision making (Zube et al. 1982). Other methods, **however, exist and offer different foci for** visual landscape analysis.

Zube (1986) compared the contents of five reviews of the field from a broad range of journals noting the similarity in the categorizations of landscape visual analysis methods:

> Converging conclusions . . . were reached independently in nearly all of the reviews . . . Each of the reviews identified a set of paradigms or models for purposes of categorizing the multiple approaches to visual analysis . . . (and) there was considerable agreement in the conceptualization of these models or paradigms (Zube 1986, 17).

Conceptual Classifications of Assessment Methods

The models, the professional, behavioural and humanistic paradigms (Zube 1986, 17), have different underlying theoretical and disciplinary bases. These differences lead to varying approaches for assessing a landscape, and hence, to different practical methods.

The Professional Paradigm

The professional paradigm is based on the formal principles of design and their systematic use in analysis; the product of such an analysis, undertaken by an "expert", is usually a description of the landscape in physical and aesthetic design terms with values assigned on the basis of such descriptions. The use of "expert" judgments assumes that trained professionals, usually landscape architects or foresters, are capable of objectively analyzing scenic beauty and translating landscape qualities into formulas that can be used in design (Zube et al. 1982, 6). The USDA Forest Service, the Ontario Ministry of Natural Resources and the British Columbia Ministry of the Environment, for example, discuss formal artistic qualities, such as form, line, and texture in describing a landscape and developing management options.

The United States Department of Agriculture, Forest Service developed and implemented a system of establishing Visual Quality Objectives (VQOs) for its designated forests and published a series of handbooks guiding the management of the forest landscape (USDA Forest Service, 1974). VQOs are assigned to landscape management units within each national forest following an inventory of the characteristic landscape in terms of form, line, colour and texture. Logging must be undertaken in accordance with the VQO restrictions and limitations.

Similarly, the United States Department of the Interior Bureau of Land Management (BLM) has in place a system for visual landscape management. This system stresses contrast as its primary defining factor in visual assessment, for example, the degree to which a proposed or existing development contrasts with form, line, colour and texture in the natural or characteristic environment. Sensitivity levels, scenic quality, user attitudes and volumes of use also contribute to a definition of Management Classes (One to Five) within which proposed activities may or may not meet contrast rating levels assigned to each of the five management classes (Specht 1983, Yeomans 1986).

In Canada, the Ontario Ministry of Natural Resources has had ***Design Guidelines for Forest Management*** (Hough, Stansbury and Associates, Ltd. 1973) in place since 1973. These guidelines are less procedural than the BLM and U.S. Forest Service systems. Forest lands are inventoried and designated either Forest Management Area (lands managed for timber production) or Special Influence Area (lands managed for other values), and management objectives established for both. Site protection factors and aesthetics factors are detailed for various potential problem components such as roads, cutting and utilities.

In various other Canadian jurisdictions the visual resource management systems draw upon the systems of the United States Forest Service and Bureau of Land Management. The British Columbia Ministry of Forests and Alberta Forestry, Lands and Wildlife have guidelines based on the work of the U.S. Forest Service, emphasizing the Visual Quality Objectives of Protection, Retention, Partial retention, Modification and Maximum modification, but lacking the detailed procedures (British Columbia Ministry of Forests 1981, Alberta Forestry, Lands and Wildlife 1988). The British Columbia Ministry of the

Environment draws on the BLM system, emphasizing scenic quality ratings, landscape sensitivity, and visual absorption capability, within a Visual Resource Management Class (Yeomans 1983).

The professional paradigm has been the most extensively used and is dominant in the practice of visual impact assessment (Zube 1986); as indicated by the number of visual resource management systems using this approach. Researchers, however, have demonstrated the lack of reliability of these methods; agreement is low among different individuals assessing the same landscape using the same methods and procedures (e.g. Feimer et al. 1979).

The Behavioural Paradigm

The behavioural paradigm, drawing primarily from psychology, differs from the professional paradigm in that it uses the observer or participant in the landscape as the measuring instrument, with the objective being to discern human responses to the landscape. The focus has been to develop predictive landscape dimensions which may be physical (vegetation, water) or design and cognitive concepts (mystery, legibility), and relate variations in these dimensions with ratings of quality or beauty using statistical analysis (Zube 1986). The goal is an understanding of how variations in the visual landscape relate to various perceptions of scenic beauty (Zube 1986). In terms of the reliability and validity, standard psychometric indices for measurement instrument evaluation, the behavioural approaches have been found to be the most reliable and valid within-specified confidence limits and when panels of assessors have been used (Dearden and Sadler 1989, Feimer et al. 1979). These approaches have used large samples and detailed statistical techniques, making them more costly and complex than the professional approaches (Dearden and Sadler 1989), and therefore less useful for practitioners.

The Humanistic Paradigm

The humanistic paradigm attempts to understand the interactions between humans and the landscape in terms of personal experience and meaning, and draws on the disciplines of cultural geography and phenomenology. The focus is on information about individual experience and different places, rather than on group perceptual norms as in the behavioural approach or on aesthetic design features as in the professional approach. Because the methods employed are often highly idiosyncratic, and the focus is on a limited number of individuals, the data yielded are applicable only to the landscape in question; generalizability to a larger population and other landscapes is inappropriate(Zube 1986).

A Unifying Approach

In order to take advantage of the strengths that each approach can offer, it will be necessary to establish a unifying theory that links the three paradigms(Zube 1986). Dearden (1987) has discussed the concept of consensus as a link between varying theoretical approaches and their methods. Landscape evaluation is seen to be an interaction of factors both external and internal to the individual, and where external factors dominate over internal factors, levels of consensus will be higher. Certain circumstances are likely to predispose toward different levels of consensus, and different approaches vary in their dependence on consensus; professional approaches, behavioural approaches and humanistic approaches range from most to least consensus-oriented. By identifying circumstances that intuitively and empirically can be linked to consensus, it is possible to suggest guidelines for choice of appropriate methods. Circumstances such as size of landscape evaluated, presence of water, degree of naturalness are suggested as environmental circumstances of importance (Dearden 1987).

