

# **A FRAMEWORK FOR EVALUATING THE EFFECTIVENESS OF FOREST PRACTICES LEGISLATION AT PROTECTING DRINKING WATER SOURCES**

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## **Abstract**

The Ministry of Forests and the Ministry of Water, Land and Air Protection are working together to develop a framework within which to evaluate the effectiveness of forest and range practices legislation at protecting drinking water sources. The proposed framework suggests a spatial and temporal context for evaluations, levels and scales of evaluations, variables to monitor, study designs for water quality monitoring, and indicators.

## **Introduction**

Approximately 75% of British Columbians obtain their drinking water from surface water sources (Provincial Health Officer, 2001). Half of B.C.'s residents obtain their water from Vancouver and Victoria's protected watersheds, but the remaining 25% obtain their water from watersheds used for a variety of recreational and economic activities, including forestry and grazing.

The potential impact of forestry and range use activities on drinking water sources is minimized through forest and range practices regulation. Since 1995, such regulation has been under the *Forest Practices Code of British Columbia Act* (the Code), and in future will be regulated by the *Forest and Range Practices Act*.

The purpose of the Forest Practices Code, as identified in the Act's preamble, is to support sustainable use of the forest, including conserving water, and other forest resources. *The Forest*

*and Range Practices Act (FRPA)* is expected to require the same level of protection of the water resource, but in a more results-based and less prescriptive way.

Fundamental to the *Forest and Range Practices Act* is the establishment by government of objectives for all resource values, including water. Forest and range plans must be consistent with achieving those objectives in order to receive approval. Compliance and enforcement activities will focus on whether the results or actions committed to in the plan were met or carried out. A program of effectiveness evaluation carried out by government will ascertain whether the approved plans and practices met the objectives for the resource values.

The Ministry of Forests and the Ministry of Water, Land and Air Protection (MWLAP), with the cooperation of the Ministry of Health Services and Ministry of Sustainable Resource Management (MSRM) are working together to design a framework within which to evaluate how well forest and range practices legislation protects drinking water sources. The objectives in designing the framework are:

- to ensure that effectiveness evaluations are meaningful, credible, and scientifically defensible
- to facilitate comparisons both spatially and temporally
- to enable the knowledge gained to be transferred to comparable watersheds.

## **Strategic Framework**

A strategic framework was developed to identify the various project elements that were needed to support a drinking water focused effectiveness evaluation program.

Elements of the strategic framework are:

- knowledge base
- watershed classification
- reference watersheds
- provincial level sampling design
- measures of effectiveness
- variables to measure
- watershed level sampling design
- evaluation levels
- information management
- stakeholder involvement
- work plan

## **Knowledge base**

A literature review of how other jurisdictions have approached effectiveness evaluations of forest and range practices is needed, as well as a review of the results of effectiveness evaluations that have been conducted.

## **Watershed classification**

Because not every watershed is likely to be evaluated, it is desirable to identify watersheds that have similar characteristics relevant to their response to management activity. With such a classification system, knowledge gained in one watershed can be transferred to some extent to other similar watersheds.

## **Reference watersheds**

Conceptually, we accept that the goal in managing resource activities in watersheds is to maintain conditions fairly close to natural, or at least not so far from natural that they cause environmental or social problems that wouldn't otherwise be experienced. The difficulty with this is that natural conditions are highly variable, and often unknown, since few undisturbed watersheds are studied. A system of reference watersheds in representative watershed types would provide a basis for comparison with harvested and grazed watersheds in similar watershed types. To be useful, candidate watersheds will have to be of similar size, have similar slopes and biogeoclimatic conditions, and should probably have the same aspect.

## **Provincial level sampling design**

B.C. is a large and diverse province. It is important to ensure that a representative range of watershed types and forest and range practices are evaluated. While it may be financially impossible to sample the entire range of forest and grassland watersheds, evaluations could focus on those types that are of the greatest significance in supporting forest and range activities, pose the greatest risk to water supplies, or are of greatest importance in supplying drinking water to communities. In addition, selection of sample watersheds should consider the potential for comparison between regions.

## **Measures of Effectiveness**

The objectives against which forest and range practices will be evaluated will be set by government, either through the Forest and Range Practices Act, or by MSRM as a result of land use plans.

Where government objectives are measurable, these will serve for measures of effectiveness. For others which are more conceptually stated, it may be necessary to define at the watershed level what conditions would need to exist to consider that the objective had been achieved.

## **Variables to measure**

The evaluation framework must define the land and water variables to be assessed. It is preferred that those selected can be measured quantitatively. Water quality variables to be measured must be those known to be affected by forest harvesting, or range use. Watershed conditions to be measured must be those known to affect water quality, quantity and timing of flow. While there may be some variables that are of interest to specific watersheds, it is important to have a core set of variables for provincial consistency.

