



# **Yukon Placer Mining Adaptive Management Framework**

*Created by:*

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**January 16, 2007**

## **1.0 YUKON PLACER MINING ADAPTIVE MANAGEMENT FRAMEWORK**

### **1.1 Introduction and Objectives**

An integrated regulatory regime for the environmental management of the Yukon placer mining industry is being implemented by the Yukon Placer Secretariat. Founded on principles of adaptive management and incorporating a risk-based approach to regulation, the regulatory regime is intended to balance the objectives of a sustainable Yukon placer mining industry and the conservation and protection of fish and fish habitat supporting fisheries.

Through changes in stream structure, water withdrawal, and sediment discharge placer mining has the potential to adversely affect fisheries habitat, and thus requires an authorization by the Minister of Fisheries and Oceans under Section 35(2) of the *Fisheries Act*. An integrated regulatory regime for placer mining has been developed jointly by Yukon, Fisheries and Oceans Canada, and the Council of Yukon First Nations, and will be the basis for new *Fisheries Act* authorizations. Under this new management regime, authorizations for placer mining will be issued on a watershed basis. The basic structure of the regime was established in May 2005 (Yukon Placer Implementation Steering Committee, 2005), and is designed around a risk management framework under which the conditions of operation for placer mines will differ according to the sensitivity of a watershed, and habitat suitability of reaches within the watershed.

As part of the new regulatory regime, 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). These protocols will assist in verifying the effectiveness of the new management regime, and provide a rational basis for future changes to the regime, if appropriate. Ultimately, an Adaptive Management Framework (AMF) is required for integrating the results of the information generated from the three effects-monitoring programs.

### **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. Responsibility for collection of the supporting information.
5. The spatial context for decision-making.
6. The temporal context for decision-making.

7. Observed conditions (monitoring results) that constitute an acceptable or non-acceptable outcome.
8. The management response considered appropriate, given the combined monitoring results.
9. The level of confidence that will be placed on the analysis of effects.
10. Contribution of traditional knowledge to management decisions.

### **1.3 Critical Assumptions**

The new regime 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 a suitable proxy for 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; and specifically, the Reference Condition Approach is the appropriate bio-assessment method to apply to the Yukon's freshwater ecosystems.
5. The Type A indicators identified in Part 1 of the Economic Health Monitoring Protocol will reliably signal a trend in the viability of the placer mining industry.
6. Sampling will occur with enough frequency at the right locations and at the right times to generate meaningful results.
7. The monitoring efforts of separate agencies can be coordinated in a manner that increases the significance of the collected data.
8. 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 regime'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 exceptional circumstances of an unforeseen nature, adaptive management decisions to change the terms or conditions of watershed authorizations will not be made until monitoring has occurred for at least three years after implementation of the new regime. Depending upon the magnitude of unacceptable monitoring results, the most likely management response will be focused or intensified monitoring. 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 regime 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 regime achieve these management objectives in Category A and Category B watersheds, and all habitat suitability types?

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 regime is found to be providing inadequate protection); or
- 3) to relax the operating requirements in a watershed authorization (because the regime 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 Implementation Management Group (IMG), or its successor. Decisions related to monitoring programs will be made by the responsible agency, decisions related to watershed authorizations will be made by Fisheries and Oceans Canada, and decisions related to water use licenses 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, 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. 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 Objective monitoring:

1. Are the WQO established in the new regime 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 exposed to placer mining where watershed 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. Where sites are not in reference condition, is there an improvement over time?

For Economic Health monitoring:

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

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

An important element of the regime design is that WQO are expected to be a suitable proxy for 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; Yukon Department of Economic Development

Responsibility for the integration of monitoring results that will support Adaptive Management decision-making rests with the Yukon Placer Secretariat's Implementation Management Group, or its successor.

## **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 regime'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, four Category A and four Category B watersheds will be monitored every two years, in a five-year cycle. The WQO monitoring will mirror this, but may be more comprehensive given the degree of automation and lower costs of analysis.

<b>YEAR:</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
4 Cat. A watersheds x 4 sites, plus follow-up sites	16	16	16	16	Report, and target areas of interest
4 Cat. B watersheds x 4 sites, plus follow-up sites	16	16	16	16	
Follow-up sampling at selected sites	4	4	4	4	
Easily accessible watersheds	4	4	4	4	

In addition to the scheduled monitoring activity, up to four additional remote sites may be re-sampled each year if warranted by results from preceding years.

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 rules will apply to the results of each of the monitoring protocols.

Water Quality Objective 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 afforded by the regime. 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. On legacy streams (i.e. streams which have been subjected to the effects of placer mining prior to implementation of the new regime) monitoring must reveal a trend toward declining aquatic health before the results are considered relevant in the context of improving measures to conserve and protect fish and fish habitat supporting fisheries.

Economic Health monitoring:

1. Both stages of the EHMP will be exercised for the first five years after implementation.
2. Results must be attributable to the regime 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. Any result where the ratio of observed versus expected biota is less than 0.82 (i.e. O:E below the 10<sup>th</sup> percentile of reference sites) will be considered unacceptable, unless the site is located on a legacy stream. All sites with this result will be monitored in subsequent seasons to determine whether the new management regime 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 regime must be reported and considered under the adaptive management process. Financial losses, 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 regime 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 can not be made if aquatic health is failing or in decline.

2. WQO are intended to be a proxy for 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 exceptional circumstances of an unforeseen nature, adaptive management recommendations for changes to watershed authorizations will not be made until monitoring has occurred for at least three years after implementation of the new regime.
4. Except in response to exceptional circumstances of an unforeseen nature, changes to watershed authorizations that result in more restrictive requirements will be phased in for operations that were authorized under the new regime, 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 exceptional circumstances of an unforeseen 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 may 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 may 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 may 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 regime 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 new placer regime 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 watershed authorizations, under the perception that there are problems when in fact water quality and aquatic health are acceptable.

The regime 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 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**

The adaptive management process is suited to evaluating data of an empirical nature. For this reason, the type of traditional knowledge provided in annual reports by First Nations should be similar to scientific knowledge (i.e. it should consist of verifiable facts and observations).

First Nations will be provided the opportunity to report on relevant traditional knowledge prior to the 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 regime and its effects on fish habitat and fisheries. For traditional knowledge to be considered within an annual adaptive management report, the information is required no later than December 31<sup>st</sup> each year.

While it is not possible to predict what traditional knowledge may be provided after implementation of the new regime, it is anticipated that this information will be related to fish and fish habitat, fisheries, water quality, and their inter-relationships. 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 Notes on the following figure**

The following flowchart 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.

## Effects Monitoring Programs and the Adaptive Management Process



