

Babine Watershed Monitoring Framework – Overview

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1. Purpose

Effectiveness monitoring assesses whether following planned management strategies achieves desired objectives. It is not possible, however, to monitor all strategies and objectives because of limited time and funding. This Monitoring Framework provides a scientific basis and transparent decision-making process for setting monitoring priorities in the Babine Watershed. Six government-approved land-use plans include objectives and management strategies for the Babine Watershed. Using the Monitoring Framework will help to allocate funds to those monitoring projects that will provide the most useful feedback about the planned management strategies.

Babine Watershed Land Use Plans

- Bulkley LRMP
- Kispiox LRMP
- Babine LUP
- Nilkitkwa LUP
- West Babine SRMP
- Babine River Corridor Park MDS

2. Content

The Monitoring Framework consists of three components needed to prioritise monitoring.

Monitoring Framework Contents

- *Land-use Plan Summary*: compilation of goals, objectives and strategies (or indicators and targets) from the six Babine land-use plans and provincial legislation
- *Knowledge Base*: summary of background scientific information relating planned strategies to objectives and goals
- *Procedures*: methods for using the Knowledge Base to determine monitoring priority

First, a “Land-use Plan Summary” documents the commitments in the land-use plans that require monitoring. These commitments include goals, objectives and strategies. The resource values listed in the plans are grouped into 14 goals, each containing from one to eight objectives. For each objective, the plans contain one or more measurable strategies that direct management activities. Strategies can also be expressed as indicators and targets.

Types of Commitment	Example
Goal	Conserve grizzly bears
Objective	Minimise human/bear interaction
Strategy = Indicator + Target	Maximum density of open roads per watershed

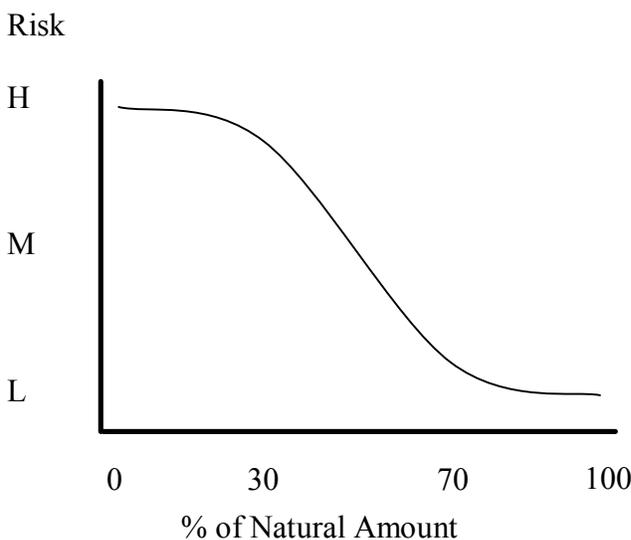
Second, a “Knowledge Base” provides current scientific information about the relationships between planned management strategies and the objectives and goals listed in the land-use plans. This component forms the core of the Monitoring Framework, including all of the relevant available information needed to assess the priority for monitoring for each objective and management strategy. The Knowledge Base is designed to be updated as knowledge improves.

Third, a set of “Procedures” uses the information in the Knowledge Base to answer questions that determine monitoring priorities for each objective and strategy included in the land-use plans. Following the procedures results in three lists of monitoring priorities for the Babine Watershed.

3. Information—the Knowledge Base

The Monitoring Framework relies on the concepts of risk and uncertainty to assess the need to monitor. Risk is defined as the chance of not achieving an objective for any management strategy. High-risk strategies have a high probability of not achieving the desired objective and may be good candidates for monitoring to detect if, and when, a negative consequence occurs (e.g. grizzly bear population declines precipitously). Because of incomplete knowledge, however, the level of risk associated with a particular strategy will rarely be certain. If uncertainty is high, a strategy with a low *estimated* risk may actually pose a high risk to an objective. The Monitoring Framework not only explicitly acknowledges uncertainty, but uses it to rank monitoring projects. Uncertain strategies may be good candidates for monitoring to improve knowledge, particularly relating to the accuracy of risk estimates.