While the professional paradigm is the most used in undertaking visual impact assessment as part of the broader environmental impact assessment process, specific techniques for undertaking landscape evaluation can be drawn appropriately from any of the three paradigms. The techniques chosen will depend specifically on the type of information required to assist decision making. No matter which techniques are chosen, public involvement is essential when visual concerns are raised. This involvement, as an integral part of visual assessment (i.e. in evaluating the visual landscape) and as part of environmental review (i.e. in participating in public forums) will ensure that visual values are included in environmental impact assessment.

FINDINGS and DISCUSSION

The findings of the case studies are discussed under the four areas of analysis: "assessment methods", "prediction", "mitigation measures" and "documentation".

Assessment methods

The Alberta and British Columbia forest services have written guidelines for visual landscape management (British Columbia Ministry of Forests 1981, Alberta Forestry, Lands and Wildlife 1988). These guidelines provide step by step procedures and techniques to guide foresters and resource managers in visual resource management and impact assessment for logging activities (Table 1).

Table 1: Procedures for visual impact assessment according to ***Forest Landscape Handbook*** (British Columbia Ministry of Forests ***198 1)*** and ***Forest Landscape Management Strategies for*** *Alberta* ***(Alberta*** Forestry, Lands and Wildlife 1988).

B. C. Ministry of Forests procedures	**Alberta Forestry, Lands and Wildlife procedures**
Step 1: Landscape Inventory - map visible landscape - describe landscape features - determine landscape sensitivity*	Visual Resource Inventory - map viewsheds - identify key features - determine visual sensitivity ratings* - identify and photo key viewpoints
Step *2:* Detailed Landscape Analysis - map further detail - select visual quality objectives (VQOs)**	Visual Quality Objectives (VQOs)** Determine Visual Absorption Capability (VAC)***
Step *3:* Design and Layout - design to meet VQOs	Simulate landscape with changes
Step **4:** Logging and Silvicultural Practices - to complement VQOs	Visual Management Actions for acceptable contrast - design and layout - operations - follow-up treatments
Step 5: Follow-up - management actions acceptable? - desired results from step 3 & 4? - publish examples?	

* Visual landscape sensitivity is a measure of observers' variable response to the landscape in terms of the landscape's physical features and viewer-related factors (e.g. number of viewers).
** Visual quality objectives (VQOs) set limits to the form and scale of visible alteration in a landscape. Both the B.C. and the Alberta procedures establish VQOs of Protection (no activity allowed); Retention (activities not visually evident); Partial Retention (activities slightly alter landscape); Modification (activity may visually dominate); Maximum Modification (activity dominates).
*** Visual absorption capability (VAC) is the relative ability of the landscape to accept management manipulations without significantly affecting its visual character.

Despite this level of detail, neither forestry operation reviewed conducted the visual assessment according to the direction provided. Using ***Forest Landscape Management Strategies for Alberta (1988)*** as a basis for comparison for the Cox Hill case, several components of the visual resource management program were found to be missing. The landscape inventory undertaken was incomplete. No visual sensitivity levels or visual absorption capability (VAC) was determined and no visual quality objectives were established. No boundaries of the viewable area, no key features and no visual sensitivity data were included on the map as outlined in the ***Strategies (Alberta*** Forestry, Lands and Wildlife 1988, 13). A photographic record of views from ten key observation points along the roadway through the area was initially compiled and these points placed on a map which also included the direction of view.

Computer-generated perspective plots were created by digital terrain modelling (DTM) to simulate the visible portions of the proposed cut blocks in order to determine acceptable design and layout (Figure 1, page 25). For one viewpoint, the perspective was overlain onto photographs and colour retouched to resemble vegetation. Management options in each of design and layout, operations and follow-up treatment were proposed and undertaken. The Spray Lakes Sawmills' forester and the Forest Service landscape forester then judged the visual impact of the cut blocks from the perspective plots and simulations, and made adjustments to the size and shape of the cut blocks on the harvesting plan maps (J. Bastone, pers. comm. 1992). After harvesting was complete, the two foresters returned to the viewpoints to view the cut blocks, and to take pictures. Besides these pictures, no further analysis was undertaken.

The Warspite Creek case was incomplete in terms of the guidelines provided in the ***Forest Landscape Handbook*** (B.C. Ministry of Forests 1981) (Table 1). The landscape inventory lacked several of the components outlined in the ***Handbook,*** including description of landscape features and visual sensitivity. No detailed landscape mapping was undertaken. As well, the visual quality objectives (VQOs) were not an explicit part of the analysis; that is, management activities were not directed at attaining a particular VQO.

Photographs were taken from several viewpoints; perspective plots were developed using digital terrain modelling, and planimetric views of the blocks were coloured to show which areas of the cut blocks would be visible from the highway. Visual simulations were created using overhead transparencies of pictures of the views overlain with the computer generated plots (Minutes of meeting, Nov. 3 1987). Two viewpoints were selected, based on the duration and frequency of viewing of the cutblocks from each -- a major rest stop on the highway and a residential subdivision between the highway and the proposed cut area (Minutes of meeting, Nov. 3 1987).

In terms of selection of the key viewpoints, both of these forestry examples omitted what could be considered major viewpoints. The only viewpoints that were considered in the Cox Hill case were from the Powder-face Trail, the vehicular access road. No views from the hiking - biking trail that parallels this road were included. This would seem to be a major omission given the importance of these types of recreation in the area, and the potential for longer viewing times while on foot or bike than in a vehicle along the road.

The cut block at War-spite is a focal point when looking along Dutch Creek from a small development of visitor cabins and from a small trail beside the creek. From the highway, this view is noticed only for a very short time, however, and only if one looks along the creek towards the cut block; it is secondary to imposing hoodoos in front of the driver.

Viewpoints were selected based primarily on the visual experience of drivers along vehicular roadways, rather than other types of traffic, such as hikers on trails. From roadways, there are more likely to be a greater number of viewers. From hiking trails, the duration of view for the observers is likely to be longer. The handbooks note that both the duration of view and number of people viewing should be considered (B.C. Ministry of Forests 1981, 31; Alberta Forestry, Lands and Wildlife 1988, 13).

