*Information Gathering and Management Component, Monitoring Values for SFM Activity Area, Terrestrial Biological and Physical Monitoring and Aquatic Biological and Physical Monitoring Activities* **–**

# Strategic Principles and Operational Checklists for Biodiversity Monitoring & Reporting

Working Draft, 29 April 2003

This document should be used by FIA Recipients implementing work under the Terrestrial Biological and Physical Monitoring and Aquatic Biological and Physical Monitoring Activities.

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**What do the checklists do for the ministry?**

- Improve consistency in program design/delivery across the ministry
- Increase awareness and interaction among programs within the ministry
- Help ensure quality of programs across the ministry
- Identify opportunities for collaboration/cooperation leading to greater efficiencies
- Facilitate application of the adaptive management approach
- Improve institutional memory
- Help maintain leadership in monitoring and reporting

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**What can these checklists do for your project?**

- Help improve design and delivery
- Increase relevance and credibility
- Help prepare stronger arguments for funding
- Increase awareness of and communication with other projects
- Identify opportunities for efficiency through cooperation/coordination with other projects
- Reduce the chance of gaps in knowledge or procedures
- Improve record-keeping
- Facilitate learning

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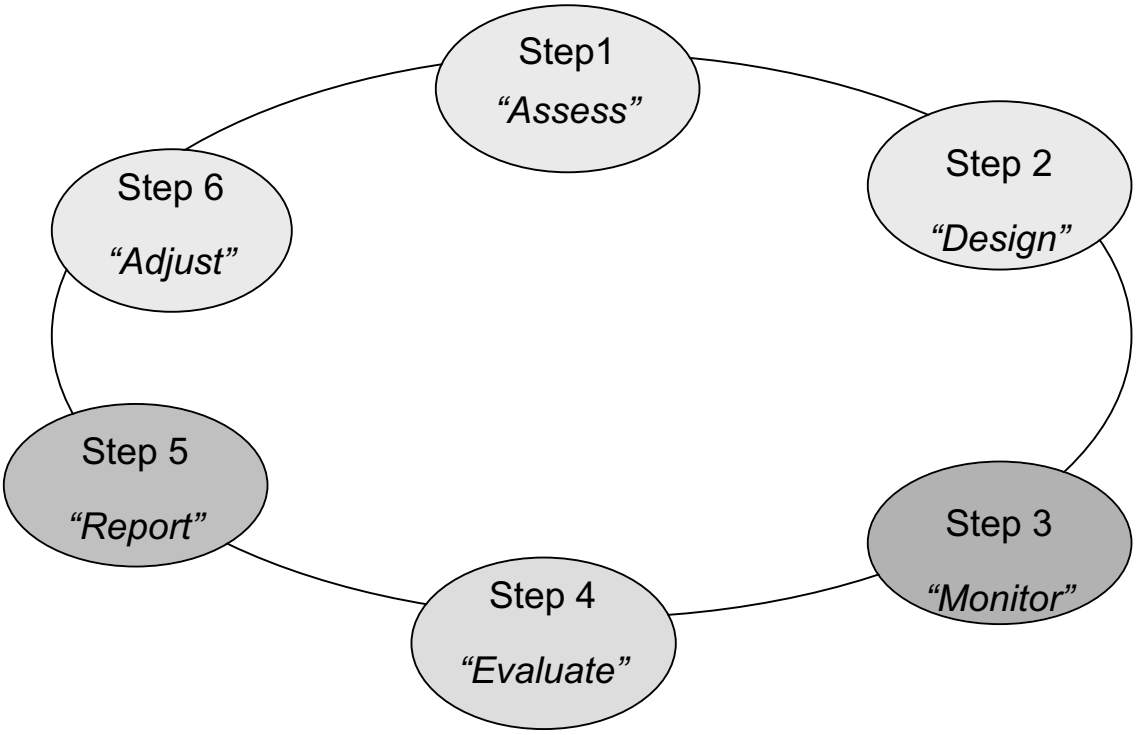
The checklists presented in this document are tools for project design—at the strategic and operational levels—they have been designed consistent with the six-step adaptive management framework (see illustration) whose purpose is to facilitate and foster continuous improvement. The checklist is not an exhaustive list, and depending on the project, additional tasks or further detail may be required.


