INSTITUTIONAL ARRANGEMENTS FOR SNOW AVALANCHE MANAGEMENT IN CANADA[1]

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Abstract.--The objectives of this paper are twofold: to identify the agencies involved in avalanche management in Canada and to evaluate the institutional arrangements of those agencies. The findings indicate that avalanche management strategies are not very sophisticated when compared with other countries such as Switzerland or parts of the United States.

CONTEXT OF THE STUDY

The management of snow avalanches in Canada has its historical roots in resource exploration and corridor development during the 1800's, particularly in the Rocky Mountains, the Coast Mountains and the Interior Mountains of British Columbia (B.C.). Since this time, the number of agencies involved in avalanche management in Canada has expanded considerably into both public and private sectors. The objectives of this paper are (1) to identify the agencies involved in avalanche management in Canada and (2) to evaluate the institutional arrangements of those agencies.

PROCEDURE

Agencies involved in avalanche management in Canada firstly were identified. Data were collected from a variety of sources: published literature, newspapers, and interviews with major avalanche managers in Canada. The major avalanche management agencies then were evaluated.[3] Evaluation of agency programs was based on five criteria, comprehensiveness, clarity, effectiveness, accountability and adequacy. Further, as a measure of sophistication of management strategies, comparisons and contrasts were made between Canada and other countries with avalanche hazards.

INSTITUTIONAL ARRANGEMENTS

Agency Involvement

In total, there are roughly forty to fifty agencies involved in avalanche management in Canada and most of these are located in British Columbia. Fewer than ten agencies are major avalanche management agencies. In general, agencies can be differentiated by their mandate and/or function and these tend to be either: single mandate/function, dual mandates/functions or multiple mandates/functions.

Those agencies with single mandates or functions include the Alpine Club of Canada (ACC), the Royal Canadian Mounted Police (RCMP), the B.C. Ministry of the Attorney General, the B.C. Ministry of Municipal Affairs and the B.C. Ministry of Energy, Mines and Resources. Their functions or mandates are either to inform and educate, search and rescue, or regulate/zone.

Agencies with the mandate or function to inform and/or educate the public, tend not to have legislative status. The Alpine Club of Canada is such an agency. Other agencies with search and rescue functions, for the most part, are response-oriented in post-avalanche circumstances and have little involvement in avalanche prevention, for example the RCMP. Those agencies with a mandate/function to regulate and/or zone are active participants in the normative decision making process. Their legislative powers give them the potential to greatly reduce the impacts of avalanches in Canada. These include the B.C. Ministry of the Attorney General, B.C. Ministry of Municipal Affairs and the B.C. Ministry of Energy, Mines and Resources.

Agencies with dual functions or mandates tend to be national in their scope and are involved in information/education and either research and monitoring or search and rescue/contingency planning. These agencies are the National Research Council of Canada (NRC), the National Hydrology Institute of Environment Canada (NHI), the

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[3]This study was done as part requirement for the author's Ph.D. What is presented here are some of the main conclusions of the study. For greater detail refer to McFarlane (1984).

Atmospheric Environment Service of Canada (AES), the Canadian Ski Patrol System (CSPS), Emergency Planning Canada (EPC) and the B.C. Provincial Emergency Program (PEP). Characteristically, these agencies are consultative and advisory.

Multiple-function avalanche management agencies tend to be agencies whose mandates are to provide for the 'safety' of the public. In addition to information/education, search and rescue/contingency planning, regulation/zoning, and research/monitoring, these agencies are involved in avalanche protection and avalanche control. Multiple-function agencies are: Parks Canada, Alberta Recreation and Parks, B.C. Provincial Parks Branch, B.C. Ministry of Transportation and Highways, and various ski agencies. A characteristic common to these agencies is that they have a unit area which must be managed, an area of which the public makes substantial use.

Selected Agency Evaluations

Parks Canada

Parks Canada is a major avalanche management agency with a legislative mandate to provide safety for park users. To assist in achieving this objective, Parks Canada has implemented a zoning scheme. The scheme is general and is tied mainly into zoning for development rather than recreation.

Parks Canada has both an avalanche hazard forecasting program, and an avalanche search and rescue plan that provides a network between park wardens, the Ski patrol foreman, a dispatcher, a physician, and the RCMP. The search and rescue scheme is detailed and explicit. The need for such clarity is the occurrence of downhill skiing and ski-touring within the park boundaries involving numerous ski tourists during the winter months.