Researchers elsewhere have found that visual impact assessment is often incomplete (Duffey-Armstrong 1979). This lack of detail and systematic process in the forestry examples seems to be especially amiss in such important recreational areas, where protection of the visual resource is usually essential to recreationists' enjoyment of the area.

The Rogers Pass Project Visual Impact Assessment was undertaken by an independent consultant for CP Rail. No guidelines for undertaking visual impact assessment are in place for projects in the national parks (MacLaren Plansearch and Lavalin 1983). The methods chosen for assessing the visual impacts of the surface route of the rail expansion were based on procedures and techniques that had proven successful in other projects. The consultants reported at the time that the assessment was using "state-of-the-art technology and the most contemporary landscape analysis and assessment techniques" (MacLaren Plansearch and Lavalin 1983, 4).

A comprehensive inventory and analysis of the visual features of the area was developed, focussing on the view from the Trans Canada Highway. The landscape's capacity to absorb the impacts created by the second rail line was assessed through Visual Absorption Capability (VAC), determined at each of eleven key observation points. The visual impacts of five possible rail alignments were examined, with each alignment being a refinement, in terms of reducing visual impacts, of the preceding one. Both CP Rail staff and Parks Canada (as Canadian Parks Service was then called) staff were involved in this design review process. For the final three alignments, computer perspectives of the cuts and fills that would be seen were overlaid on photographs to simulate the visual impacts (Figure 2). Mitigative measures were considered for each cut and fill required. A range of mitigative techniques were included -- retaining walls, bridge structures, revegetation, horizontal alignment shifts and conservation of existing vegetation screening (MacLaren Plansearch and Lavalin 1983).

The location of the tunnel ventilation shaft building and facilities was the subject of considerable discussion and concern during 1982 Environmental Assessment Review Process (EARP) hearings (Polster

1990), but the detailed visual impact assessment completed by MacLaren Plansearch and Lavalin (1983) dealt only modestly with the ventilation shaft in its analysis. In fact, only one small section of the 104-page document refers to the ventilation shaft and reports the structure "will be barely visible from the Summit Monument, given its distance, scale, and form, and the presence of 70 foot tall coniferous trees" (97). This fact was also noted in the final report of the EARP Panel, stating "only brief mention (in the report) was made of the potential visual impacts of the structure" (FEAR0 1983, 9). Subsequently, a study was undertaken to determine the visibility of the ventilation shaft (FEAR0 1983).

The techniques used in all three case studies would be considered to be within the professional paradigm (Zube 1986). Discussion of the landscape dealt with "form" and "scale" and other design terms. Unfortunately, none of these assessments drew upon the behavioural or humanistic methods to determine observer response to or experience of the existing landscape, or the proposed landscape changes. "Expert" judgment was the basis for all landscape evaluation. Various other researchers have found that formal aesthetic approaches using professionals or "experts" is most favoured by practitioners (Dearden and Sadler 1989, Zube et al. 1982).

The use of experts in landscape evaluation and methods in the professional paradigm should not be considered more "objective" than methods with behavioural or humanistic bases. All methods used to assess the visual landscape are observer-based environmental assessments, using the perceptual abilities of humans to judge the quality of a setting, as opposed to technical environmental assessments, which employ mechanical, physical or chemical monitoring equipment to produce a reading of environmental quality (Gifford 1987,144). Observer-based environmental assessments are useful and necessary for assessing environmental qualities such as visual and aesthetic aspects of an environment.

Various researchers have pointed out that more than one approach is necessary for landscape evaluation (Dearden 1987, Zube et al. 1982) and that the approaches are not mutually exclusive. Behavioural approaches tend to focus on the users of the landscape as well as the landscape itself (Zube

1986); in areas of recreational value, including the opinions and preferences of the users as observers is important to ensure that these values, in terms of visual impacts, are incorporated into the visual assessment process.

Predictions

In terms of the visibility of the proposed developments, the predictions, in the Cox Hill and Rogers Pass Project cases were accurate. Except for small deviations, the size and shape of the cut blocks in the forestry case and the cuts and fills in the Rogers Pass project were very close to what was predicted using digital terrain modelling and photo simulations (Figures 1 and 2). While perspective plots were created for the Warspite Creek forestry operation, these were not available in the project file and were not located elsewhere. New digital terrain modelling methods and more sophisticated equipment than that used during the Warspite project is now being used by the British Columbia Forest Service to simulate timber harvesting cut blocks and roads (H. Mitchell, pers. comm. 1992).

While the perspective plots developed can accurately reflect the physical features of a future landscape, they are very limited in terms of the effects of the various features on observers, even when overlain onto photographs. That is, the spatial attributes (size and shape) of a visual impact, but not its significance, in terms of preference and acceptability, can be determined. For these cases, reactions to the proposed development of travelers along the Trans Canada Highway in the Rogers Pass Project, along Highway 93 in the Warspite Creek project and along the Powderface Trail in the Cox Hill project should have been assessed. This would have required the use of behavioural methods, and reflects the limitations of the purely expert methods as discussed earlier. These implications are further discussed in the Recommendations section later in the paper.

Mitigation measures

To establish if mitigation measures were effective, it was originally intended that the results of the mitigation measures implemented would be compared to the visual quality objectives (VQOs) established for the area, for the forestry cases. The lack of visual resource inventory, visual quality objectives and visual sensitivity levels for the Cox Hill forestry operation makes it difficult to establish whether or not visual mitigation measures were successful, in terms of meeting visual quality objectives. Several of the management actions suggested in ***Forest Landscape Management Strategies (1988)*** were incorporated into the harvesting proposal that is required from the proponent for approval by the Forest Service before timber harvesting can begin. The cutblock size of 10 ha keeps the cuts in scale with the surrounding landscape, suggesting a VQO of retention (Table 1); however, the cut block results in a highly contrasting area, suggesting a VQO of modification (Figure 1). This inconsistency is reflective of the lack of explicitly established VQOs based on visual analysis and determination of visual sensitivity levels and visual absorption capability.

