



Fish Habitat Management System for Yukon Placer Mining

Adaptive Management Framework

Prepared by

**The Yukon Placer
Adaptive Management Working Group**

November 2008

1.0 ADAPTIVE MANAGEMENT FRAMEWORK

1.1 Introduction and Objectives

A new system for managing placer mining activity under the *Fisheries Act* is being implemented by the Yukon Placer Secretariat. Founded on principles of adaptive management and incorporating a risk-based approach to decision-making, the Fish Habitat Management System for Yukon Placer Mining is intended to balance the objectives of a sustainable Yukon placer mining industry with the conservation and protection of fish and fish habitat supporting fisheries.

As part of the new management system, a set of protocols have been designed to guide three effects-monitoring programs. These are the Aquatic Health Monitoring Protocol (AHMP), the Water Quality Objectives Monitoring Protocol (WQOMP) and the Economic Health Monitoring Protocol (EHMP). The monitoring programs will assist in verifying the effectiveness of the management system in meeting its objectives and provide a rational basis for future changes, if appropriate.

The Adaptive Management Framework (AMF) describes how information generated from the three monitoring programs and traditional knowledge will be reviewed and considered. It also guides the development of recommendations for changes that may be required to ensure the objectives of the fish habitat management system are achieved.

1.2 Elements of the Adaptive Management Framework

The Adaptive Management Framework is essentially a set of decision rules that determine how the results of the three effects-monitoring programs are considered in combination. It includes the following elements:

1. Decisions to be made in the management process.
2. Responsibility for decision making.
3. Information that will support decision making.
4. Contribution of traditional knowledge to management decisions.
5. Responsibility for collection of the supporting information.
6. The spatial context for decision-making.
7. The temporal context for decision-making.
8. Observed conditions (monitoring results) that constitute an acceptable or non-acceptable outcome.
9. The management response considered appropriate, given the combined monitoring results.
10. The level of confidence that will be placed on the analysis of effects.

1.3 Critical Assumptions

The fish habitat management system and its effects-monitoring programs are based on a set of assumptions that must be tested as early as possible through the monitoring effort and data analysis. The principal assumptions are:

1. Water Quality Objectives (WQO) are an indicator of aquatic health.
2. WQO are set appropriately for each level of watershed sensitivity and habitat suitability.
3. Sufficient information will be derived from the water quality and compliance monitoring programs to determine whether the concentration of sediment at WQO monitoring points originates from instances of non-compliance, lawfully operating placer mines, or other sources.
4. Benthic macro-invertebrates are sensitive enough to changing stream conditions to be an effective primary indicator of aquatic health in general.
5. The Reference Condition Approach is the appropriate bio-assessment method to apply to the Yukon's freshwater ecosystems.
6. Sampling under the Aquatic Health and Water Quality Objectives monitoring protocols will occur with enough frequency, at the correct locations and at the times necessary to generate meaningful results.
7. The Type A indicators identified in Step 1 of the Economic Health Monitoring Protocol will reliably signal a trend in the viability of the placer mining industry.
8. The monitoring efforts of separate agencies can be coordinated in a manner that increases the significance of the collected data.
9. Monitoring results contributed by other parties (i.e. First Nation governments or independent researchers) that follow the governing Protocols can be used in the adaptive management process.

1.4 Decisions to be made in the management process

In a general sense, decisions made in the adaptive management process are decisions that will improve the habitat management system's effectiveness in conserving and protecting fish and fish habitat supporting fisheries, while maintaining a sustainable placer mining industry in the Yukon. Specifically, these will be decisions to change some element of the monitoring programs, or decisions to change some element of a watershed authorization.

Except in the case of unforeseen circumstances of an exceptional nature, adaptive management decisions to change the terms or conditions of watershed authorizations will not be made until monitoring has occurred for three to five years after implementation of the management system. Depending upon the magnitude of unacceptable monitoring results, the most likely management response will be focused or intensified monitoring with

priority given to test sites in habitats of higher sensitivity. Decisions to change watershed authorizations will be based upon unambiguous data with proven significance.