Step1
"Assess"
Step 2
"Design"
Step 3
"Monitor"
Step 4
"Evaluate"
Step 5
"Report"
Step 6
"Adjust"

## PART 1: ***Strategic Principles for Monitoring Projects***

☐ **Provincial Consistency**:

In order to facilitate sharing of data and analysis across larger geographic/ecological areas all attempts should be made to ensure the indicators used and their measurement protocols are consistent with other projects. If yours is the first monitoring project of its type the design should consider how data from other areas might be brought together and used to report on larger areas. Even if this is not part of your study design future projects may be conducted using data from this project.

☐ **Management Concepts:**

It is essential that monitoring projects be consistent with the 'area based', 'cumulative effects', and 'ecosystem' monitoring / management concepts. Essentially these concepts mean that the focus will be on determining status, trends and impacts on biodiversity within ecosystems defined by natural ecological, biophysical boundaries, and will evaluate the combined effects of all human activities on biodiversity.

☐ **Common Lexicon:**

Common Monitoring and Reporting (M&R) terminology and definitions should be used across MWLAP, and be consistent with those in the Integrated Environmental Monitoring strategy (IEMS).

- This requires that the "dictionary" be clearly communicated and accessible.

Where IEMS definitions do not exist, adopt those in standard use by MWLAP or other credible programs.

☐ **Coordination:**

Monitoring activities should be coordinated with other credible and relevant programs to capitalize on opportunities for comparison, integration and/or aggregation of results.

- The ability to integrate and aggregate – within MWLAP, across ministries, and beyond the provincial government – will add relevance and value to M&R efforts.
- Environmental indicators and monitoring protocols that are common across broad areas should be used wherever practical.

☐ **Collaboration:**

Partnerships and leveraging of other credible and relevant programs should be encouraged and supported.

- Monitoring can be expensive and time consuming; opportunities to collaborate with other programs in other ministries, or outside government, should be taken. This can make monitoring more cost effective, and at the same time add value to MWLAP efforts.
- Monitoring programs should also take every opportunity to involve stakeholders, academics, and members of the public. This includes seeking a wide range of scientific knowledge and advice from various sources and disciplines.

☐ **Openness:**

Data and information should be freely shared to promote and inform stewardship, and regularly reported in a targeted, transparent and meaningful way.

- Requires a commitment to openness, whether the news is "good" or "bad".
- Requires a commitment to clearly documenting and communicating all the pertinent information (e.g. objectives, predictions, uncertainties and limitations, risks, decision,

actions, outcomes). This should help ensure that the context for any M&R is clear and understood, and that the M&R is relevant.

- Also requires a commitment to organizing and storing information and knowledge so it can be used in the future.

☐ **Common Standards:**

Monitoring information should be collected, analyzed, managed and stored according to common domain standards.

- This will provide credibility and consistency necessary for partnerships and for comparison and aggregation of results.

☐ **Adaptive:**

Where practical, monitoring and reporting in MWLAP should follow an adaptive management approach.

- This implies a commitment to learning. It provides a framework for continuous improvement, which must be balanced with the need for continuity over time in both monitoring and reporting.

☐ **Excellence:**

M&R in MWLAP should demonstrate leadership in quality, integrity and objectivity.

- Monitoring programs must collect data that are high quality and scientifically defensible; and should keep pace with scientific advances.

## PART 2: Adaptive Management at the *Operational Level*--Checklist

### Assessing the project--Checklist 1

*When planning environmental monitoring projects or during regular review of any current projects:*