Various agency policies restrict the effectiveness of the Park mandate (provisions for visitor 'safety'). The problem seems to be one of accountability and a centralization of the decision process. Permission to act on avalanche management matters must be obtained from Ottawa rather than from within the park administration located in the Rocky Mountains. Therefore, greater liaison between the two centers with respect to the decision making process appears to be in order. Efforts need to be made to close the gap between the normative planning process on the one hand and the strategic and implementation planning processes on the other.

National Research Council of Canada

The National Research Council (NRC) has no legislative mandate under which it operates, however, its goals and objectives are clearly spelled out. These relate to research for social, economic and regional development. The agency's mandate generally is to create, acquire and promote scientific and technical knowledge and to provide that information to various sectors of the economy.

Thus, the NRC focuses on three major research areas related to avalanches. These are avalanche engineering, avalanche hazard evaluation and forecasting, and research on the geotechnical aspects of snow mechanics. Limitations of personnel in the avalanche section of the NRC affect the emphasis placed on each of the three foci. Generally, avalanche hazard and evaluation has less emphasis than do the other two research areas.

In addition to research, the NRC provides a technical information service. This service is available to governments, industry and consultants. To assist in the dispersal of this information, the agency structures the formats for and contents of various avalanche training courses for personnel involved in avalanche control and safety.

In 1980, the NRC also became headquarters for the Canadian Avalanche Newsletter. The objective of this newsletter is to assist communication between persons and organizations engaged in snow avalanche work within Canada. In addition to the newsletter, NRC also is headquarters for the Canadian Avalanche Association formed by a steering committee December 30, 1981 (an Association largely technical in its orientation and membership).

While the mandate of this agency is clearly spelled out, its effectiveness is to some extent questionable, in large part because of the decision process. The decision process is responsible for emphasizing programs in technological science and not social science. An attempt should be made by the agency to broaden its base of operation and to research other scientific knowledge that is socially oriented. This need is even more urgent in light of trends in the last ten years that indicate recreationists are the group being more frequently impacted by avalanches than any other group.

National Hydrology Institute of Environment Canada

The National Hydrology Institute, in its present circumstance, will not be likely to increase its profile in avalanche management in Canada, even though its mandate to manage the environment and people is both broad and comprehensive. There is a tremendous amount of experience that this agency can contribute to avalanche management in Canada. However, what becomes apparent, with this agency moreso than with any other, is that the east-west dichotomy of decision-making and priority-setting is a major stumbling block to this federal agency's involvement in avalanche management. Thus, if this agency wishes to increase its profile in avalanche management, it must develop strategies to increase its profile in Ottawa at the normative decision-making level. Should this agency decide not to attempt to increase its profile in Ottawa, it must accept the possibility of a further reduction of its role in Canadian avalanche management.

Alberta Recreation and Parks

Alberta Recreation and Parks, although involved in avalanche management by necessity, does not have the legislative mandate to do so. As of 1984, the Alberta Provincial Parks Act (RSA, 1980) gave no statutory powers to provide for the 'safety' of park visitors. Fortunately, park headquarters in Edmonton has officially recognized the role of Kananaskis Provincial Park to provide safety from

snow avalanches. Unfortunately, the funding to accompany official recognition has not been as forthcoming, with government restraint programs bearing the brunt of the blame.

In Kananaskis Park a lack of funding is particularly critical. Here, avalanche managers have less than four years to prepare for the 1988 Winter Olympics. Present strategies incorporating road closures during the winter months likely will be inadequate to meet the demands of spectators and participants for the Olympics. A comprehensive management plan is needed. Delay in developing this plan and setting priorities may leave Kananaskis Park avalanche managers unprepared to deal with the influx of spectators and participants for the 1988 Winter Olympics and potential avalanche hazards.

The costs of effective avalanche management will be very high for this agency and should be phased in immediately. Unfortunately, with a large scale event such as the Winter Olympics and a currently limited avalanche protection and control program, high costs cannot be avoided.

British Columbia Provincial Parks Branch

Unlike Alberta, B.C. Provincial Parks Branch has a legislative mandate to provide park visitors with 'reasonable safety'. The Parks Branch plays an important role in the regulation of ski areas and heli-skiing operations, in addition to provincial park management.

However, there is no official policy with respect to the agency's role in avalanche management. Further, park officials at the normative decision making level are reticent to become too deeply involved in avalanche control. Thus, the onus for avalanche safety tends to rest largely on the individual recreationist.

What also has happened is that the park manager has been left somewhat in limbo. Although there is a need for better avalanche protection, park programs have no authority to focus on avalanche protection to any extent. Consequently, avalanche management plays a minor role in park strategies. For example, as of 1984 there was enough search and rescue equipment in Mt. Assiniboine Park (in the Rocky Mountains) for only four people.