The Monitoring Framework uses graphs to display how different indicator values are related to the risk to an objective (see Figure below). Data describing the status of indicators provide the x-coordinate on the graph; risk is read off the y-axis. Because the risk curves are preliminary and await testing, risk is currently divided into three broad categories (low, medium and high). In the example shown, risk is high when the indicator value is less than 30%, low when the indicator is above 70% and medium between 30% and 70%.



Risk to biodiversity versus percentage of each seral stage in each biogeoclimatic subzone.

The level of risk may change over time as management strategies are implemented because indicator values change. Hence, the risk posed by the current indicator level could be high but future risk low, or vice versa. The Knowledge Base includes information on the current and future indicator levels (x-coordinates). Current indicator level is based on inventory data; future indicator level is based on the targets listed in the various land-use plans.

In some cases, current values for the indicators are missing (e.g. average number of snags per cutblock). Similarly, future indicator values, or management targets, may not be clearly articulated in land-use plans. Thus, both current and future indicator values may be missing. Sometimes, missing indicator data can be estimated. Estimates are noted in the Knowledge Base.

The level of uncertainty associated with an indicator can be envisioned as a band around each risk curve. Actual risk may fall anywhere within the uncertainty band, but is more likely closer to the risk curve. Estimated uncertainty bands are sometimes explicitly drawn on graphs, but because of complexities, uncertainties are more often discussed in text. Uncertainty is divided into three classes: low uncertainty means that actual risk is very likely to fall within the estimated risk class; medium uncertainty means that there is a chance that actual risk may also fall in the adjacent categories (e.g. actual risk may be low or medium if estimated risk is low); high uncertainty means that actual risk could fall into any risk category (though is still most likely within the estimated risk category). The text separates different sources of uncertainty.

The information needed to assess current and future risk and uncertainty forms the core of the Knowledge Base. This information allows for assessment of the relative benefits of monitoring for any objective and strategy. Additional information refines the benefit estimate and provides relative cost estimates. Supplementary information addresses the uncertainty around achieving each goal, the influence of goals on other goals, the influence of each objective on a goal and the recovery period for each objective. Sections on the ease of monitoring provide estimates of the relative costs of monitoring.

The information in the Knowledge Base comes from published scientific literature and interviews with experts. Where information does not exist for the Babine Watershed, it has been derived, where possible, from areas with similar circumstances.

Information Contained in Knowledge Base

For each goal:

- Overview of current knowledge relating objectives to goal
- Uncertainty about achieving goal if objectives are achieved
- Influence of goal on other goals

For each objective:

- Relative influence of objective on goal
- Recovery period of objective
- Overview of current knowledge of risk and uncertainty (including graph of relationship between indicator and risk)
- Summary of available indicator data
- Current estimated risk and related uncertainty
- Future estimated risk and related uncertainty
- Ease of collecting indicator data
- Ease of improving the risk curve by reducing uncertainty
- Ease of detecting negative consequences

The following table presents an example of information from the Knowledge Base regarding risk and uncertainty for the indicator shown in the Figure on page 2. The Knowledge Base also contains detailed explanations and supporting information on how the risk and uncertainty levels were derived.

Plan Component	Example
Goal	Maintain Biodiversity
Objective	Maintain Natural Seral Stage Distribution
Indicator	Percent of each seral stage relative to natural
Assessment	
Uncertainty about achieving goal	Moderate
Influence of goal on other goals	High
Influence of objective on goal	High
Recovery period of objective	Long
Current indicator value (x-coordinate)	Old seral, Nilkitkwa: 73 – 100%
Future indicator value (x-coordinate)	Old seral, Nilkitkwa: 35 – 48%
Current risk of not achieving objective (y-coordinate)	Low, with high uncertainty
Future risk of not achieving objective (y-coordinate)	Moderate, with high uncertainty

4. Using the Information to Set Priorities—the Procedures

Following the procedures in the Monitoring Framework leads to three separate lists of ranked monitoring topics—one for each type of monitoring. There is no objective way to compare ranks among lists. Within each list, objectives and strategies are ranked first by priority as determined

from risk and uncertainty estimates, and secondly by supplementary information on benefits. Each objective and strategy is also accompanied by a cost estimate based on the ease of monitoring.

