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Democratizing Risk Management: Successful Public Involvement in Local Water Management Decisions

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This paper discusses a successful public involvement effort that addressed and resolved several highly controversial water management issues involving environmental and flood risks associated with an electrical generation facility in British Columbia. It begins with a discussion of concepts for designing public involvement, summarizing research that indicates why individuals and groups may find it difficult to make complex choices. Reasons for public involvement, and the range of current practices are discussed. Next, four principles for designing group decision process are outlined, emphasizing decision-aiding concepts that include ''value-focused thinking'' and ''adaptive management.'' The next sections discuss the Alouette River Stakeholder Committee process in terms of objectives, participation, process, methods for structuring values and creating alternatives, information sources, and results. Discussion and conclusions complete the paper.

1. INTRODUCTION

Two prestigious U.S. advisory panels, the Presidential/Congressional Commission on Risk Assessment (1997) and the National Research Council's Committee on Risk Assessment (1996), called for increased public involvement in setting policy for risk management questions. This directive has drawn responses from risk professionals ranging from wholehearted endorsement to deep skepticism. Such a range in responses is understandable. On one hand, it is clear that policy for risk management involves public resources and public values, so it is easy to argue that judgments by the public should be used to help guide such decisions. On the other hand, all concerned parties would agree that risk management decisions are enormously complex, replete with technical uncertainties and perplexing value tradeoffs. Making and implementing wise policy choices is difficult, even for those who have specialized in risk management efforts for decades. How then could members of the interested lay public hope to understand and play a meaningful role in making such complex, high stakes choices?

Perhaps wisely, neither of the panel reports spelled out in detail what it meant by public involvement and how it should be conducted.[2] Because there is a wide range of both motivations and processes for public involvement, greater clarity is needed urgently. Moreover, despite the existence of a voluminous literature discussing the pros and cons of various public involvement alternatives, documented success stories that provide insight about concepts and methods are in short supply.

This paper attempts to address that gap. It discusses a successful public involvement effort that ad-

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[2] The Appendix of National Research Council, 1996, provides an example of a multiattribute value elicitation approach completed by John Lathrop for Florida Power that has conceptual links to the approach here.

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dressed and resolved a highly controversial water management question involving an electrical generation facility in British Columbia. In late Fall 1995, two of us (Gregory and McDaniels) were asked by the provincial electrical utility, British Columbia Hydro and Power Authority (BC Hydro), to design and implement a process that would result in a new operating plan for managing water flows in the Alouette River in southwestern British Columbia. The intent was to help develop a water management plan to address ecological risks, power generation, and flood control for the river. The third author (Fields) coordinated the activities of BC Hydro on this project.

The paper begins with a discussion of concepts relevant for public involvement, then turns to the Alouette River experience, which was built on those concepts. Section 2 first considers several lessons from both descriptive and prescriptive decision research to inform public involvement efforts, focusing on the decision-aiding potential of concepts such as ''value focused thinking'' and ''adaptive management.'' Section 3 turns to the Alouette River Management Committee process. It discusses the history of the issues, outlines initial steps, and summarizes the key activities that included structuring objectives, creating alternatives, characterizing impacts, clarifying tradeoffs, and seeking areas of agreement. Section 4 presents the results, including the consensus decisions reached on all major issues. Section 5 provides discussion and conclusions.

2. CONCEPTS FOR DESIGNING PUBLIC INVOLVEMENT

2.1. Individual and Group Behavioral Decision Research

Behavioral decision research with individuals has developed over the last three decades as a major theme in social psychology and a fundamental influence on social science applications in risk management. These research findings show consistently that, in experiments and real life situations, ''humans are quite bad at making complex, unaided decisions'' (Slovic, Fischhoff, and Lichtenstein, 1977). Individuals naturally respond to complex tasks by using their judgmental instincts to find an easy or adequate way through the problem at hand. They respond to probabilistic information or questions involving uncertainties with predictable biases that often ignore or misprocess important information (Kahneman, Slovic, and Tversky, 1982). They seem to have little instinctive ability to clarify objectives (March, 1978), create a wide variety of alternatives (Keeney, 1992), or structure decision tasks (Simon, 1990). When asked to consider value tradeoffs or select among alternatives, they may employ a number of heuristic reasoning processes that are susceptible to a variety of contextual or task-related influences (Payne, Bettman and Johnson, 1992). In short, there are many reasons to expect that, on their own, individuals (either lay or expert) will often not make informed, thoughtful choices about complex issues involving uncertainties and value tradeoffs.

Behavioral research regarding group decision processes is equally discouraging about the unaided ability to make wise choices about complex tasks. In general, groups can (at best) do about as well as the more deliberative or well-informed members would on their own in addressing complex judgment tasks. Groups can have improved performance over individuals because more perspectives may be put forward for consideration, and because the chances of having natural systematic thinkers involved is higher. On the other hand, the performance of unaided groups is susceptible to the tendency to establish entrenched positions, a tendency which makes discussion of compromise difficult. Groups also are subject to adopting a common perspective and ignoring contrary information, a tendency termed ''group think'' (Janis and Mann, 1977). As a result, a single forceful or cantankerous member can have a dramatic effect on a group's activities.