Not only are there inadequacies in avalanche search and rescue equipment, another problem area is the lack of knowledge about the back-country user. Where do recreationists go, how knowledgeable are they in avalanche evaluation and have they had any formal avalanche training? These are a few of the areas of concern for park managers, and yet funding as of 1984 has not been available to address these concerns to any extent. There is a need for the park manager to communicate these concerns to park officials in Victoria, B.C. and to lobby for increased funding and an inclusion of avalanche management into park policy directives.

British Columbia Ministry of Municipal Affairs

The mandate of this agency is comprehensive, giving powers to: relocate and close municipal highways, develop community plans, regulate sitings of buildings, and regulate land use through zoning. Thus, the B.C. Ministry of Municipal Affairs has a strong potential to improve avalanche management in B.C. However, the application of this mandate has been inadequate in that as of 1984 it has been applied on an ad hoc basis only. It is this agency in addition to the B.C. Ministry of Highways and Transportation that have a significant potential to influence avalanche management in Canada.

Zoning is a sound pre-planning strategy that could eliminate or reduce the time and cost of current in-depth case-by-case development approval processes. Further, as has occasionally happened in the past, the likelihood of having to implement costly buy-back programs for approved and existing developments that have subsequently been found to be located in avalanche paths would be more remote. Zoning of land for avalanche hazards is a wise and practical preventative strategy.

British Columbia Ministry of Highways and Transportation

One of the major avalanche managers in B.C. is the Ministry of Highways and Transportation. The mandate under which this agency operates is that of public safety for highways and ski lifts. The mandate is explicit and clear. Between 1974 and 1984, this agency very effectively brought the avalanche hazard on B.C. highways under control.

Another responsibility of this agency has been the approval or non-approval of access for development proposals (in cooperation with a number of other agencies). However, in the past there have been instances where applications for development have not been approved by this agency and yet development has gone ahead regardless. Thus, the lack of legal enforcement powers of the agency has resulted in costly government buy-back schemes (mentioned earlier under B.C. Ministry of Municipal Affairs).

Not only are enforcement powers a problem for this agency, scale of jurisdiction also poses some difficulties. In contrast to a municipality that has defined boundaries and jurisdiction over a small unit area, the B.C. Ministry of Highways and Transportation has a less defined and yet much broader areal expanse for which it is responsible. Moreover, eighty percent of B.C. is mountainous (Freer and Schaerer, 1980, p. 345). Thus, these scales pose some difficulties with respect to mapping the avalanche hazard in B.C. and consequently, difficulties in zoning the avalanche hazard. Steps have been made in these directions but as of 1984 there is no comprehensive avalanche zoning program.

British Columbia Provincial Emergency Program (PEP)

In integral part of responses to the avalanche hazard, this agency has a wide and comprehensive network. The function of the PEP mainly is search and rescue and contingency planning. Its main

objective is to protect life and to minimize damages from environmental, man-made, and natural disasters. The legislative mandate of this agency places the onus to attend to avalanche hazards on the municipalities. Thus, the PEP operates a decentralized program. Personnel for the most part consist of ten thousand volunteers. Volunteers need not be qualified by can be trained in search and rescue through the PEP.

The major problem facing this agency is a lack of funding that has resulted from government restraint programs. A consequence of these restraint programs has been that the previous system of decentralized municipal hazard responses has been partly replaced by centralized provincial responses to the hazard. Such a situation could result in further problems. Emergencies often need immediate action, and delays in responding to avalanche accidents can be literally a matter of life and death. Thus, the PEP needs to evaluate the implications of its restraint policy and to select a strategy that will meet both the agency objectives and legislative mandate.

Summary

In addition to agency mandates, roles and functions, a number of avalanche management problems have been identified. One is in the area of mandate utility. With respect to several agencies (mainly those involved in park management), it is not clear what the mandates mean in terms of avalanche hazards. In other words, head offices have been vague in spelling out specific policies to deal with avalanches. Consequently, present mandates are unclear and inadequate in meeting the needs of the park manager.

Further, where agencies are involved in making recommendations, a municipality cannot be forced to implement those proposals. Thus, in some cases, avalanche management agencies can be found liable when advice is neglected or ignored. This area of the law needs clarification in placing the onus on the agency that ignores the advice and not on the agency that gives the advice.

Government restraint programs also have given avalanche managers a few problems. 'Higher priority' programs have had to continue at the expense of other 'less important' programs. Further, the decentralization of functions has been reduced because of government freezes, and greater centralization of avalanche management has resulted. In both cases, a shortage of personnel has been a major problem.