Overall, the effects-monitoring programs must provide information related to two key questions:

1. Does the fish habitat management system effectively conserve and protect fish and fish habitat supporting fisheries (i.e. no net loss of habitat), and provide the opportunity to maintain the viability of placer mining?
2. Does the management system achieve these management objectives in Category A and Category B watersheds, and all habitat suitability classes?

The answers to these questions will be determined by combining the results of the three monitoring programs in analyses that will be conducted for individual watersheds (additional detail is provided in the descriptions of the three monitoring protocols). Basically, the following three decisions can be made in the management process:

- 1) to increase and focus monitoring efforts to better understand cause and effect;
- 2) to tighten the operating requirements (because the habitat management system is found to be providing inadequate protection); or
- 3) to relax the operating requirements in a watershed authorization (because the system is found to be unnecessarily stringent to achieve adequate protection).

These decisions can be made under a variety of circumstances that are summarized in Section 1.11.

1.5 Responsibility for Decision Making

Adaptive management recommendations will be made by the Yukon Placer Secretariat's Inter-governmental Management Group (IMG). The IMG will also make decisions regarding changes to monitoring protocols; the design of monitoring programs; and data analysis, reporting and the integration of results.

Decisions related to the implementation of monitoring programs will be made by the responsible agency. Decisions related to watershed authorizations and site specific authorizations will be made by Fisheries and Oceans Canada, and decisions related to water use licences and placer mining land use approvals will be made by the Yukon Water Board.

1.6 Information that will Support Decision Making

Adaptive management decisions will be drawn from the results of the three monitoring programs. Decisions will be based upon reports provided by the agencies responsible for effects-monitoring, and traditional knowledge provided by First Nations. Data may be accepted from other parties if it is collected with rigorous observance of the relevant monitoring protocol, and submitted within the required timeframe. All monitoring data will be reviewed, analyzed and validated by the IMG with support from technical staff. For each program, the data collected will be used to answer a series of key questions specific to the target of the monitoring protocol as follows.

For Water Quality Objectives monitoring:

1. Are the WQO established in the management system being achieved?
2. If not, is this due to placer mining activity or to other causes?

For Aquatic Health monitoring:

1. Are there stream systems and watersheds exposed to placer mining where aquatic health is not being maintained in reference condition (i.e. the same condition as streams not exposed to human activity)?
2. If so, is this due to placer mining activity or to other causes?
3. Are the test sites in habitats of higher sensitivity in reference condition?
4. If not, is this due to placer mining activity or to other causes?
5. Where historically mined sites are not in reference condition is there an overall improvement over time?

For Economic Health monitoring:

1. Are there changes in industry viability?
2. If so, can these changes be attributed to the requirements of the management system?

Data collection for the three effects-monitoring programs is described in detail in the relevant monitoring protocol.

An important element of the management system's design is that WQO are expected to be an indicator of aquatic health. That is, by achieving the WQO aquatic health should be maintained or improved. The information provided

from the monitoring programs should demonstrate the validity of this fundamental assumption.

Traditional knowledge will also influence adaptive management decisions (see Section 1.14)

1.7 Responsibility for Data Collection, Analysis, and Reporting

Responsibility for data collection, analysis, and reporting under each of the three monitoring protocols rests with:

Water Quality:	Client Services and Inspections Branch, Yukon Department of Energy, Mines and Resources
Aquatic Health:	Oceans, Habitat and Enhancement Branch, Fisheries and Oceans Canada; Fisheries Management Branch, Environment Yukon
Economic Health:	Minerals Management Branch, Yukon Department of Energy, Mines and Resources

Responsibility for the integration of monitoring results that will support Adaptive Management decision-making rests with the Yukon Placer Secretariat's Inter-governmental Management Group.

1.8 Spatial Context for Decision-making

As a general rule, decisions made under the adaptive management process will be at the watershed scale. The spatial distribution of sampling within watersheds that will support this decision-making is described in detail in each of the three monitoring protocols.

1.9 Temporal Context for Decision-making

Three to five years of monitoring the management system's performance will likely be required before adaptive management decisions that result in regulatory adjustments are made. The terms and conditions of watershed authorizations may be amended within a shorter timeframe in response to exceptional circumstances of an unforeseen nature. Changes to monitoring programs may also occur from year to year if this is necessary to provide the information required for adaptive management decisions.