## **Watershed level sampling design**

A consistent sampling methodology for sampling within watersheds is needed to support regional and provincial analysis and comparison. A suitable sampling design and methodology is also needed to ensure that the results are scientifically defensible. Water quality sampling should follow the well-established protocols developed by the Resource Inventory Committee (WLAP, 2002).

## **Evaluation Levels**

Ideally, all effectiveness evaluations would pair water quality monitoring with observations of resource practices and land conditions. It is anticipated that a number of these evaluations will take place on a periodic basis, however it is unlikely that budgets will allow for a wide application of this approach. It may be possible to design a scaled-down version, using a subset of variables, that can be carried out in a greater number of watersheds, yet still provide meaningful information.

## **Information management**

Structures will need to be in place to handle the information gathered from effectiveness evaluations. Information systems will be necessary to store, analyze, and make accessible the results of effectiveness evaluations.

## **Stakeholder involvement**

Representatives of the forest, ranching and water purveyor associations are being, or will be, consulted on the development of the framework. This will be only be the first step in an ongoing process of stakeholder involvement.

## **Work Plan**

As other framework elements are completed, a work plan will be prepared which will propose the location and timing of effectiveness evaluations.

## **Progress to Date**

Summit Environmental Consultants Ltd. (Summit) was contracted in January 2002 to begin work on some of the framework elements. This included conducting a review of how other jurisdictions have approached similar effectiveness evaluations, and proposing a framework within which to plan, organize, schedule and conduct effectiveness evaluations (Summit Environmental Consultants Ltd, 2002). Work has been carried out on other framework elements as well, including the development of a water quality monitoring database.

## **Jurisdictional Review**

Most Canadian provinces do not generally consider drinking water a “forestry” issue due to the low proportion of drinking water that is obtained from forested watersheds on Crown land. Although most provinces have recently, or are currently, revising drinking water policy following several outbreaks of water-borne disease, managing forestry activities is a minor part of source protection plans outside of B.C. In the other provinces, much more attention is directed towards intensive livestock agriculture and other land uses. Where forests are the source of drinking water, the quality is very good compared to other surface sources. Also, land use activities in forested watersheds elsewhere in Canada generally occur on lower-risk terrain than in B.C., and concerns about forest practices are weighted to impacts on aquatic habitat.

The relationship between forest practices and drinking water is an issue of public debate in the United States Pacific northwest. The federal *Clean Water Act* requires states to implement water quality protection programs as well as some form of effectiveness evaluation. This must include some linkage between the use of “on the land” best management practices (BMPs) and actual “in the stream” water quality. In Oregon the Forest Practices Monitoring Program has been implemented to evaluate effectiveness through scientifically valid study designs. Monitoring for effectiveness includes field inspections of BMP compliance (Dent and Robben, 1999; Dent, 2001), “desired future condition” evaluations (Oregon Department of Forestry, 2000), and water quality monitoring (Dent and Robben, 2000). Other states have generally put less effort into effectiveness evaluation, but there are a series of U.S. Environmental Protection Agency-sponsored BMP demonstration projects. As in Canada, water quality from American forested watersheds is thought to be relatively good, even where harvest takes place, and other land uses are higher priority for BMP evaluation.

Criteria and indicators (C&I) have become key components of evaluating progress towards sustainability in the forest sector, and water-related C&I have been developed (Woodley *et al*, 2000). The Canadian Council of Forest Ministers and Montreal Process C&I related to water tend to be rather broad (i.e. applied at a provincial scale) and are not sensitive enough for operational level drinking water effectiveness evaluations. In B.C., the Arrow Innovative Forest Practices Agreement is working with University of British Columbia researchers to develop a set of local criteria and indicators for sustainable forestry, and has undertaken a pilot project to test the C&I at the landscape unit scale in the Slocan Valley (Arrow IFPA, 2001).

### **Summit's Proposed Framework**

In general, effectiveness evaluation programs elsewhere have included some or all of the following:

- 1) inspections and audits of forest and range practices;
- 2) tracking of criteria and indicators; and
- 3) water quality monitoring to determine the relationship between forest/range practices and water quality at the intake.

Each of these general approaches by themselves has some limitations that would make it difficult to draw firm conclusions about policy effectiveness, especially in the context of results-based forest practices legislation. Summit therefore recommended that the drinking water effectiveness evaluation framework for 2003 and onwards be comprised of an integrated program that would include three major elements:

1. “On the land” inspections and audits of BMPs with the results maintained and tracked in a central database. Inspections and audits would be completed relatively frequently and in all Forest Districts.
2. Development and tracking of a set of indicators in selected Forest Districts, such as those with ten or more community watersheds. The recommended indicators include length of new roads built in watersheds, length of roads on unstable or potentially unstable terrain, numbers of permitted range animals in watersheds, number of licensed water intakes, and number of reported boil water advisories. All of the recommended indicators can be calculated from maps and data that are available to the public. The indicators would be compiled and reported regularly.
3. Water quality monitoring to evaluate BMP effectiveness and refine BMPs. A basic trend and impact assessment program is recommended for at least three regions (e.g. coastal, southern interior, and Kootenays), with five or six watersheds per region. Such a program would be consistent with programs in Alberta for agriculture and the U.S. for forestry. An experienced statistician should be involved throughout the design and implementation of any monitoring program.