These findings should not be taken as a condemnation of public involvement on the grounds of cognitive shortcomings. They relate to *unaided* efforts at judgment tasks, not to situations in which individuals or groups are aided within structured decision processes. Thus, these findings (intentionally) ignore the crucial role played by those who help participants structure, understand and grapple with the required decision tasks.[3]

The views of two eminent decision scientists help

[3] One reviewer was concerned that the remarks in Sections 2.1 to 2.3 displayed a condescending attitude toward the competence of citizens to make collective decisions, and that the specific paragraph aggrandized the role of experts. Although we can understand these sensitivities, we must disagree with their substance. We think the findings of behavioral decision research are clear and well established. We think the ability of structured processes to improve on unaided decision making is becoming more established (Keeney, 1992), and is a major reason why society has interest in the role of citizen participation.

clarify what is needed to assist individuals and groups to address complex risk management questions. James March draws attention to the need for help with identifying and defining goals by observing that ''human beings have unstable, inconsistent, incompletely evolved and imprecise goals at least in part because human abilities limit preference orderliness'' (March, 1978, p. 598). Herbert Simon emphasizes the need for an effective decision structure and workable tasks: ''[h]uman rational behavior is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor'' (Simon, 1990, p. 7). The implication is that efforts to assist public involvement processes in making defensible choices should stress methods for clarifying fundamental individual or social objectives and for structuring the decision tasks so they are meaningful, and within the capabilities of those involved. At the same time, the goals and tasks must be useful for making responsible choices in the given decision context.

2.2. Reasons for Public Involvement

Public involvement, in various forms, has been a feature of the North American political landscape for decades. An early paper by Arnstein (1969) provided a taxonomy for public involvement based on the role of the participants within the process. At the bottom rung of Arnstein's public involvement ladder, the interested parties are only ''informed'' of policy issues; at the top rung, the public ''makes the decision.'' Arnstein's choice of metaphors may have had a detrimental effect on expectations for public involvement practice. By implying that letting the public make the decision is the ''highest'' form of public involvement, that paper may indirectly have contributed to heightened expectations. Virtually all public involvement efforts with group processes have to address the question of whether the participants are empowered to set policy, and then explain why not. Yet, given representative governments and the complexity of the issues involved, there are formidable reasons to assert that one should never allow public involvement processes to actually set policy. Presumably that role should be reserved for legitimate government agencies or elected representatives, who are empowered by institutions to make public choices. At most, the objective of public involvement should be to provide insight that will foster widely supported policy choices reflecting public values, and to build lasting support for those choices.[4] Another taxonomy, similar to Arnstein's but cast from the viewpoint of the process proponent, could be based on the ends (objectives) the public involvement activities are intended to achieve. These ends range from simply informing publics (to obtain their approval for selected actions) to meaningfully involving the public (in order to make choices that reflect public values). The means (techniques or methods) to conduct public involvement efforts to achieve these ends have been discussed at length elsewhere (Creighton *et al.,* 1982). Of course, the methods selected for a given public involvement effort should be selected on the basis of the ends to be achieved. Although this seems like basic advice, in our view, it has been overlooked in a surprisingly large share of public involvement efforts we have observed.

A third taxonomy, provided by Fiorino (1990), outlines three rationales for public involvement in risk decisions: normative, substantive, and instrumental. The normative rationale ''derives from the principle that government should obtain the consent of the governed,'' and consequently ''citizens have rights to participate meaningfully in public decision making.'' The substantive rationale is that ''relevant wisdom is not limited to scientific specialists,'' whereas instrumental reflects the understanding that successful implementation is far more likely with broad public support (National Research Council, 1996, pp. 23–24).

2.3. The Extremes of Current Public Involvement Practice

One could characterize much of public involvement practice in North America by dividing it into two extremes on a continuum of ''stakeholder control'' of involvement activities. One extreme involves group processes, relying on consensus among participants as the decision rule. The most extreme form of this approach, and one that has wide endorsement, argues that the decision process a particular group should adopt should be entirely designed by the group itself. For example, consider a set of principles developed by the Canada National Round Table on

[4] The exception might be public involvement with official referenda, which have problems of their own (Magleby, 1984), and decision structuring processes that have been proposed to address them (McDaniels, 1996).

the Environment and the Economy (1993) intended to encourage improved decisionmaking to achieve a sustainable future for Canada. The principles call explicitly for "consensus" in "self-designed process" involving "all parties with a significant interest" as the prescription for improved decisionmaking. While we can understand the political reasons for offering such guidelines, we believe they will often be unworkable in practice. In particular, we think relying on lay participants to self-design decision processes for complex risk management questions could be a recipe for disaster, precisely for reasons outlined in Section 2.1.[5]

The other camp, polar opposite from consensus processes, allows public participation only in the form of specific, formally structured value judgments. For example, members of the public may only provide judgments about specific nonmarket value tradeoffs cast in terms of willingness-to-pay in dollar terms (Mitchell and Carson, 1989). Remaining aspects of the decision process—such as the range of objectives considered, the nature of the alternatives proposed, and the characterization of the impacts of alternatives—may be influenced by the values of focus groups or media reviews but are presented in a distilled form based on judgments made by the analyst or project proponent. This extreme approach is standard practice for social benefit/cost analysis based on welfare economics. It too has obvious shortcomings that have led to extensive criticisms (Kelman, 1981; Gregory, Lichtenstein, and Slovic, 1993).