Monitoring information to be evaluated in the adaptive management process will be provided in the form of annual reports.

For assessment of aquatic health one new reference site and three test sites will be monitored in up to eight watersheds every year. Under this schedule repeat results should be available for every watershed within five years of implementation. The schedule may be weighted to monitor watersheds with significant mining activity more frequently than lightly or un-mined

watersheds, and a greater number of sites may be monitored in some watersheds. The WQO monitoring will mirror this, but may be more comprehensive given the degree of automation that can be employed and lower costs of analysis.

In addition to the scheduled monitoring activity, up to eight additional sites may be re-sampled each year if warranted by results from preceding years. The IMG will revise the annual monitoring schedule based upon the results of the adaptive management process.

The sampling frequency for the three effects-monitoring programs is described in detail in the relevant monitoring protocol. The results of the effects-monitoring programs will be evaluated on an annual basis.

1.10 Observed Conditions that Constitute an Acceptable or Non-Acceptable Outcome

In determining whether the overall outcome of the monitoring programs is acceptable or not, the following general principles will apply to the results of each of the monitoring protocols.

Water Quality Objectives monitoring:

1. Results attributable to lasting natural occurrences will not be considered an unacceptable outcome.
2. Results attributable to non-compliance at placer mining operations will not be considered relevant in the context of adaptive management decisions about the effectiveness of protection provided by the habitat management system. Non-compliance will be dealt with as an enforcement issue.

Aquatic Health monitoring:

1. Test sites must be out of Reference Condition before the results are considered relevant in the context of improving measures to conserve and protect fish and fish habitat supporting fisheries.
2. Test sites on historically mined streams and watersheds (i.e. those which have been subjected to the effects of extensive placer mining prior to implementation of the new fish habitat management system) may initially be found out of Reference Condition, but follow-up monitoring is expected to reveal a trend toward improving aquatic health.

Economic Health monitoring:

1. Both steps of the EHMP will be exercised for the first five years after implementation.
2. Results must be attributable to the fish habitat management system before the results are considered relevant in the context of adaptive management decisions.
3. Only economic effects will be considered.

For water quality monitoring, any results that indicate the WQO have not been achieved must be reported and considered under the adaptive management process. Any failure to achieve the WQO in highly sensitive habitat or habitat of moderate-high sensitivity will be considered unacceptable. The significance of a failure to achieve WQO in other habitat classes will depend upon the frequency and magnitude of the failure.

For aquatic health monitoring, any results that indicate a test site is not in reference condition must be reported and considered under the adaptive management process. A test site will be considered undisturbed if the value for observed versus predicted biota (O-P) falls inside the range at which 75% of reference residuals were considered to be in reference condition. Any result where the O-P value falls outside the 90% range will be considered unacceptable. All sites with this result will be monitored in subsequent seasons to determine whether the management system results in a trend toward improved aquatic health.

For economic health monitoring, any result that indicates that industrial health is in decline and that this trend can be attributed to the management system must be reported and considered under the adaptive management process. A demonstrated inability to pay the cost of reclamation and restoration efforts, and the temporary or permanent suspension of operations will all be considered unacceptable results.

1.11 Appropriate Management Response

Provided that the monitoring data is conclusive, there are eight possible combinations of monitoring results. A few key decision rules, however, limit the number of management responses that will be considered appropriate.

1. A system designed to manage placer mining activity under the *Fisheries Act* must not pose an unjustifiable risk to fish and fish habitat supporting fisheries. Therefore a recommendation to relax the standards or requirements stipulated in a watershed authorization will not be made if aquatic health is failing or in decline.

2. WQO are intended to be an indicator of aquatic health. Therefore a recommendation to relax the standards or requirements stipulated in a watershed authorization can not be made when a WQO is not achieved, unless there is clear evidence that acceptable aquatic health can be maintained with a less stringent WQO, and the WQO is also amended accordingly.
3. Except in the case of unforeseen circumstances of an exceptional nature, adaptive management recommendations for changes to watershed authorizations will not be made until monitoring has occurred for three to five years after implementation of the fish habitat management system.
4. Except in response to unforeseen circumstances of an exceptional nature, changes to watershed authorizations that result in more restrictive requirements will be phased in for operations that were authorized under this management system, and which based their mining plans on the requirements stipulated in those watershed authorizations.
5. Recommendations to adjust the effects-monitoring programs can be made at any time it is deemed necessary to improve the quality, consistency and relevance of information derived from the programs.