- ☐ **Identify and document goals and objectives for the project.** What is its purpose?
- ☐ **Identify and document how the project directly or indirectly supports environmental management decisions.** What questions will it answer? How do you expect the results to be used? How does it relate to strategic objectives in government, the ministry or the plan(fit into the "big picture")?
- ☐ **Develop a written terms of reference for the project.** At a minimum this should include project objectives, scope, methodology and approach that will be used, timing of project work, type and level of resources required (staff, consultants, technical experts, and travel funds) and reporting process that will be followed.
- ☐ **Identify and get agreement from the project sponsor.** Ensure the projects terms of reference have a clear sponsor who is responsible for issues related to staff time, budget and deliverables.
- ☐ **Identify and document the target audience for the monitoring results.** Who do you expect will use the results? Engage them in the development of the project, at least to the extent of understanding and documenting their needs.
- ☐ **Establish and document measures of success for the project.** How will you determine if the objectives have been met?
- ☐ **Review other related projects**, whether former, present, or planned (within WLAP, within the BC government, and within BC by organizations outside the BC government) so you are fully aware of what else is going on. What lessons that can be learned from these?
- ☐ **Identify and document the resources that will be necessary and the timeframe for which they will be required** (including funding, people, expertise, equipment). Either confirm the availability of these resources or document a plan to acquire them. In the case of new projects, be sure to consider both the start-up or development costs as well as the cost of regular monitoring once the project is operational.
- ☐ **Consider the costs of not conducting the monitoring project.** The opportunity costs of monitoring are the costs of allocating resources that might fund a different stewardship activity. Given the level of available resources, what is the likelihood that you will have sufficient rigour to detect a change? What are the consequences if you fail to detect one?
- ☐ **Identify and document the scope of the project.** In general terms, what do you plan to monitor, where (follow ecological boundaries rather than administrative ones), and for how long? What *type* of monitoring will be undertaken? To help complete this task also consider clearly articulating what is not within the scope of the project.
- ☐ **Consider the report.** In general terms, what will your report look like? Who is the audience? Draft an outline and consider how the report will help achieve the project objectives.
- ☐ **Explore partnership opportunities** with other levels of government, universities and institutes and the private sector, as a way of leveraging a cost-effective increase in the availability of reliable monitoring information. Describe plans for partnerships / collaboration /

integration with other relevant project and the expected benefits (e.g. efficiencies gained or value added – either for your project, theirs, or both), or the rationale for not doing so.

- ☐ **Identify and document the team.** What individuals/groups/agencies will participate?
- ☐ **Describe plans and mechanisms to facilitate aggregation to ecosystem, regional, provincial, and national reporting levels**, where applicable. Will your project operate as part of a larger, coordinated effort?
- ☐ **Describe how the best available science will be used to design and conduct the monitoring and report the results.** Plan to include consultation with and review by independent scientists during monitoring design to facilitate statistical validity of the results.
- ☐ **Be prepared to demonstrate the relevance of the project in terms of social and/or economic values and issues.**
- ☐ **Review the rest of the checklist**, so you know what needs to be done throughout the design and implementation of the project. Knowing this up front may minimize problems later on.

# Operational Checklist 2 – Designing the project

*When designing any new environmental monitoring projects within the ministry, or during design modifications of any current projects:*

☐ **Identify and document the indicators to be monitored, and whether they are proxies.** Select environmental indicators that have demonstrated ecological relevance, statistical credibility and cost-effectiveness; and that are sensitive to change on a scale that is consistent with the objectives. All indicators must be validated by science-based processes. If they are proxies, look for ways to validate them. Where new indicators are being used, a science-based process should be in place to confirm their usefulness. Only use locally unique indicators if those more commonly and broadly applied are not suitable for the specific M&R objectives. Avoid indicators without a known reference measure (e.g. target, scientific threshold, or baseline), as reference measures are important for interpretation of results.

☐ **Identify and document in detail the intended measurement procedures/protocols for these indicators.** All measurements must be validated by science-based processes. If using new measurements, a science-based process should be in place to confirm their usefulness. Only use locally unique protocols if those more commonly and broadly applied are not suitable for the specific M&R objectives.

☐ **Identify and document the methods you intend to use to analyse the data.**

☐ **Identify and document protocols that will be used for data quality control, data archiving, and data access.** This includes: How and who will ensure quality control over input data? Who will coordinate and manage the archives? How will the archival system accommodate technological changes in data collection or archiving methods? Will the system allow queries that may require new analyses and interpretation of existing data? How will the data storage systems be integrated with other archival systems?

☐ **Test data collection and analysis methodology and revise as needed.** This testing may be done through a pilot project/dry run of which the results can be used in the project.

☐ **Describe how the best available science will be used to design and conduct the project**. Have independent science experts review the project plan, literature review, and project design to facilitate statistical validity of the results. Subjecting the design to scientific scrutiny by people outside of the process also helps avoid institutional biases.

☐ **Identify and document any guidelines, standards or best practices that might apply.** Identify and document the best practices that will be followed, and why.

☐ **Ensure spatial units used for monitoring are discrete, representative and capable of aggregation for reporting at broader scales.**

☐ **Clearly define and document the sample design and any site selection criteria.** Determine the “population” that the project will “encompass.”

☐ **Incorporate peer review into the design and analysis phase of your project.**

☐ **Include replicates and controls in the monitoring design where possible.**

☐ **Identify and document the current state of science, uncertainties and risks, predicted outcomes** based on current state of science, **and planned actions** based out outcomes.