Types of Monitoring

- i. Collecting indicator information
- ii. Detecting negative consequences associated with management activities
- iii. Improving knowledge and reducing uncertainty

4.1 Priority Based on Risk and Uncertainty

The first list of monitoring topics (type i) includes those objectives and strategies for which indicator data are insufficient to estimate current or future risk. Each objective and strategy is given a priority of 1 if the indicator value cannot be estimated or 2 if it can be estimated. Within these two classes, objectives and strategies are further ranked by supplementary features and accompanied by a cost estimate.

The second and third lists of monitoring topics (types ii and iii) each include all of the objectives and strategies for which indicator data exist or can be estimated. Priorities within each list are determined in a 3-step process that

1. scores current risk and uncertainty to determine current monitoring priority,
2. scores future risk and uncertainty to determine future priority and
3. scores current and future priorities to determine overall monitoring priority for each indicator.

The Monitoring Framework provides one set of tables to derive priorities for detecting negative consequences (scores range from 1 – 4) and another to derive priorities for improving knowledge and reducing uncertainty (scores range from 1 – 4). Monitoring to detect negative consequences is generally assigned high priority when risks are high and uncertainty low. Overall priority is based more on current than on future priority because negative consequences may be imminent. Conversely, monitoring to improve knowledge is assigned high priority when uncertainty is high. For this list, overall priority is based more on future priority because refining future targets allows for a change in strategy.

4.2 Supplementary Features

Within each list and within each of the priority classes based on risk and uncertainty, each objective and strategy pair receives a score based on three supplementary features. These features affect the benefits of monitoring—for example, grizzly bear populations recover more slowly than equivalent clearcut area, hence benefits may be higher for monitoring grizzly populations if all else is equal. Each feature is scored from 1 to 3; scores are simply added to form a secondary monitoring score ranging from 3 to 9. Indicators receiving highest priority scores for supplementary features are those that have

- high influence of the goal on other goals;
- high influence of the objective on the goal;
- long recovery period for the objective.

One supplementary feature—uncertainty about achieving the goal if all objectives are achieved (i.e. due to unaccounted factors)—does not contribute to the secondary monitoring score. This feature is used by itself to determine the need for increasing the scope of studies to include missing factors.

4.3 Ease of monitoring

Ease of monitoring is described for each objective and strategy to aid in cost/benefit analyses. While the assessment of ease is subjective, it considers such factors as type of study (e.g. analysis of existing data vs. field experiments), temporal and spatial scope necessary to achieve meaningful results, and levels of specialised skills and equipment required.

5. Other Results

Certain outcomes for risk and uncertainty ratings indicate the need for possible further actions, besides effectiveness monitoring. These outcomes are described in the Monitoring Framework and summarised in the table below.

Risk to Objective and Related Uncertainty				Action Recommended
Current Risk	Current Uncertainty	Future Risk	Future Uncertainty	
		H	L	Consider amending objective or indicator in land use plan
		L	L	Confirm land use plan direction
L	L	L	L	May use objective as a control in larger study
H	M, L	M, L	M, L	Implementation monitoring is high priority
	H		H	Consider changing target in land use plan to allow for uncertainty

6. Updating the Monitoring Framework

The Monitoring Framework is intended to be a living document, and improved upon as better information emerges. Periodic updates can incorporate new information into the Knowledge Base. This information will come from the results of local research and monitoring studies, and relevant results published in the scientific literature. Following each update of the Knowledge Base, the three lists of monitoring priorities need revising. Given the technical nature of the Monitoring Framework, updates will require consultation with various natural resources management experts.