The eight possible combinations of monitoring results are outlined in the following table, with a description of the likely management response. A check mark indicates that results are within tolerable limits, while an "X" indicates that results are outside of tolerable limits.

The numbers associated with the column heading "Years of Monitoring" describe the number of years for which monitoring results are available. Seasonal and annual variation from natural causes is highly unpredictable, and for this reason adaptive management decisions that result in regulatory changes must be based on several years of record (except in the case of unforeseen circumstances of an exceptional nature).

#	Water Quality	Aquatic Health	Economic Health	Years of Monitoring	Possible Management Responses
1	✓	✓	✓	1	No change to authorizations is necessary, but changes to improve monitoring programs may be considered.
				2	No change to authorizations is necessary, but changes to improve monitoring programs may be considered.
				3+	No change to authorizations is necessary, but changes to improve monitoring programs may be considered.
2	✓	✓	✗	1	Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				2	Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				3+	Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey. Consideration may be given to relaxing some requirements of watershed authorizations.
3	✓	✗	✓	1	Monitoring of aquatic health will be intensified in areas with unacceptable results, and water quality monitoring and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining.
				2	Monitoring of aquatic health will be intensified in areas with unacceptable results, and water quality monitoring and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining.
				3+	If unacceptable results are related to placer mining, consideration will be given to making the relevant requirements of watershed authorizations more stringent.
4	✓	✗	✗	1	Monitoring of aquatic health will be intensified in areas with unacceptable results, and water quality monitoring and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining. Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				2	Monitoring of aquatic health will be intensified in areas with unacceptable results, and water quality monitoring and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining. Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				3+	If unacceptable aquatic health is related to placer mining, consideration will be given to making the relevant requirements of watershed authorizations more stringent. If unacceptable aquatic health is observed and this condition is not related to placer mining, consideration will not be given to relaxing requirements of watershed authorizations until such time as acceptable aquatic health is achieved.
5	✗	✓	✓	1	Water quality monitoring will address the reason for unacceptable results. Attention will be given to the relationship between the WQO and aquatic health.
				2	Water quality monitoring will address the reason for unacceptable results. Attention will be given to the relationship between the WQO and aquatic health.

#	Water Quality	Aquatic Health	Economic Health	Years of Monitoring	Possible Management Responses
5	X	✓	✓	3+	Water quality monitoring will address the reason for unacceptable results. Attention will be given to the relationship between the WQO and aquatic health. The outcome for water quality and aquatic health monitoring suggests that the WQO might be unnecessarily stringent. Consideration may be given to amending this element of the watershed authorizations.
6	X	✓	X	1	Water quality monitoring will address the reason for unacceptable results. Attention will be given to the relationship between the WQO and aquatic health. Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				2	Water quality monitoring will address the reason for unacceptable results. Attention will be given to the relationship between the WQO and aquatic health. Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				3+	The outcome for water quality and aquatic health monitoring suggests that the WQO might be unnecessarily stringent. Consideration may be given to amending this element and other elements of the watershed authorizations.
7	X	X	✓	1	Monitoring of aquatic health and water quality will be intensified in areas with unacceptable results, and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining.
				2	Monitoring of aquatic health and water quality will be intensified in areas with unacceptable results, and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining.
				3+	If unacceptable results are related to placer mining, consideration will be given to making the relevant requirements of watershed authorizations more stringent.
8	X	X	X	1	Monitoring of aquatic health and water quality will be intensified in areas with unacceptable results, and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining. Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				2	Monitoring of aquatic health and water quality will be intensified in areas with unacceptable results, and compliance monitoring will focus on the same areas to determine whether the problem is related to placer mining. Monitoring of economic health will be intensified, with emphasis on factors identified in panel survey.
				3+	This would be the most difficult situation to deal with and would suggest that, both management action and redesign of the management system might be necessary.
<p>✓ = Parameter is within tolerable limits</p> <p>X = Parameter is outside tolerable limits</p>					

1.13 The Level of Confidence Required in the Analysis of Effects

All data collection and interpretation systems have limitations, and it is possible that incorrect conclusions may be reached about the cause of observed effects. Given the hypothesis “*The fish habitat management system will protect and maintain water quality, aquatic health and economic health*”, the following table represents the possible outcomes of monitoring and the associated inferences.