The company can return to the area to make a "second cut" in approximately twenty years (Alberta Forestry Lands and Wildlife 1986), taking trees from areas adjacent to those cut in the first pass, but the proponent reported that this second pass is not planned for at least forty years (J. Bastone, pers. comm. 1992). These areas were included in the development of the operating plan for the first harvest; the visual impacts of the second cuts were considered by:

- including cuts in flat as well as steeper areas equally for the first and second passes so that visibility of cuts is roughly the same for both passes

-ensuring the average cut block is not greater than 10 ha to minimize visibility

Because of this "two-pass" system, the final impacts of this project, and hence of the mitigation measures, will not be known for some years.

In order to mitigate and manage visual impacts, a number of measures were used in the Warspite Creek timber harvesting plan which was submitted to the B.C. Forest Service for approval before harvesting could commence. Logging road construction required special consideration to minimize visual impacts. Where the road would be visible from the highway, it would be cut by hand to minimize the extent of clearing required and therefore visibility; otherwise heavy machinery could be used (Minutes of meeting, Nov. 3 1987). A number of other construction and reclamation techniques would be required including reduced side-cutting and skid clearings, grass seeding, and resloping. As well, the edges of the cut-blocks were feathered or curved, islands of trees were left standing to mimic the vegetative patterns on the nearby mountains, and larch and immature stems were reserved (Minutes of meeting, Nov. 3 1987).

The Invermere District Landscape and Recreation Resource Inventory (199 1) has been an ongoing project of the Forest Service for several years. While the inventory was not complete at the time of harvesting the Warspite Creek area, preliminary work had shown that the area was likely to have visual quality objectives of "partial retention" or "modification". Based on these objectives, certain management activities are required: "the partial retention VQO requires that alterations remain visually subordinate to the characteristic landscape. Repeating the line, form, colour and texture is important to ensure blending with the dominant elements" (British Columbia Ministry of Forests 1981, 74). The measures used to meet this VQO appear to have been relatively successful, as revealed in post-harvesting visits to the area (Figure 3). The harvested area viewed from each of the two viewpoints does not dominate the view, even in the snowy winter months. Leaving an island of trees in the largest cut block mimics the open meadows of nearby slopes: Reclamation of the roads appeared to be successful, as their cuts and fills are indistinguishable in the cut areas.

Part of the success of the mitigation measures was due to the ongoing field work during harvesting by foresters from the proponent company and the Forest Service to ensure that the views would be as minimally affected as predicted. The foresters involved made at least one trip per week during cutting to assess the visual impact of the cuts (H. Mitchell, pers. comm. 1992). Where adjustments were required, changes were made to the original plan. Where cutting along the cut block edge lines as determined by the perspective plots was deemed to be important for minimizing visual impacts, the trees were flag taped to ensure that cutting would meet this edge as closely as possible.

For the Rogers Pass project, the re-location of the ventilation shaft and the change in the exterior cladding were the two major mitigation measures used to reduce that structure's visual impact. Because of the visual concerns raised by participants at the 1982 hearings regarding the location of the ventilation shaft, the EARP Panel directed CP Rail to investigate alternative sites for the ventilation shaft. Based on the field analysis undertaken for the present study and the conclusions of the EARP panel (FEAR0 1983) and a previous post-project analysis (Ross and Tench 1987), these measures have minimized what could have been an unacceptable visual impact. Early identification of the concern led to mitigative measures that could be incorporated into the design and construction of the structure; this is ideal in environmental planning situations and the goal of environmental impact assessment. The result is minimal visual impact of this structure.

While minor adjustments were made to the surface route, all of the mitigation measures (retaining walls, revegetation, horizontal alignment shifts and conservation of existing vegetation screening) were used, with the most substantial design change being the use of a viaduct (Ross and Tench 1987). This 1.2 km long viaduct was used in one section of the track to eliminate huge cut and fill scars resulting from the use of conventional engineering techniques in the steep terrain. The bridge at the beginning of the viaduct is the most visible portion from the Trans Canada Highway (Figure 2).

In addition to the viaduct, over 2.8 km of retaining walls were planned to reduce the width of the cut and fill areas, but large disturbed slopes would still be visible. The EARP Panel concluded that significant visual and terrain impacts would remain for at least a decade and recommended that CP Rail and Parks Canada should work together to try to improve the design to mitigate these impacts before construction began (FEAR0 1983). No substantial design changes were developed and the final alignment as determined in the visual impact assessment was used (Ross and Tench 1987).

Ross and Tench (1987) in their post-project analysis of the Rogers Pass project discuss three adjustments made to the surface route during construction because of the resulting visual impacts. These will be briefly discussed in terms of the remaining impacts. The first is a larger than anticipated fill slope at one section resulting in a major visual impact in this visually sensitive area. Successful revegetation has occurred on this site (Polster 1990). The second adjustment was a larger than proposed rock cut because of unstable rock in the cut. The result, which could not reasonably have been avoided (or predicted) is a more visually obtrusive rock cut. This impact remains.

The third adjustment, and perhaps the most important, involved the use of upslope retaining walls. Initially, CP Rail had proposed fewer retaining walls and revegetation of the cut slopes even though this would have increased the size of the cuts and thus their visual impact. The use of more retaining walls was strongly advocated by Parks Canada, by the Panel technical expert and by the Panel to reduce the length of cut and fill slopes. The visual impact of the retaining walls themselves, particularly the upslope retaining walls, however, is great. This author is in agreement with the conclusion reached by Ross and Tench (1987) that:

> In retrospect, it is clear that for most applications, the visual impact of the grade would have been less if the upslope retaining walls had not been constructed and the slopes had been laid back and revegetated.

Even now, in 1992, these retaining walls are very noticeable, much more so than the areas that were laid back and revegetated. It seems ironic that a technique used in attempting to greatly reduce visual impact actually resulted in greater impact than was necessary.