Indicators are likely the least informative effectiveness evaluation technique. Compared to the “on the land” and “in the stream” monitoring, they provide only indirect evidence that forest and range management policy maintains drinking water. Thus indicators should be used only in combination with the monitoring programs, to support analyses of whether policy is effective.

Summit recommended that the monitoring variables consist of a core set that would be monitored frequently (either continuously or discreetly, about 30 times per year) and a secondary set monitored less frequently (about 10 times per year). The core set of variables would consist of discharge, water temperature, specific conductance, turbidity, and pH. The secondary set includes

total suspended solids, fecal coliforms, *E. coli*, and true colour. These variables are the most likely to be influenced by forest and range practices and/or have an effect on drinking water quality (MacDonald et al., 1991). Other variables could be added, depending on local interests, such as nutrients where fertilizers are used in silviculture.

### **Water quality monitoring database**

One of Summit's report recommendations was to make use of water quality monitoring information already collected. The information would be analyzed with respect to the quality of water in these watersheds. While it is unlikely that any cause and effect relationships could be determined in a retrospective study, it can provide information about the quality of water in a number of community watersheds, most of which have experienced some degree of forest harvesting activity.

Subsequent to the recommendation from Summit, MOF undertook the creation of a database of information about where water quality monitoring had been carried out, the water quality variables monitored, and the characteristics of the watersheds in which they were located (Hystad, 2002). This project, which is the subject of a separate paper in these proceedings, focused on watersheds that were monitored under the Forest Renewal BC resource inventory program, most of which were community watersheds.

### **Summary**

Work is progressing on the development of a framework for evaluating the effectiveness of forest and range legislation and practices at protecting drinking water sources. The Ministry of Forests and the Ministry of Water, Land and Air Protection are developing a framework to ensure that these effectiveness evaluations will be meaningful and credible, will facilitate comparisons, and will support continuous improvement of forest and range policy and practices.

### **References**

Arrow IFPA, 2001 (Arrow Innovative Forest Practices Agreement). Lemon Landscape Unit Planning Study. Arrow IFPA Newsletter #3. <http://www.arrow-ifpa.com/publications/newsletters/>

- Dent, L. 2001. Harvest effects on riparian function and structure under current Oregon forest practices rules. Forest Practices Monitoring Program. Technical Report 12. July 2001.
- Dent, L. and J. Robben. 1999. Oregon Department of Forestry: Forest Practices Compliance Monitoring Project. 1998 Pilot Study Results. Forest Practices Monitoring Program. November 1999.
- Dent, L. and J. Robben. 2000. Oregon Department of Forestry: Aerial Pesticide Application Monitoring Final Report. Forest Practices Monitoring Program. Technical Report 7. March 2000.
- Hystad, P., 2002. Water Quality Monitoring Database. Ministry of Forests, Victoria. Unpublished report. pp 39.
- MacDonald, L.H., A.W. Smart and R.C. Wissmar, 1991. Monitoring guidelines to evaluate the effects of forestry activities on streams in the Pacific Northwest and Alaska. U.S. EPA Report No. EPA 910/9-91-001. U.S. Environmental Protection Agency, Region 10, Seattle, WA. pp. 165
- Oregon Department of Forestry (ODF), 2001. Harvest effects on Riparian Function and Structure under current Oregon Forest Practice Rules. ODF Executive Summary of Technical Report 12. July 2001. 9 pp.
- Provincial Health Officer, 2001. A report on the health of British Columbians. Provincial Health Officer's annual report 2000. Drinking Water Quality in British Columbia: The public health perspective. pp. 147. BC Ministry of Health Planning, Victoria B.C.
- Summit Environmental Consultants Ltd., 2002. Effectiveness Evaluation Framework: Forest Practices Code and Drinking Water. pp 77. Report prepared for Ministry of Forests, Victoria, B.C.
- WLAP. Water Quality Web Site, Ministry of Water Land and Air Protection.  
<http://wlapwww.gov.bc.ca/wat/wq/wqhome.html#9>. Accessed Jan 27, 2003.

Woodley, S. and nine others, 2000. North American Test of Criteria and Indicators of Sustainable Forestry. Final Report. Center for International Forestry Research. Published by United States Department of Agriculture Forest Service.