☐ **Identify and document the models used to explore, select and communicate the design and predicted outcomes.** Models (which can range from simple graphs or diagrams to complex computer simulation models) can be extremely powerful for exploring and communicating the state of knowledge, alternative hypotheses, and potential outcomes.

# Operational Checklist 3 – Implementing the monitoring

*When implementing any environmental monitoring projects within the ministry:*

- ☐ **Ensure all participants understand the goals and objectives of the project**, as well as the need to stick to the specifics in the Design.
- ☐ **Document the names of participants, and their roles.**
- ☐ **Provide training to members of the project team for areas they will have responsibility, including the standard of documentation expected. Ensure new data collectors are trained** by experienced personnel before they begin collecting field data. Ensure volunteer data collectors are properly trained and coordinated throughout their participation by a professional scientist.
- ☐ **Identify and document the measurement procedures/protocols used in the field/lab.** Clearly document sampling methods carefully enough so that someone not associated with the original data collection can reproduce the original sampling or analytical protocols. This is particularly important as methods and instrumentation change, so that data from early parts of a time series are quantifiably comparable to data from later parts of the same time series. Individual investigators must clearly record changes in their methods, and document the influence of those changes on the measurements. Note any variations from what was planned in the Design, and document the rationale for the changes.
- ☐ **Identify and document protocols used for data quality control, data archiving, and data access.** (Note any variations from what was planned in the Design, and the rationale for the change.) Quality control/quality assurance includes three components: scientific validity, compatibility with other programs (e.g. can common indicators be compared?), and interpretability (can others understand and use it?) The data on which ecological indicators are based must be archived and available to a wide range of interested parties if the indicator is to be accepted and used.
- ☐ **Verify that relevant guidelines, standards and best practices are being met.** (These were identified under Checklist 1 – Assess.) Ensure all equipment used in collection of monitoring data is calibrated, operated and maintained according to industry/domain standards. Investigate and follow, where applicable, standards available from the Standards Council of Canada or from the International Organization for Standardization (ISO).
- ☐ **Ensure that there are sufficient incentives in place for participating investigators to maintain quality checks on their data.** Indicator reliability depends on the accuracy of the underlying data. No amount of attention to data quality during the archiving and computational phases can substitute for the quality of the input data. In this critical sense, the ultimate responsibility for data quality lies with the investigators who collect them.
- ☐ **Record site and auxiliary information** that may be helpful in interpreting monitoring results and understanding potential confounding factors.
- ☐ **Georeference newly-collected environmental monitoring data** using Universal Transverse Mercator coordinates (Zone, Easting and Northing) based on NAD83. Collect Global Positioning System data according to the British Columbia Standards, Specifications and Guidelines for Resource Surveys using Global Positioning System (GPS) Technology. Maintain archival data to preserve its geographic relevance, including information around location names, coordinates, and datums.

# Operational Checklist 4 – Evaluating the results

*When evaluating the results any environmental monitoring projects within the ministry:*

- ☐ **Identify and document the analytical methods used.** This includes all methods used to analyse, synthesize and aggregate the data. Clearly document these methods carefully enough so that someone not associated with the original data analysis can reproduce the results. Note any variations from analysis methods planned in the Design, and document the rationale for the change.
- ☐ **Document the reference measures used to interpret the indicator data.** What provided the interpretive context for the evaluation? For example, were indicator results measured against a past value (baseline or temporal comparison/trend analysis), a desired value (a target or management objective), some known threshold, or values elsewhere (spatial comparison)?
- ☐ **Document the names of the participants in data analysis activities, and their roles.**
- ☐ **Archive the complete description and availability of any models, and their metadata**, used to derive final indicators. Models are active research tools, and will continue to evolve. Ensure there is as much traceability in the models as there is in the measurements. The archive must be robust enough to ensure that the time series of the indicator can be reprocessed as models improve.
- ☐ **Archive the results of the analysis.** If the biological data that go into the calculation of multimetric indicators are not otherwise archived, also archive the original data in addition to the values of the indicator or index itself.
- ☐ **Compare the results with the predicted outcomes** identified under Checklist 2 – Design. Did the predicted outcomes occur? If the actual results are different from those predicted, determine why, and consider the implications. Was it because the monitoring or analysis were not implemented as planned? Were there confounding factors? Or were any assumptions incorrect, requiring an update to our knowledge (state of science) regarding the ecosystems being measured?
- ☐ **Clearly identify what has been learned.** This may range from lessons learned about techniques and process (e.g. monitoring design, measurement techniques, or analysis methods) to the expansion of our knowledge of natural systems (e.g. ecosystem structure or processes, or the response of natural systems to anthropogenic pressures).