The approach in this paper adopts a middle course between these two extremes. It employs a group process, with substantial responsibility placed on group participants to provide judgments, to assimilate information, and to provide views on the acceptability of alternatives. Yet it also adopts a clear structure for the decision process, requiring both formal and informal benefit/cost comparisons. The general outlines of this structure are established by the group leaders, and although participants have the ability to fine-tune, the scope of their role falls well short of a license to redesign the process.

[5] Note that in making this statement, we are not discrediting the wisdom or abilities of lay participants to contribute to defining the decisions to be made, clarify values important for the decision from their viewpoint, or contribute technical information about risk management choices (National Research Council, 1996). Rather, we are relying on the findings of behavioral decision research (and our own experience) which demonstrates that structuring a complex decision process is not instinctive or straightforward, and can often benefit from practical advice.

2.4. Concepts for Designing Group Decision Processes

We believe four concepts are particularly important for group decision processes for complex risk management choices. All involve the pragmatic application of formal decision analytic concepts.

2.4.1. Value-Focused Thinking

Keeney (1992) describes "value-focused thinking" in simplest terms as "deciding what is important and how to achieve it." Value-focused thinking emphasizes the preeminent role of values in all decisionmaking. It involves value-structuring approaches drawn from multiattribute utility theory. It uses these judgments to create more attractive alternatives that stand a better chance of wide support, determine the information needed to characterize impacts of alternatives, and, formally or informally, evaluate alternatives. Value-focused thinking was the key to designing and implementing the public-involvement process described in this paper.

2.4.2. Adaptive Management

Holling (1978), Walters (1986), and others developed "adaptive management" as a means of coping with profound uncertainties in managing complex natural resource systems involving predator–prey relationships such as fisheries. Since then, it has been applied to a wide range of resource management issues as well as strategy design and other management contexts (McDaniels, Healey, and Paisley, 1994). In simple terms, adaptive management could be characterized as follows: When faced with profound uncertainties, take a purposeful step forward, monitor the consequences, learn from the results, and avoid costly failures. It sees decision making as an iterative process rather than a one-time exercise, and emphasize the role of learning from successive management choices. While adaptive management could be applied in a formal experimental design (Walters, 1986), it is also helpful as an informal impetus to seek opportunities for learning over time in any iterative decision context.

2.4.3. A Structured Decision Process

The basic steps of decision analysis (Keeney, 1992; von Winterfeldt and Edwards, 1986), which are

essentially the steps of any structured planning or decision framework, provide a responsible, informative and complete structure for a decision process. For the purposes of designing public involvement with groups of stakeholders, these steps can be cast in terms of a series of questions:

- What ends (objectives) are important to achieve in selecting a management alternative for the question at hand?
- What alternatives can be constructed to achieve these objectives?
- What information is needed to characterize the impacts of these alternatives, in terms of measures for the stated objectives?
- What tradeoffs arise in selecting among the alternatives?
- What alternatives can the participants support?

2.4.4. An ''Informative'' Decision Rule

The last question raises the issue of the appropriate decision rule for group public involvement processes directed towards recommending risk management alternatives.[6] Perhaps the most common is a consensus rule, in which every participant effectively has a veto over the decisions of the group (and often over every step of the process). In our view, a far more useful and informative decision rule is to ask participants what alternative(s) each can support. By ''informative'' we mean a decision rule that fosters learning about the process, the alternatives, and the values of participants (which should be important for public involvement). Greater insight occurs throughout the process because less time is spent dealing with objections that might occur with a veto-based consensus rule, and as a result every step is more straightforward.

An informative decision rule is akin to approval voting (Brams and Fishburn, 1983) as opposed to unanimous agreement. However, the group does not make its ultimate recommendations based on majority or plurality voting, because typically the number of participants and the groups they represent is not rigorously structured as a legislative body with a representative structure. Instead, the decision rule is simply to report to the elected or appointed decisionmakers who are seeking input through the process what alternatives the various stakeholders can support. This approach is in keeping with the role of decision analytic approaches with multiple stakeholders, where utility functions for various groups could be used to inform the decisionmaker on preferences of constituents (von Winterfeldt and Edwards, 1986).[7]

[6] The National Research Council (1996) report stresses the need for decision rule in ''Achieving Closure'' (pp. 129–131). It outlines variants of veto-based decision rules, but does not mention the ''approval'' rule outlined here.

3. THE ALOUETTE RIVER STAKEHOLDER INVOLVEMENT PROCESS

3.1. Project Objectives

An operating plan provides a set of working guidelines for a hydroelectric generating facility. In this case, it identifies operational procedures to be followed by BC Hydro system staff for the Alouette hydroelectric facility, in the light of stakeholder interests and values as well as natural conditions (e.g., rainfall). The Alouette hydroelectric facility includes a reservoir and dam on the South Alouette River, a tributary of the Fraser River in southwestern British Columbia, and a tunnel to two other hydroelectric facilities that generate power from South Alouette River water.