The distinction between the visual effects on observers of the mitigation options (retaining walls vs. revegetated slopes) is an important one, with major consequences for design and for impact evaluation methods. Mitigation measures themselves result in visual impacts that must be evaluated in terms of acceptability and preference. As mentioned earlier, the use of behavioural methods in impact assessment is essential. The use of shading or colour for the photomontages to resemble the actual change (e.g. light shading for concrete, darker for bridge structure) and additional simulations demonstrating the effects of time (e.g. for revegetation, simulating the “green-up” over a decade) might have made the differences more obvious.

Documentation

The procedures used to undertake the visual assessment components of the proposed forestry operations were not documented systematically or clearly. The relevant handbooks and guidelines were not referred to in the documentation. Despite the fact that the inventory for the Warspite Creek area was underway, no reference was made to this activity either. The existence of this project was referred to in conversations only.

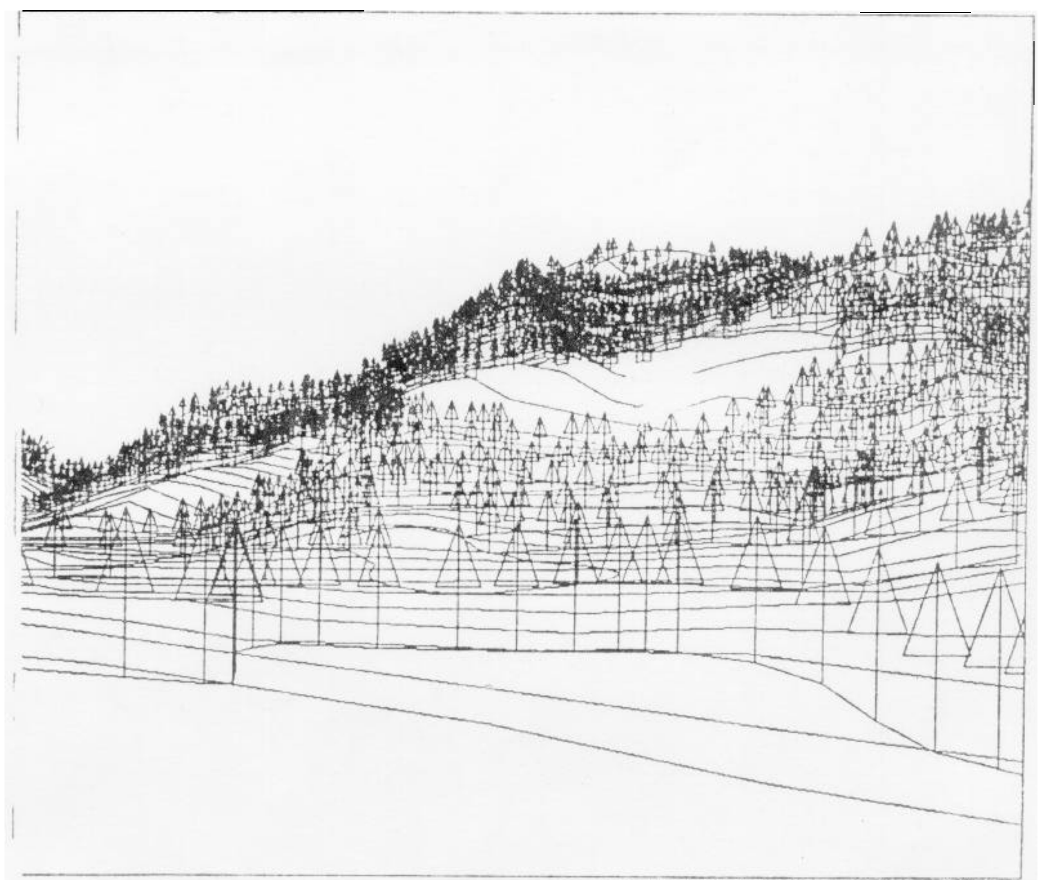
In the forestry cases, the digital terrain modelling perspective plots (for the Cox Hill case) and the before and after photos were not accompanied by any visual sensitivity information, visual absorption capability information or written conclusions about the effectiveness of the procedures used to minimize visual impacts. A follow-up memo from the Alberta Forest Service landscape forester addressing four cut block design concerns was the only written documentation of visual impacts and mitigation measures (T.Tumer, February 1990) used in the Cox Hill case. For forestry operation planning, information for mitigating environmental effects is to be provided in the pre-harvest block assessment form; visual concerns, however, can be dealt with only under the "comments" section of this form. For most of the twenty-one cut block pre-harvest assessments for the Cox Hill harvesting proposal no visual sensitivity information was provided.

Similarly, in the British Columbia forestry case, the Pre-harvest Silvicultural Prescription form contains the most specific information about cutting techniques and mitigation methods for minimizing visual and other impacts. When the Warspite Creek project was undertaken in the late 1980s, no space was allocated specifically for visual concerns and mitigation, but since then, a section for visual landscape considerations has been added (H.Mitchell, pers. comm. 1992).

Most of the information about the visual assessment methods and mitigation methods for the forestry case studies was obtained from the interview process. The people interviewed were interviewed in depth and repeatedly contacted. Because these projects are fairly recent, those involved in the planning were still with the proponent companies and the respective forest services when this post-project analysis was undertaken; had they not been, it would have been virtually impossible to glean information about the visual impact assessment from file documentation alone. In both cases, the computer perspective plots were not included in the file with the rest of the project data and information. Locating perspective plots and some of the photographs was not often an easy task. The perspective plots for the Warspite Creek case were not found.