# Operational Checklist 5 – Reporting the results

*When reporting the results any environmental monitoring projects within the ministry:*

- ☐ **Ensure reporting is done regularly, and is transparent, targeted, and concise.**
- ☐ **Link environmental results to Legislation, policy, best management practices and social/economic values where appropriate.**
- ☐ **Report internally for the purposes of establishing and maintaining institutional memory**. Records should be kept of all aspects of monitoring projects: objectives, design (temporal scale and frequency, geographic scale, collection methods and protocols, QA protocols), predictions, "stopping rules" if applicable, implementation, risks, uncertainties, limitations, surprises, necessary deviations from the design during implementation, analysis, results, decisions, and participants at each stage of the process. (If you have followed the other checklists, you already have this information documented – just make sure it is organized and stored in a manner that facilitates easy future retrieval.)
- ☐ **Properly label all graphs.** All graphs should include: location, date (if not already apparent on the x-axis), labels for both the x-axis and y-axis, units for all data graphed, reference measures, and labels or a legend for all data graphed.
- ☐ **Include all caveats, assumptions, uncertainties, and data limitations and gaps**, or make this information readily available.
- ☐ **Ensure the audience knows the monitoring is being undertaken, why, and knows if/how they can gain access to the results.**
- ☐ **Ensure an appropriate level of peer review is incorporated into the report development phase.**
- ☐ **Ensure the distribution mechanism is appropriate for the audience.** For example, if the information will be posted on a web site, do all members of the intended audience have Internet access? If the information is intended to be downloaded from a web site, is the file size reasonable for those without a high speed Internet connection?
- ☐ **Adopt a "right to know" philosophy and make the databases available** to interested parties, not just the synthesized results. (Sensitive data are an exception. Some data are not appropriate for release to the public for ecological, academic or other reasons.)
- ☐ **Document surprises.** Were there any events our outcomes that were not expected? What were they, and why did they happen? If they were negative, how can they be avoided in the future?
- ☐ **Share lessons learned.**
- ☐ **Verify the usefulness of the information for the target audience.** This can be done at varying degrees of formality and effort, ranging from ad hoc discussions with selected audience members to surveys and focus groups, and should be scheduled at a reasonable time period following the dissemination of the results/report.

# Operational Checklist 6 – Adjustments

*Following the evaluation of results any environmental monitoring projects within the ministry, or following feedback from the audience for the monitoring results:*

- ☐ **Identify and document any changes that are <u>needed</u> to the project.** This includes changes to either the monitoring project itself, or to the reporting of the results. These may become apparent from the results of the Evaluation, through feedback from the target audience, or may be triggered by other factors such as funding, program or policy changes. If considering changes to measurement protocols, manage any changes to standards with consideration of the continuity of data sets. Adjustments of actual data collection procedures may have significant implications for long-term monitoring programs (specifically, the ability to track trends may be compromised if values change due to changes in monitoring design). If no changes are needed, it is still important to document this fact.
- ☐ **Identify and document any changes that are <u>made</u> to the project, and the reasons for the change.** These may or may not match the set identified above (for example, needed changes may not actually be implemented due to limited resources or to maintain data continuity for tracking trends).
- ☐ **Commit to re-assessment** (and returning to Checklist 1 – Assess) if any significant changes are made to the project, and document the planned reassessment schedule and frequency.
- ☐ **Identify and document any changes that are needed beyond the project.** This includes changes that appear to be warranted – based on the results of this project – to policy, procedures or knowledge elsewhere within WLAP. Also identify if any of these changes are implemented.

NOTE: Changes to indicators and associated protocols need to be carefully considered particularly if the project includes repeated measurement over time. Adjustments in indicators or measurement protocols may reduce the comparability of data resulting in projects that are unable to achieve the intended objective.

## Sources for the M&R Checklists

The checklists have been adapted from information from the following sources:

### Personal Communications

Interviews with MWLAP staff for a Strategic Assessment of Monitoring and Reporting in the Ministry of Water, Land & Air Protection, 2002. British Columbia

Email correspondence with representatives from the governments of: Canada, Alberta, Nunavut, and New Zealand.

Comments and discussions during the Biodiversity Monitoring and Reporting Strategy Development Workshop, December 3-4, 2002, Victoria, BC.

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