From the viewpoint of BC Hydro, which sponsored the work, the immediate regulatory objective was to meet the directive of the British Columbia Water Comptroller (the provincial regulator of water use). As one condition of relicensing another nearby facility, the comptroller instructed the utility to ''consult'' with specific groups of stakeholders in developing a water management plan for the South Alouette River. The broader objective of the utility was to meaningfully address concerns over fisheries and flood control issues that had been sources of controversy on the South Alouette for decades.

The authors' principal responsibilities on this project were to structure and facilitate discussions of

[7] The stakeholder-based multiattribute utility theory approach, often discussed but rarely practiced, is to elicit utility functions for each stakeholder group, and then use these to score various alternatives (Hobbs and Horn, 1997). The results clarify areas of agreement and disagreement and can be used to help create win–win alternatives. Yet, the cognitive effort, time requirements and possible annoyance or confusion to stakeholders are substantial costs of this approach. Moreover, it does not meet Simon's criterion of ''workable decision tasks'' for most stakeholders. How the tradeoffs are combined with technical performance scores would not be transparent to most participants.

the Alouette Stakeholder Committee (ASC), which included technical guidance on clarifying members' objectives, using these values to create operating plan alternatives, fostering understanding by committee members of the pros and cons of selected alternatives, and leading the group toward making specific decisions about its recommendations.

3.2. Membership of Stakeholder Committee

The stakeholder committee had 17 official members drawn from a wide array of interested groups and organizations. Members of the ASC were selected on the basis of several criteria. First, the participation of certain key agency representatives and community groups was specified by the directive of the Provincial Water Controller. Second, invited individuals were considered to represent a group with an interest (a ''stake'') in the outcomes of discussions concerning BC Hydro's operating plans on the river. These groups included local citizens, municipal staff members, provincial and federal government agencies, First Nations, BC Hydro, and other key user groups. Third, selected individuals were considered to be good candidates for an open, participatory process that would rely heavily on skills of articulation, listening, learning, and mutual cooperation.

Two rules were also adopted by the ASC to aid in the stakeholder involvement process. First, if a member was unable to attend one meeting due to a scheduling conflict, it was agreed that a designated alternate could take their place at the table. Second, if other people wanted to observe a meeting of the ASC, it was agreed that they could listen and watch providing they did not sit at the ASC table and providing they did not speak or otherwise disrupt the committee's deliberations. Some observers provided information when asked for input from the ASC.

3.3. Stakeholder Committee Meetings and Reporting

Meetings of the ASC generally were held at a high school in Maple Ridge, a community of about 20,000 people, about 60 km east of Vancouver. A total of 15 official meetings, averaging about three hours each, occurred over a 6-month period from January to July, 1996. The committee meetings were structured on the basis of the five fundamental questions noted in Section 2.4 as comprising a structured decision process.

The meetings typically began with a status report by the consultants, followed by brief discussions of member concerns. The main agenda items in most meetings included presentations, either by the consultants or by invited speakers, to address gaps in the information base that were considered by ASC members to be critical for informed decision making. These gaps ranged from questions about the system operating procedures employed by BC Hydro engineers to the status of work being conducted on the Alouette River by a multiagency Fish Flow Study Team. After each meeting, a set of minutes was prepared and circulated to document progress. These minutes, combined with the many brief reports prepared to summarize and present information at meetings, provided an ongoing record of activities. As the process drew near conclusion, ASC discussions were summarized in a draft consultant's report, which was circulated to all members of the committee. After two more meetings, a final report was submitted by the consultants to all ASC members and to BC Hydro. This document was made available to interested members of the public and it served as the basis for BC Hydro's submission of a water management plan to the provincial water comptroller.

3.4. Process Considerations

The intent of the consultants was to provide a respectful, open forum for discussion of issues relevant to determining a preferred operating plan, or set of plans, for the Alouette system. Members of the ASC were reminded that their role was not to write the operating plan proposal for the water comptroller. Instead, they were charged with providing advice to BC Hydro concerning the key elements of an operating plan preferred by stakeholders. Final decisions regarding the content of the application would be made by BC Hydro. However, it was acknowledged that any elements of an operating plan that were agreed to unanimously by ASC members would carry a substantial significance. If any deviations from the eventual ASC recommendations were to be sought by BC Hydro, these were to be identified and explained.

It is one thing to say that the desired process should be open; it is another thing to make sure that desired standards of transparency and comfort are achieved. This was particularly true in light of the

legacy of mistrust and adversity that was inherited from the history of Alouette system operating concerns. As a result, the consultants made several explicit decisions:

1. Share all information, by distributing copies of key data to all ASC members;
2. Seek flexibility, by acknowledging the precedent-setting nature of the discussions;
3. Develop information in response to ASC members' questions, through modelling and computer simulations;
4. Bring in speakers and presenters, as requested by ASC members;
5. Have ASC members participate in decisions regarding evaluation strategies;
6. Maintain close ties with other relevant community and provincial activities; and
7. Acknowledge the emotional content of the issues under consideration.[8]

It was also acknowledged that close communication should be maintained with the citizenry of Maple Ridge through several independent, parallel processes. For example, an open house was held midway through the stakeholder involvement process. It provided an opportunity for informal comments and input from local residents. Discussions within the ASC, coupled with related initiatives outside the ASC, led to a special public meeting with riparian residents to discuss concerns of community residents who might be affected particularly by changes in flood-control policies. Additional periodic reports were made by ASC members to key decision makers, including the mayor of Maple Ridge and senior management at BC Hydro.