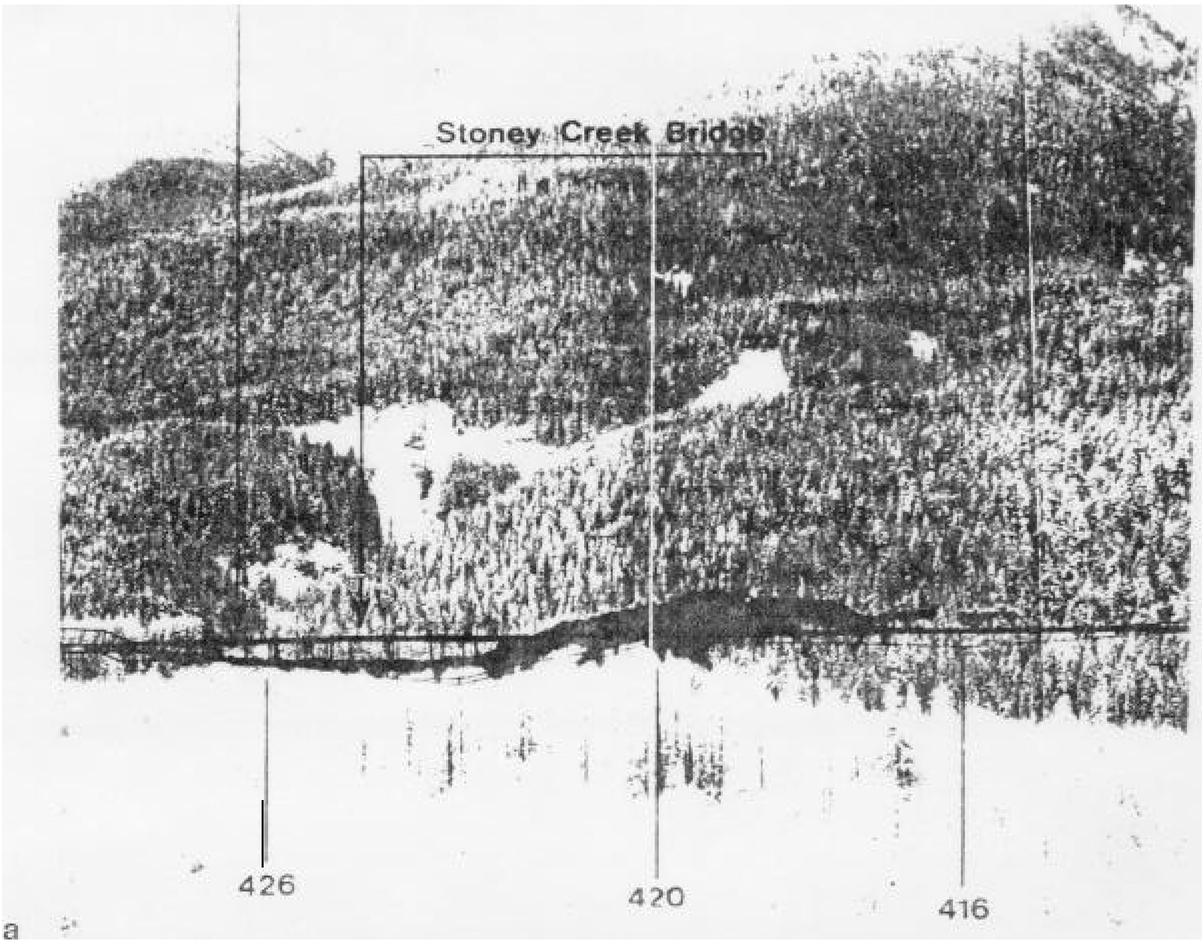
Documentation associated with the Rogers Pass project was readily available, and the Visual Impact Assessment report detailed and clear enough to undertake post-project analysis easily. Interviews were required only to obtain the opinions of those involved in the process, rather than details of the process itself. This detail is perhaps reflective of the project as part of EARP. The assessment methods, findings and mitigation methods were required in some detail and in written form so that the EARP panel could review the project. The documentation must be communicated in a way that is useful and informative for decision makers.

a

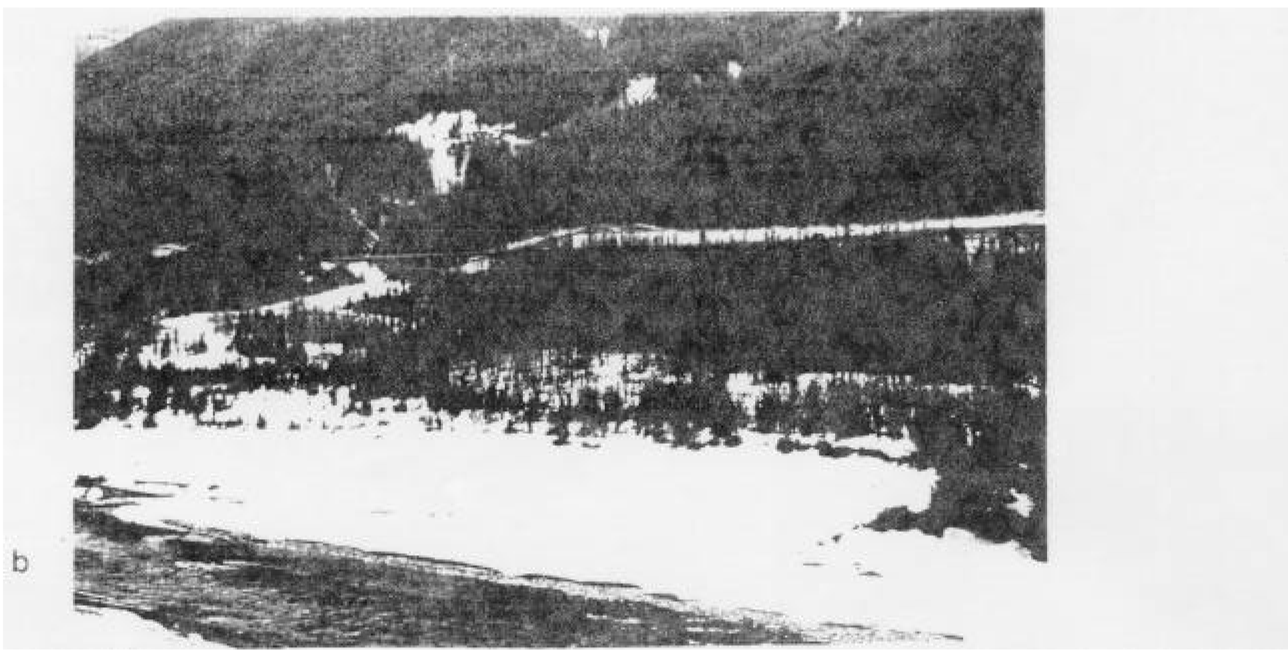


b

Figure 1 : Cox Hill Timber Harvesting Operairon
a) *Post-harvesting photograph and b) cut block perspective plot*