		Conclusion from Sampling	
		WQO, AH or EH maintained	WQO, AH or EH not maintained
True Situation	WQO, AH or EH maintained	Correctly conclude that WQO, AH or EH is maintained	Incorrectly conclude that WQO, AH or EH is not maintained when in fact it is (Type I error, false rejection of hypothesis)
	WQO, AH or EH not maintained	Incorrectly conclude that WQO, AH or EH is maintained when in fact it isn't (Type II error, false acceptance of hypothesis)	Correctly conclude that WQO, AH or EH is not maintained

Possible error outcomes for the monitoring results and the associated inference. This table applies to each of the three domains independently (i.e. WQO=Water Quality Objective; AH=Aquatic Health; EH=Economic Health).

There are two possible errors of inference associated with each of the values (grey shaded cells). The *potential* risk of these errors is assessed in the respective monitoring protocols. The *acceptable* risk of such errors is a policy decision which involves examination of the costs and benefits of different monitoring protocols, and how cautious policy makers would like to be. The risks of Type I and II error could be made equal, or different. For example, lowering the risk of Type II error will emphasize protection of WQ, AH and EH. Lowering the risk of Type I error will emphasize avoiding unnecessary changes to watershed authorizations, under the perception that there are problems when in fact water quality and aquatic health are acceptable.

The system designed to manage placer mining activity under the *Fisheries Act* must not pose an unjustifiable risk to fish and fish habitat supporting fisheries. As a consequence, adaptive management decisions will err on the side of concluding that aquatic health is unacceptable when in fact this may not be true (Type I error). This bias is justified on the basis that the consequences of impaired aquatic health may be serious (especially in habitats of higher sensitivity) and expensive to remedy. Depending upon the magnitude of unacceptable results related to water quality and aquatic health, the most likely management response will be focused or intensified monitoring. This response is inexpensive compared to the potential

environmental costs of mistakenly concluding that aquatic health is acceptable.

1.14 Incorporation of Traditional Knowledge in Decision Making

Considerable effort has been made to provide First Nation governments with an opportunity to share traditional knowledge that will augment the fish habitat management system. Much of the traditional knowledge provided influenced the habitat suitability classification maps and identified Areas of Special Consideration which may represent current or historically important fisheries and fish habitats. Other traditional knowledge is more value driven in nature and has been used to inform other elements of the management system (i.e. the appropriateness of proposed standards and thresholds).

First Nations will be provided the opportunity to report on traditional knowledge prior to the annual evaluation of monitoring results for watersheds in their traditional territories. This opportunity may be facilitated through a survey form soliciting information on what a First Nation may have observed about the management system and its effects on fish habitat and fisheries. For traditional knowledge to be considered within an annual adaptive management report, it must be provided no later than December 31st each year.