The most crucial process considerations were those relating to points raised in Section 2.4 regarding the structured decision process and decision rule. The consultants presented the set of basic questions to guide the process, and the proposed decision rule, to the group. Both were confirmed by committee members as a reasonable basis for structuring the group's activities.

Another key decision was how tradeoffs would be considered and articulated by the committee. The consultants summarized three possible approaches: (1) all tradeoffs could be considered in dollar terms, based on willingness-to-pay concepts; (2) all tradeoffs could be considered in terms of multiattribute utility measures; or (3) tradeoffs could be considered, by determining the (qualitative or quantitative) pros and cons of alternatives and then letting participants select and provide a reasoned explanation for the alternatives they prefer. After some discussion, the committee selected the third approach, recognizing that the background research and thoughtful introspection required for (3) were also first steps for responsibly completing (1) or (2) as well, so (3) could be followed by (1) or (2) if desired.

3.5. Identifying Stakeholder Values

The starting place for the ASC activities was to define and understand participants' values for the decisions at hand. The values of committee members indicated ''what mattered'' and served as the basis for design of a recommended operating plan. The approach for clarifying values as a basis for structuring objectives followed the concepts of multiattribute value characterization (Keeney, 1992). Initial information suggesting possible objectives for Alouette facility water management came from a series of interviews with more than 20 key informants, including community leaders as well as with individuals in government agencies.

Drawing on these interviews, a preliminary set of objectives (in no particular order) for an operating plan was developed:

- avoid adverse effects from flooding;
- promote recreational activities;
- promote the health and biological productivity of the South Alouette River and Alouette Lake (including fisheries); and
- avoid cost increases to provincial residents.

Discussions of these objectives revealed that something was missing. ASC members were concerned about the level of uncertainty in our current knowledge of fisheries ecology and management on the Alouette River. It was acknowledged that additional studies, to be conducted over a period of time (perhaps 1 year, perhaps 10 years), were needed to deepen our understanding of the fundamental relationships between water flow and velocity, aquatic and riparian habitat, and fisheries productivity. As a result, a fifth objective was added to the list:

- promote flexibility, learning and adaptive management for the Alouette system.

Table I presents this set of structured objectives.

[8] For a related discussion of process issues, see Fisher and Forester, 1993; Renn, Webler, and Wiederman, 1995; or Majone, 1989.

Table I. Objectives and Measures for ASC Water Management Planning Activities

Overall Objective: Select the best possible operating plan for the Alouette River.	
Objective	**Measure**
1. Avoid adverse effects of flooding	• Frequency of floods, of a size equal to or greater than the flood of November, 1995 (3,200 cfs daily average flow at Alouette Dam)
—on people	
—on private property	
—on public property	
—on cultural resources	
—on perceptions	
2. Promote the ecological health and productivity of South Alouette River and Alouette Lake	• Hectares of high quality fish habitat in Alouette River
—for fish (salmonids and others)	• Quality of fish habitat in Alouette Lake
—for other species (plants and animals)	• Shape of river hydrograph
3. Avoid cost increases for provincial electrical supply	• Annual dollar costs of generation to be replaced, in 1996 dollars
—costs of electrical energy	
—other financial costs	• Environmental costs associated with incremental generation, in 1996 dollars
—costs of environmental impacts of replacement generation	
4. Promote recreational opportunities associated with Alouette Lake and South Alouette River	• Number and quality of recreation opportunities affected
—for the river and its environment, including boating, swimming, fishing, hiking, viewing, and horseback riding	
—for the lake and its environment, including boating, swimming, fishing, hiking, viewing, and camping	
5. Promote flexibility, learning and adaptive management regarding impacts of water flows on ecology of South Alouette River and Alouette Lake	• Learning opportunities and flexibility resulting from management structure
—flexibility for ease of changes in management	
—learning about ecology	
—adaptive management for incorporating learning and flexibility	

The overall objective is to: ''Select the best management plan for the Alouette facility.'' The subobjectives specify the characteristics of the ''best'' plan, assuming there were no constraints or limits on what could be achieved. In practice, it is unlikely that any single alternative could fully achieve all these objectives because several of them conflict, as is natural in public policy issues. Thus, tradeoffs among the objectives must be considered to clarify what the best possible alternative would entail.

Measures to indicate how well the objectives are achieved are also shown in Table I. The choice of measures necessarily reflects the available data, what the objectives mean, and specific choices by the ASC. Two key measurement issues were resolved during the early ASC meetings.