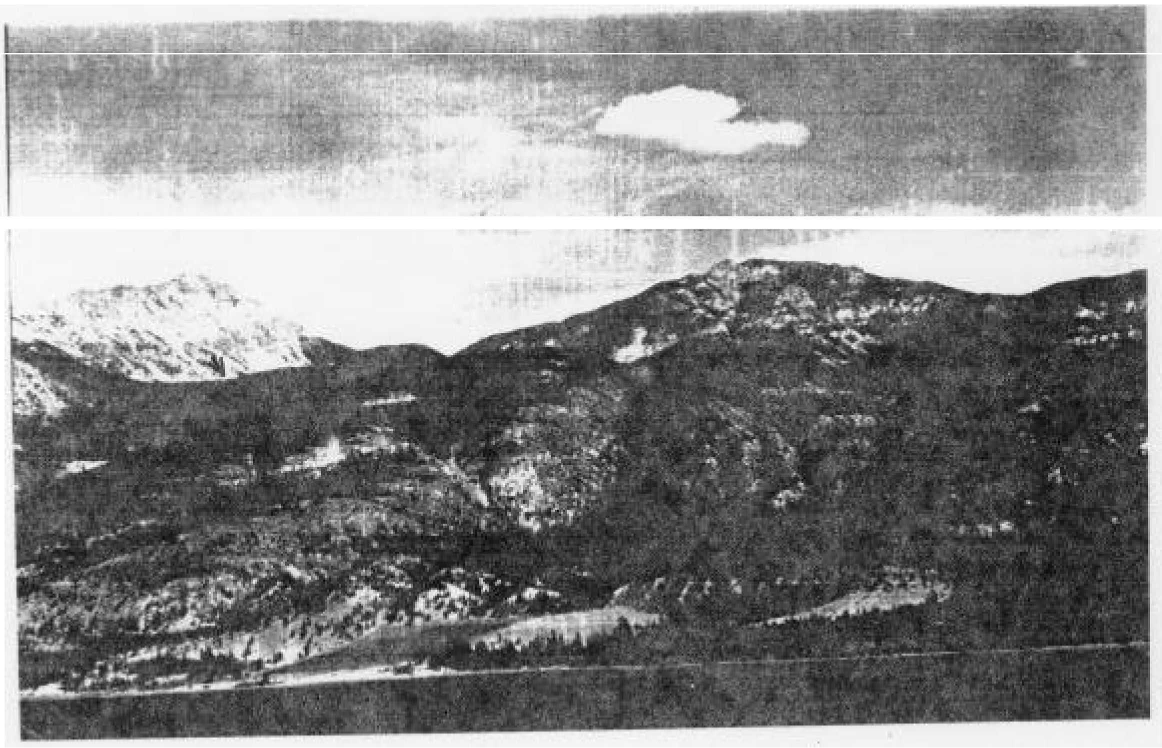


a



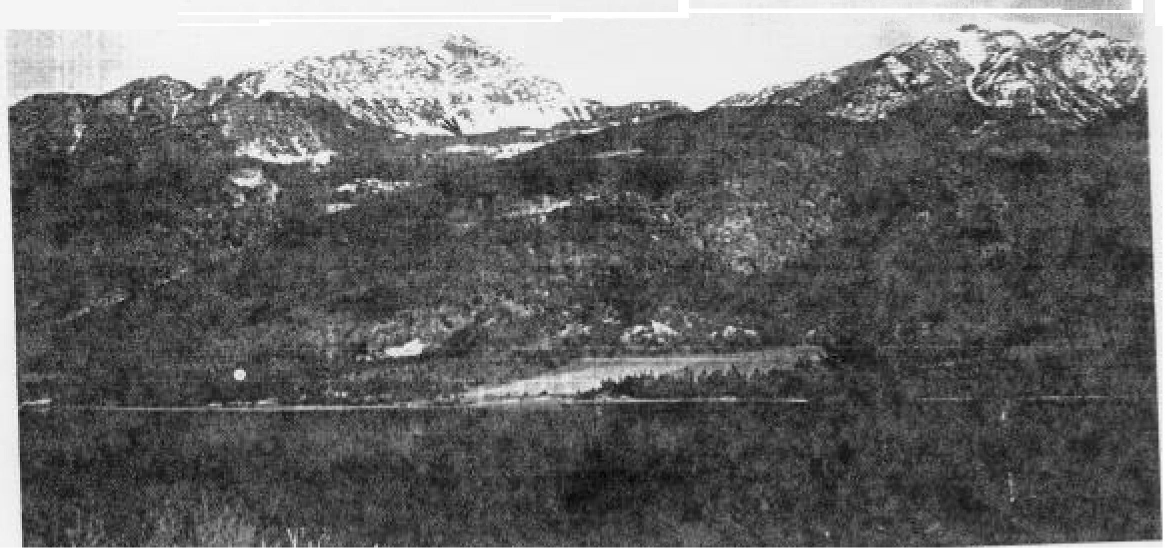
b

Figure 2 : Rogers Pass Project
a) Photomontage simulation of cuts, fills and bridge structure [illegible]
Stoney Creek and b) pre-construction photograph [illegible] Stoney
Creek



a

↘ indicates location of cut blocks



b

Figure 3 : Warspite Creek Timber Harvesting Operation
a) Pre-harvesting and b) post-harvesting photographs from Highway 93 rest stop (a key viewpoint)

RECOMMENDATIONS FOR IMPROVING VIA

Recommendation # 1: Ensure that visual concerns are identified early in the planning stages for a proposed project.

One important finding and a strength of the processes used in the various projects analysed in this study is that all of the case studies examined identified and dealt with visual concerns early in the planning process. For the forestry examples, these concerns were identified by the initiating government departments (the Alberta Forest Service for Cox Hill and the B.C. Forest Service for Warspite Creek) during their preliminary forest planning activities. For the Rogers Pass Project, visual concerns associated with the tunnel ventilation shaft and the surface route construction were identified at initial planning stages and an environmental review panel was appointed to ensure that these and other environmental concerns would be dealt with. By identifying and dealing with visual concerns early, mitigation measures can be part of the design of the proposed development, rather than ameliorating activities after visual impacts have occurred.