In terms of avalanche search and rescue equipment, there is another concern. Although not applicable to Parks Canada, most provincial parks are seriously undersupplied in avalanche search and rescue equipment to meet a large scale emergency situation. This too is an area that needs further attention.

Perhaps the biggest problem facing avalanche managers is an increase in avalanche accidents in recreation. In Canada, recreationists constitute 28 percent of all those impacted by avalanches since the late 1800s and this percentage likely will increase. Thus, if there are problems in mandate clarification and inadequate funds for search and rescue equipment, these issues need to be addressed now. Avalanche managers in recreation will have a difficult challenge, both practically and ethically, in meeting the needs of the recreationist on one hand and in providing for his or her 'safety' on the other.

There has been a heavy reliance on technology in avalanche management in Canada. More recently, the emphasis has shifted to information and education. This shift is not inappropriate given the increasing number of winter recreationists. The significance of the change is in the direction that future research should pursue. More research is needed not just on avalanche information and education but on how that information and education can be used to change a recreationist's behaviour in potential avalanche situations.

FOUR INTERNATIONAL STRATEGIES FOR MANAGING AVALANCHES

There are four major institutional strategies that are used internationally in managing avalanches. These are (1) avalanche legislation and regulation, including building permits and codes, (2) avalanche zoning and hazard maps, (3) insurance or disaster relief, and (4) information and education programs. The degree to which each of these strategies is implemented and enforced varies widely from country to country. The latter strategy has been broadly implemented in Canada, mainly by single mandate agencies; the first three have not.

Switzerland, France and the United States have the most advanced legislation in terms of regulating avalanche hazards and land use. There is a lack of comparable legislation in Canada, Norway, and Alaska to regulate communities to zone for avalanche hazards. Effort needs to be made in this direction. There should be a legislated requirement for properties with known avalanche hazards to be registered as such so that a buyer does not enter into a contract without all available information to base a decision on. However, this legislated requirement would be subject to the following difficulties,

> First, in order for an engineered structure to be built, avalanche-design criteria, specifying velocity, density, flow height, and type of avalanche, must be provided to the engineer. Although it is not possible to predict such design criteria with a high degree of reliability at the present time....
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> (Mears, 1980, p. 358)

Nevertheless, in spite of these difficulties some sort of zoning is better than none and would prevent the selling of property with avalanche hazards to unaware buyers.

With respect to mapping, a distinction between "avalanche hazard maps" and "avalanche zone plans" needs clarification as has been done in Switzerland. Elsewhere, terminology and definitions are not used uniformly and it is difficult to know what a particular country means by its use of a term. Further, clarification of these terms would help differentiate legislated versus non-legislated avalanche

hazard mapping. In the literature, this distinction is not clear.

In addition to terminology, an international zoning colour scheme would be useful (active and potential mapping is not adequate but is at least a step. There is a great deal of confusion and controversy over what this colour scheme should be: (1) red/blue/white, (2) red/blue/yellow/white, or (3) red/yellow/green. In short, however, it would appear that the red/blue/yellow/white colour scheme offers more advantages than do the others, given a gap in knowledge of avalanches with return periods greater than 300 years (yellow zone).

Further, map scales used in avalanche hazard mapping, especially in Alaska, are often inadequate (Canada also has inadequate mapping scales). Maps at 1:50,000 do not provide enough detail to be useful in land use planning and, because avalanche hazard boundaries are critical, so is detail. Thus, 1:25,000 (in keeping with metric measures) for general avalanche zone plans and 1:10,000 and 1:50,000 would give even greater accuracy. In a province such as B.C., an initial comprehensive coverage at 1:50,000 would be a start in the right direction. Large-scale mapping need only be required in development approvals at first.

There are a number of countries with avalanche problems that have insurance coverage available. A move in this direction for those countries lacking such an option (Canada is one of these) would shift the burden of payment from society as a whole to the individual and private companies. At present, there is no incentive in countries lacking insurance schemes for avalanche damages to build in safe areas, as governments can be called in for disaster relief if necessary. Further, as proposed by Frutiger (1980), insurance for avalanche hazards could be used as a way of enforcing building regulations in that they must first meet required design specifications and location restrictions in order to qualify for compensation insurance.