1. Whether flooding should be measured in terms of the magnitude of losses (to people and property) or in terms of the frequency of severe floods (i.e., those requiring protective actions). It was also acknowledged that the ASC needed to address the question of what would be defined as a ''flood.'' A flood event was determined to equal or exceed flows that occurred during a damaging flood in November 1995, that averaged approximately 3200 cfs released from the dam for the peak day. That definition was selected because the impacts associated with a flood of that level were still fresh in the minds of local participants. The best measure for flood control, given available information, was determined to be based on the frequency of floods of the November, 1995 flood (or greater). The current level of protection, determined from the operating system models, was calculated to be about 1-in-12 (i.e., if the system were operated strictly according to the then extant rules, a flood event equal to or exceeding 3200 cfs would be predicted to occur once every 12 years, on average).
2. Whether biological productivity of the South

Alouette River should be measured in terms of broad indicators of ecosystem health, the numbers of various species, the numbers of salmonids, or the area of high-quality habitat available for salmonids. After discussion, it was decided that the area of high-quality salmonid habitat would serve as the best indicator of the biological health of the Alouette River. It was noted that one possible exception to this choice is the effects of changes in flow regimes on bird populations of adjacent terrestrial areas. It was agreed that this topic could be considered in the future. Additional discussions of the effects of releases on fish populations stressed the importance of flow velocity as well as water depths, as shown by preliminary results from the Alouette River Fish Flow Study Team.

3.6. Information Requirements and Sources

Several kinds of information were required to understand the impacts of operational alternatives for the Alouette electrical facilities. The ASC meetings devoted considerable time to identifying key issues regarding the various kinds of impacts and to receiving presentations from technical specialists who provided important information about impacts. Table II summarizes various questions about impacts that were discussed during the meetings.

Technical specialists conducted substantial research and modelling efforts to provide information for the ASC planning activities. For example, BC Hydro staff conducted extensive simulation modelling about flood control and power production, considering a wide range of possible operating scenarios. This modelling focused on alternative ''operating rules'' for three key elements of the Alouette system: the Alouette spillway, the ''adit'' (a tunnel) from Alouette to nearby Stave Lake, and releases through the Alouette low-level outlet. Parts of several meetings of the ASC were devoted to ensuring that committee members understood and were comfortable with the approach taken on simulation modelling for flood control and power production. The committee asked for and received substantial information on the accuracy or ''calibration'' of the modelling efforts, leading to agreement that the results were useful and relevant for comparative analysis.

The issue of obtaining defensible fisheries information proved difficult, because the work of the Alouette River Fish Flow Study Team (an interagency effort) was occurring simultaneously to the work of the stakeholder committee. Although some early information was available regarding the study process being followed by the Fish Flow Study Team, no results were available until near the end of the ASC deliberations. In fact, the schedule for the ASC was extended to allow more time for the Fish Flow Study Team to complete its initial research. Even at the time of a presentation by fish flow team members to the ASC, substantial issues remained unresolved. The most notable was the uncertainty over the relationship between changes in river flows and quality of salmonid habitat for the South Alouette River. Two competing predictions for this relationship, based on different data sets, were considered and extensive discussions occurred regarding the differences in estimates. The ASC also recognized the need for adaptive management procedures to foster learning in a scientifically defensible manner.

3.7. Creating Operating Plan Alternatives

Several alternatives were identified as possible ways to achieve each objective. It was recognized that these alternatives would necessarily involve tradeoffs with other objectives, such as costs. The approach was to identify a range of possible alternatives, involving different levels of tradeoffs, so the ASC could understand how the tradeoffs changed from one alternative to another. In general, the approach was also to consider alternatives (and their costs) to achieve each objective separately, and then to examine how these separate alternatives could be combined into various plans. Information about the impacts of the alternatives was communicated using ''objectives by alternatives'' matrices. For a specific decision, this approach involves constructing a matrix with the relevant objectives (and measures) shown along one side and the relevant alternatives shown along the other side. The cells in the matrix then contain information that characterizes how well a given alternative performs in terms of a given objective. As discussed below, several technical issues influenced the alternatives considered for each objective.

3.7.1. Fisheries and Ecological Health

Fisheries and ecological health can be affected by ''flushing'' flows, regular flows, and fish habitat

enhancement works. Flushing flows are significant flows (e.g. 1000 cfs or greater) lasting a short period of time (e.g., 2–3 days) that remove silt from the river, thereby improving benthic and substrate habitat for salmon spawning. Operations at that time did not include flushing flows. Regular flows into the river, usually expressed as *minimum* flows, affect the amount of habitat available for fisheries spawning and rearing. Historic operations allowed for a minimum of 20 cfs to be released through a low level outlet at the Alouette dam; since September 1995, the flow had been set at 70 cfs as part of an interim agreement until the operating plan review was completed. The low level outlet of the Alouette dam can release a maximum of 105 cfs, depending on the water level in the reservoir. Fish habitat enhancement can occur by opening side channels, or spawning channels. These are natural gravel areas adjacent to the river, through which river water is diverted to make larger areas of quality gravel available for spawning.

3.7.2. Flood Control

Flood control can be affected by flow-related and non-flow related activities. Flow related actions involve use of the Alouette facilities to reduce the probability of floods on the South Alouette River. Flood protection efforts could rely on the judgement of facility operators as to when the adit and spillway should be opened, or on explicit operating rules about when these facilities should be opened, or on a combination of these approaches. Nonflow related flood control actions could entail improved communication and warnings, efforts to reduce or end development in the flood plain, or improved forecasting.