Recommendation # 2: Establish programs for monitoring both impacts and mitigation measures that consider the long term nature of visual impacts and mitigation measures.

As pointed out earlier, the final impacts of the forestry projects and the effects of the mitigation measures will not be known for decades. This timeframe highlights the importance of ongoing monitoring of project effects and their mitigation and post-project analysis to provide important feedback regarding all project effects. It also highlights the need to create simulations that reflect the changes at various stages over time. The ongoing monitoring during the Rogers Pass project was cited several times as a major success in terms of managing environmental impacts during construction (e.g. Ross and Tench 1987) and since construction was completed (Polster Environmental Services 1990; B. Leeson, pers. comm. 1992).

Recommendation # 3: The importance of recognizing the responses of observers to the visual aspects of various development features and mitigation options needs to be established through selecting and implementing appropriate simulation techniques and behavioural and humanistic assessment methods.

A major conclusion reached in ‘the Rogers Pass case study by this author and previouslv by Ross and Tench (1987) was the importance of the distinction between visual effects on observers of the various aspects of the developmerit and of the mitigation options, which have major consequences for design and reclamation. The visual effect of the retaining walls was not predicted with the visual impact assessment methods used. While visual absorption capability procedures are effective for determining the landscape's capacity for absorbing development changes in terms of physical landscape characteristics, such procedures cannot predict human perceptual response. The effect on observers would have required simulations of the proposed development that included both the retaining wall option and the revegetation option, and evaluation of observer response to these options, such as a questionnaire.

Various procedures have bccn dcvclopcd to dctcrmine opinions and preferences of observers in various settings and for various applications (e.g. Berris and Bekker 1989; Kaplan 1979). These are most appropriate when the sample population is representative of the population who will be observing the development; in the case of the Rogers Pass project, this would have been travelers along the Trans Canada Highway; for Cox Hill, recreationists on the vehicular and hiking trails; and for Warspite Creek travelers and residents in the area.

Had such procedures been used with the Rogers Pass project, the distinction between the visual effects on observers of the retaining walls and larger cuts with revegetation might have been determined, and appropriate design changes made. While these conclusions can been made in hindsight, it is difficult to say whether the appropriate changes would have been made, given that the methods used were, at the time, state-of-the-art.

Recommendation # 4: Ensure documentation associated with the project is clear and complete and outlines the visual assessment process used, including rationale for selecting the methods used. Where guidelines exist, the reasons for choosing not to include certain steps should be documented.

This documentation is important for undertaking post-project analysis and ongoing monitoring. The experience with the Rogers Pass project is evidence that sufficient and clear documentation can provide feedback to improve the current project and also future ones.

Recommendation # 5: Where visual assessment programs exist, the guidelines should be applied to relevant projects.

Even though the forestry projects were undertaken in jurisdictions with visual resource managment programs with visual impact assessment procedures, the guidelines provided were not followed, and no rationale was given for not following the guidelines. If the guidelines themselves are deemed to be unsuitable and insufficient for the needs of projects for which they are supposed to be applied, then a comprehensive review of the system and its assumptions should be undertaken.

Recommendation # 6: Visual impact assessment should be conducted and presented in a way to allow decision makers to consider visual concerns with other environmental concerns. If visual impact assessment is incomplete, this cannot occur.

Despite the fact that visual assessment is part of many development projects, a number of obstacles were encountered in selecting projects for which to undertake post-project analysis as part of this study. The shortcomings in many of the visual impact studies can be used as lessons for future projects. The criteria originally proposed for selecting cases (visual concerns were deemed important, visual impact assessment was undertaken, and the proposed development became operational) could not be met for many potential cases. There were two major reasons for rejecting potential cases. The first was that the proposed development for which the environmental assessment was completed never became operational.

The second major reason was that visual impacts due to the proposed development were not predicted or were not predicted in a way that allows for post-project analysis to occur; that is, they were often verbal, rather than visual. While the existing landscape may have been described and changes caused by the proposed development discussed in the text, no photographs of the existing landscape or simulations of the proposed impacts were included. Often, too, evaluation was not a part of the assessment; existing landscapes were described only, and methodology was not a major component.

The incompleteness of the VIA component in environmental assessment has been noted by several researchers (Duffey-Armstrong 1979; Newkirk 1983). Rather than examining the visual resource and predicting impacts to it in a systematic way, in a way similar to other components of an environmental assessment, the visual assessment component has been given “footnote status”. The result has often been a visual assessment component that is merely a list of “do’s and don'ts", offering very little upon which to base a decision.

Stephen Sheppard (1989) found that in the visual assessments he examined, only 44 percent included simulations of proposed development, and in many of these cases, this visual information was not directly integrated with the remainder of the environmental analysis. While these concerns of incompleteness and lack of integration are partly applicable to the cases discussed here, they were the major reason for which many potential case studies were rejected.

Recommendation # 7: Because the essence of visual impact assessment is the visual experience, every effort should be made to ensure that visual assessments contain visual information. This includes photographs and simulations which are representative, accurate, clear, and legitimate.

Despite the seemingly obvious statement that visual impacts are primarily visual, visual impact assessment often does not reflect the importance of the inclusion of visual information in the assessment documentation. The fact that photos of the forest areas to be cut, the perspective plots and the simulations were not an integral part of the assessment and files for the forestry projects, attests to this.

Stephen Sheppard (1989) offers detailed guidelines for creating simulations for visual analysis, emphasizing that to avoid potential problems with simulations, such as misleading simulations, simulations must be representative of the visual experience and accurately depict it. Ensuring that a camera lens that captures the landscape in a way similar to the human eye is used can minimize the bias in simulation presentation. Since many decisions to proceed with a project arc made without the benefit of actually viewing the landscape, representative, accurate, legitimate, and clear simulations are a necessity in visual impact assessment.

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