Avalanche information, through hazard forecasts, has been structured according to degree of hazard. As an index, this design is subject to Hewings' (1975) criticisms. Hewings' findings indicated a need for environmental indices to be tied specifically to human health, i.e. "What do the categories mean to an individual personally?" "Can an individual be buried or killed given a low hazard rating, etc.?" There are enough studies relating avalanche forecasts with avalanche types to be able to make these sorts of meaningful relationships and thus, the revision of hazard forecasting formats should be a consideration of avalanche hazard managers, especially as studies such as Simpson-Housley and Fitzharris, 1979; Fesler, 1981; Gallagher, 1981; and Smutek, 1981 indicate a lack of use of avalanche warnings, for example, by back-country skiers. It is not always because the victims do not know any better that they become involved in avalanche accidents. Often, it is because the warnings do not have any meaning to them.

Finally, with respect to avalanche information and education programs, what is most noticeable between the U.S. and Canada is that while a very strong role has been taken by the USFS, there is no counterpart active forest service participation in Canada. As such, a useful source of avalanche information and experience in forest operations is not a part of the normative avalanche management decision making process in Canada. Its inclusion would be invaluable in achieving a comprehensive avalanche policy outcome.

Summary and Conclusions

In conclusion, in terms of avalanche legislation and regulation, while these are part of the legal system for land use development in Canada they are implemented neither comprehensively nor continuously. Moreover, numerous loopholes exist. One such loophole is provincial/regional jurisdiction in which regions are not required to implement provincial recommendations. Such a situation points to a need in Canada to plug avalanche management legislation gaps.

Neither has zoning for avalanche hazards (nor even avalanche hazard mapping) occurred on a comprehensive scale in Canada. Rather, zoning has been an ad hoc process and infrequent, even though legislation currently exists to make the process comprehensive. Largely, it has been the municipalities that have been at fault in not implementing available legislation.

In the category of insurance (or disaster relief), in Canada the choice has been disaster relief. There is no current insurance program, either public or private, against which avalanche damages can be insured. Consequently, neither are there incentives not to build in avalanche paths.

Thus, Canada is far behind countries such as Switzerland and parts of the U.S. (particularly Colorado) in implementing the more advanced institutional strategies currently used in avalanche management in other countries. Institutional change is needed before another major avalanche calamity such as that at Ocean Falls in 1965 is allowed to repeat itself. In this respect, regional and provincial legislation needs either to clarify accountability or to improve regulations to deal with current loopholes. Further, steps toward zoning for avalanche hazards must be a priority for avalanche managers in Canada. Without the adoption of these strategies, construction will continue to occur in Canada's mountain environments in the paths of avalanches.

LITERATURE CITED

Fesler, D.S. 1981. "Decision-Making as a Function of Avalanche Accident Prevention," Proceedings of the Avalanche Workshop held in Vancouver, B.C., 3-5 November 1980. Ottawa: National Research Council, Technical Memorandum No. 133, pp. 128-138.

Freer, G.L. and P.A. Schaerer. 1980. "Snow Avalanche Hazard Zoning in British Columbia, Canada," Journal of Glaciology, Vol. 26, No. 94, pp. 345-354.

Frutiger, H. 1980. "History and Actual State of Legalization of Avalanche Zoning in Switzerland," Journal of Glaciology, Vol. 26, No. 94, pp. 313-324.

Gallagher, D.G. 1981. "Information and Warning Programs for Back-Country Travellers," Proceedings of the Avalanche Workshop held in Vancouver, B.C., 3-5 November 1980. Ottawa: National Research Council, Technical Memorandum No. 133, pp. 176-189.

Hewings, J.M. 1975. "Environmental Indices and Public Attitudes: The Case of the Ontario Air Pollution Index," Ph.D. Dissertation, Department of Geography, University of Toronto, Toronto, Ontario.

McFarlane, R.C. 1984. "Impacts of Snow Avalanches in Canada and their Institutional Arrangements," Ph.D. Dissertation, Department of Geography, University of Waterloo, Waterloo, Ontario.

Mears, A.I. 1980. "Municipal Avalanche Zoning: Contrasting Policies of Four Western United States Communities," Journal of Glaciology, Vol. 26, No. 94, pp. 355-362.

Simpson-Housley, P. and B.B. Fitzharris. 1979. "Perception of the Avalanche Hazard," in I.F. Owens and C.L. O'Loughlin (eds.) Snow Avalanches, A Review with Special Reference to New Zealand. Wellington, N.Z.: Mountain Safety Council, Report No. 1, pp. 74-81.

Smutek, R. 1981. "Experience and the Perception of Avalanche Hazard," Proceedings of the Avalanche Workshop held in Vancouver, B.C., 3-5 November 1980. Ottawa: National Research Council, Technical Memorandum No. 133, pp. 145-152.