3.7.3. Recreation Activities

Recreation activities are largely affected by flows in the South Alouette River. In summer, flows below 70 cfs and over 105 cfs at the dam could be expected to adversely affect some kinds of family-oriented recreation opportunities. Winter recreation is closely tied to steelhead angling, for which higher flows (over 70 cfs) improve angling opportunities by increasing the quality of the fishing experience (i.e., improvements in ''fishability'').

3.7.4. Power Production

Power production is affected by flows into the South Alouette River either through the low level outlet or the spillway, because that water is not available for power generation. Power production is also affected by flows through the adit to nearby Stave Lake, but to a much lesser degree. Diverting water through the adit only entails a loss of about one-third the available power from a given amount of water, because it can still generate power at the other facilities downstream.

3.7.5. Learning and Adaptive Management

Learning and adaptive management is shaped by management practices for river flows that affect fisheries issues. In part, the management practices that occur would be influenced by which organizations hold water licenses on the river, or which have an explicit role in management decisions, or both.

4. RESULTS

The operating plan alternatives considered by ASC members were constructed on the basis of the five key objectives outlined in Table I. In each case, the ASC worked to select alternatives and achieve consensus on a single component of the plan option that would achieve the desired outcome for the objective under consideration while recognizing effects on other aspects of the plan. When agreement among ASC members was not possible, participants were asked to designate their favored component of a plan from among a small set of alternatives, and to discuss their reasons for this choice based on their values and knowledge of the pros and cons of the options.

The basis of comparison in evaluating alternatives generally focused on whether the benefits from nonpower objectives justified the potential reduction in power output (and increases in cost) associated with adopting a plan that does not maximize electrical generation from the facilities.[9] The ASC discussion

[9] Considerable modeling and analysis was conducted to identify the incremental costs of each alternative for each objective. Tradeoffs between cost and each of the other objectives were thus addressed quantitatively in terms of cost increases to achieve performance improvements on another objective. Then the aggregate costs of the package of accepted policy choices (Table III) were carefully considered.

Table II. Key Factual Questions Regarding Issues Associated with Alouette Facility Operating Alternatives

Issues	Key questions
Recreation	• What types of recreation activities are important in the area? • Where on the river/lake do activities take place? • How are activities and key sites affected by different flow levels? • How are levels of recreation use likely to change in the future?
Flood protection	• How big a flood is a concern? • What can be done to avoid adverse impacts of flooding? • How effective are various measures in decreasing frequency of floods? • How often would floods occur if there were no dam?
Costs	• How big are the power benefits at issue? • How should the power benefits be valued in dollar terms? • How significant is ''certainty'' of power output at BCH? • How are mitigation costs accounted for? • How would the power be replaced?
Fisheries and ecological health	• What is the relationship between flows and the suitability of habitat for various fish species? • How much quality habitat, in hectares, results from various flows, by month? • What would be the consequences of ''flushing'' flows to improve substrate habitat?
Water licenses/flexibility and adaptive management	• What are the specific rights held by BC Hydro under its current water licenses? • What are the controls on license holders? • What does the water comptroller want to see as recommendations from the committee?
First Nations rights and interests	• How do First Nations and the courts view their rights? • What are the implications of forthcoming treaty-making activities?

recognized the importance of maintaining an assured supply of electrical power to provincial residents. However, the ASC also discussed that this security should be consistent with the multiple uses of water from the Alouette system and must recognize requirements of the federal Fisheries Act as well as future treaty agreements with First Nations. In addition, it was recognized that all elements of a proposed operating plan should be evaluated as part of a package that includes nonmonetary benefits and costs (e.g., the recreational benefits of improved steelhead angling opportunities) as well as monetary benefits and costs (e.g., the foregone power costs of flushing flows).

After 15 meetings, the ASC reached complete consensus on all major issues it was asked to address. Table III summarizes the set of specific decisions agreed to by all participants, along with a consensus recommendation to either ''reject'' or ''adopt'' the proposed action.

In addition to these direct results of the stakeholder involvement process, a longer term result has been the initiation of several changes in practice, both by BC Hydro and by the Office of the Water Controller, regarding water management and planning in British Columbia. Before the ASC process, the utility had been given water licenses with minimal restrictions, addressing only extreme operating parameters for the facilities. The ASC was the first attempt to create a more detailed water management plan for a hydroelectric facility with extensive public input. Some months after the ASC process was completed, BC Hydro and the Province of British Columbia announced the intent to develop water management plans for all hydroelectric systems in the province. The replanning processes are to adopt the same basic principles as developed by the ASC, as summarized earlier.

5. DISCUSSION

The title of this paper asserts this is a ''successful'' public involvement effort. What criteria are appropriate to judge success in an undertaking of this kind (cf Moore, 1996; Renn, Webler, and Wiedermann, 1995)?