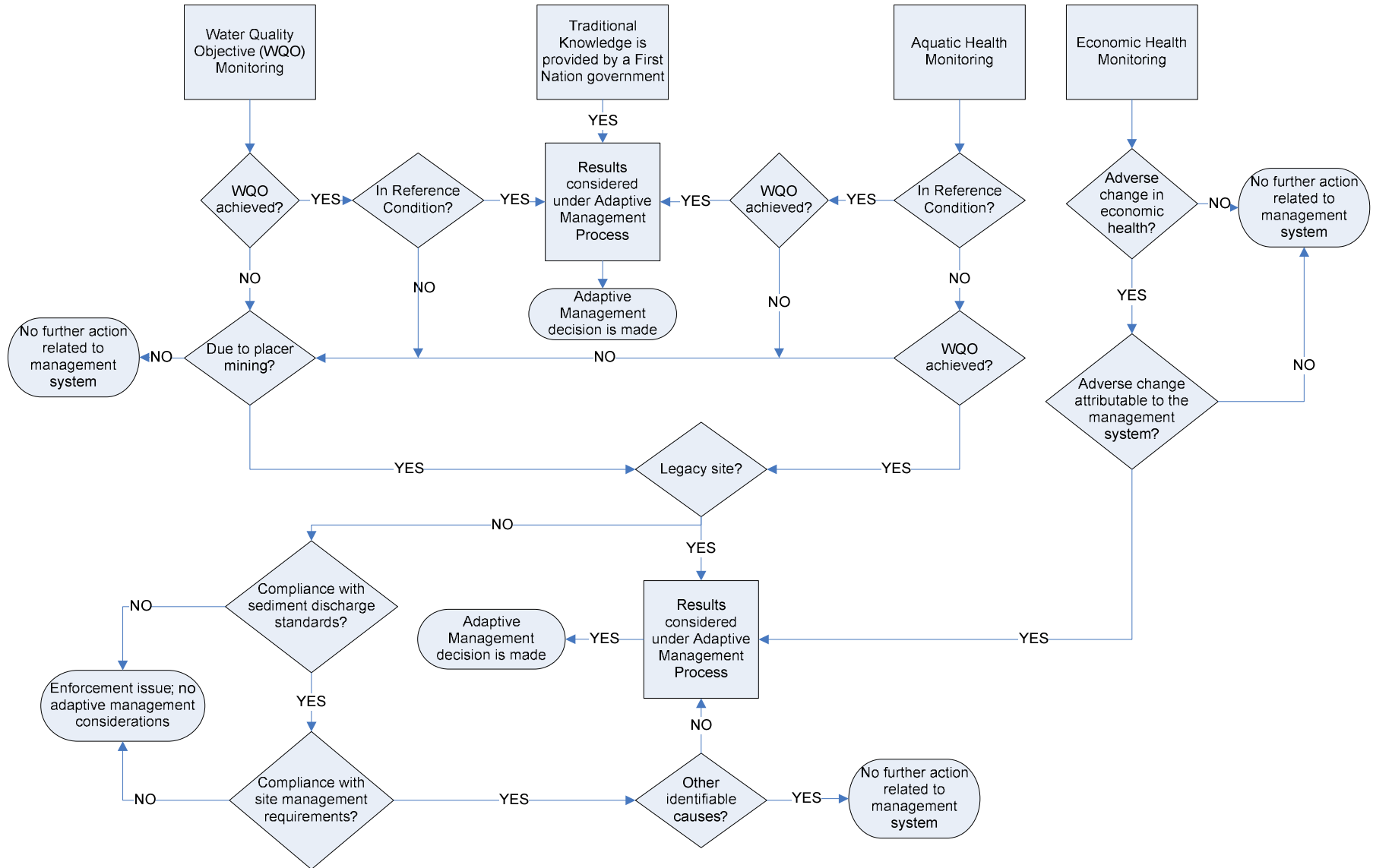
While it is not possible to predict what traditional knowledge may be shared after implementation of the habitat management system, it is anticipated that this information will be related to fish and fish habitat, fisheries, water quality and their inter-relationships; and the effects of placer mining on traditional uses and sites. Traditional knowledge may influence the monitoring programs, may lead to changes to habitat suitability classifications, and may contribute to recommendations to change other elements of watershed authorizations.

1.15 The Adaptive Management Process

The first flowchart below depicts the manner in which various outcomes of the effects-monitoring programs influence the adaptive management process. Results that are clearly not related to placer mining are not considered in the context of adaptive management. Similarly, results that are attributable to instances of non-compliance are not relevant for the purposes of adaptive management. Where the flowchart indicates that an adaptive management decision is made, the decision will conform to the rules outlined in Section 1.11, and the "Possible Management Responses" described in the table in that section.

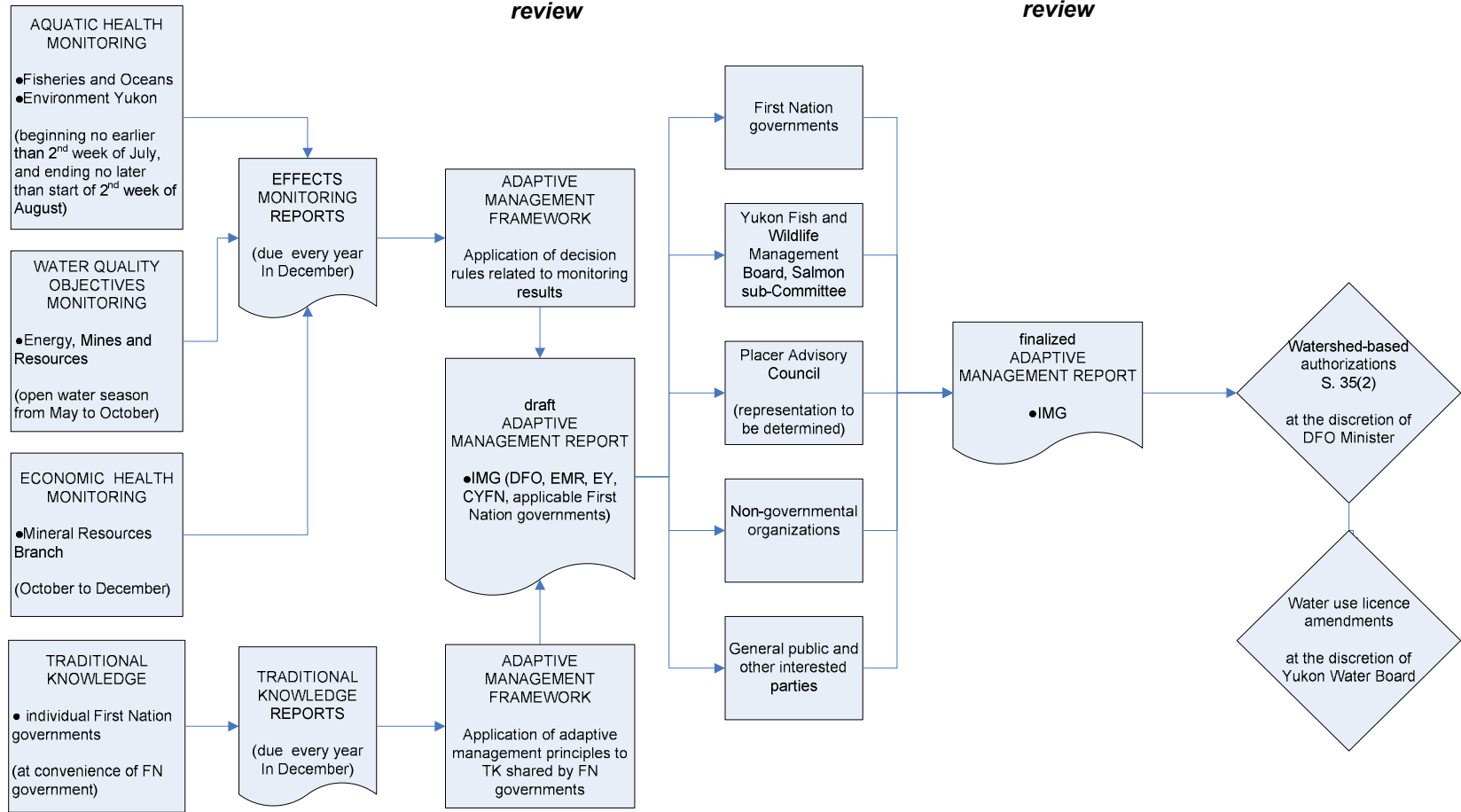
The second flowchart illustrates the adaptive management process and its participants from data collection, to analysis and reporting, to review and recommendations, and finally to regulatory changes.

Effects Monitoring Programs and the Adaptive Management Process



ADAPTIVE MANAGEMENT PROCESS

Data Collection → **Reporting** → **Inter-governmental Management Group (IMG) review** → **All Parties review** → **Inter-governmental Management Group (IMG) review** → **Regulatory Bodies review**



DATA and INFORMATION

ANALYSIS and REPORTING

REVIEW and RECOMMENDATIONS

REGULATORY CHANGES