The obvious criterion is that a consensus agreement was achieved among a group of diverse representative stakeholders. This agreement has held over the past year, with all concerned parties generally satisfied with the results. Yet, achieving consensus is at best a partial criterion for success in such efforts. As outlined here, the objective of public

Table III. Summary of Stakeholder Committee Decisions

Objective/Measure	Decision		
	Benefits	Cost	Recommendation
1. Promote ecological health			
• Should flushing flows be implemented?	Substantial improvement in quality of substrate habitat	$50–75k yearly, with preset timing	Reject
		$2–30k yearly, with flexibility in timing	Adopt
• Should base water flow (year round) be increased to full capacity of current facility?	Substantial improvements in fisheries habitat and aesthetics	$270–440k/year	Adopt
2. Avoid adverse flooding effects			
• Change operating rules for generating facility to improve protection from major flooding event	Increase protection from major flood from current 1-in-12 year to 1-in-32 year	$30k/year	Adopt
3. Promote recreational activities			
• Improve angling opportunities via higher water flows • Maintain quality of non-angling recreation	Key consideration to local stakeholders	Minimal	Adopt
4. Avoid cost increases			
• Should water flows be increased beyond capacity of current facility?	Maximum fisheries production potential	Annual costs: 700–1055k Capital costs: $3–6 million Some adverse effects on recreation	Reject
5. Promote learning and flexibility			
• Establish ongoing management committee with stakeholder representation • Fund monitoring and adaptive management studies	Provides ongoing basis for stakeholder involvement and improvements in fisheries base	Approximately $50k/year	Adopt

involvement is to provide insight to decisionmakers, not to resolve a dispute. One could imagine a group of stakeholders achieving a negotiated agreement on a policy decision and yet knowing remarkably little about the relevant objectives, range of alternatives, or the impacts and tradeoffs they involve. In fact, we suspect this may be a common state of affairs in self-designed consensus-based public involvement with a dispute resolution emphasis. Hence, consensus alone is only a partial measure of success.

Another criterion, more in keeping with the orientation of this paper, judges success by the way the steps of the process were addressed. As seen in Section 3, a set of clear objectives was structured and written down, with specific measures for each objective (Table I). A wide range of alternatives was articulated, designed to address the various objectives (Table III). Considerable modeling, data collection and expert judgment were employed to characterize the impacts of these alternatives in ways understandable to the participants and that addressed their key factual questions (Table II). The tradeoffs involved in selecting one alternative over another, and the rationales for preferring one set of actions over another, were explicitly considered by the participants. The tasks the participants were asked to complete, by selecting the alternatives they could support, were made as clear and straightforward as possible.

We believe these steps comprise the elements of a ''quality'' decision process, and thus are why this public involvement effort can be termed a success. In making this statement we are explicitly adding to the definition of ''decision quality.'' Early work defined decision quality as the result of involving ''the right people and the right information.'' More recently, decision quality has been defined in terms of the right decision framework, as well as the right people and right information (Matheson and Matheson, 1998). We would suggest that the selection of a decision framework is a critical first step in deciding who the right people are and in identifying the necessary type and quality of information. We also believe the four concepts outlined in Section 2.4 are elements

of the right decision frame for stakeholder involvement for risk management.

Another criterion for the success of this public involvement effort is in the nature of the alternative recommended by the process. In essence, the participants created a recommended alternative that was highly effective in meeting all the objectives established for the decision. In the parlance of the economist, the selected alternative moved up the cost curve for ''improving ecological health'' by increasing water releases, to the maximum possible given the existing facilities, to the point where further water releases would entail a substantial jump in capital costs. The level of flood control was selected by setting the expected annual cost of flooding equal to the incremental cost of flood control incurred. Finally, the management committee structure allows for adaptive learning over time to reduce uncertainties.

Still another criterion for judging success involves comparing the costs and benefits of the process itself. Excluding the costs of fisheries studies, which were undertaken for other purposes, the total costs of the ASC process amounted to about $700,000 Cdn ($500,000 US), including costs for consultants as well as BC Hydro staff time. The benefits included obtaining useful public input (and endorsement) for a water management plan that was a prerequisite for obtaining a new operating license for another nearby hydroelectric facility. In addition, BC Hydro managed to address and resolve issues of the appropriate water flow in the river, questions that had been a sore point in the community and with resource management agencies since the 1930s. Finally it obtained an agreement on a new flood control regime in a location where it had experienced a highly controversial flood the previous year. In essence, the utility resolved some of the most pressing regulatory, resource management, flood control, and public image concerns it faced in recent years. These are substantial benefits compared to the costs.

6. CONCLUSION

In our view, risk management decision processes can be made more ''democratic,'' as the title of this piece suggests, but only with a clear structure and a decision framework focusing on values, meaningful technical information, tradeoffs, and insight. Public involvement could take many forms, ranging from surveys to short small-group meetings to the extensive deliberative process outlined here. All these types of activities could, in our opinion, benefit from attention to the four concepts outlined in Section 2.4. On the other hand, employing these concepts will be no panacea for complex risk management choices involving difficult tradeoffs. The best one can hope for is that by combining value judgments and technical information in a structured framework involving workable decision tasks, participants will gain more insight and thus provide better informed recommendations. Anything more than this—such as the consensus agreement achieved in the case of the Alouette River—is a bonus.

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