

**Adaptive Management Framework**  
for the  
**Tłıchọ All-Season Road Project**

**Prepared for the**  
**Wek'èezhì Land and Water Board**  
**W2016L8-0001 and W2016E0004**

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### Response Framework Document History

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## Definitions and Acronyms

GNWT	Government of the Northwest Territories
GNWT-INF	Government of the Northwest Territories – Department of Infrastructure
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NSI	North Star Infrastructure (Design-Build-Finance-Operate-Maintain Contractor)
Tłıchọ ASR	Tłıchọ All-Season Road
WLWB	Wek'èezhì Land and Water Board

# 1 INTRODUCTION

The Government of the Northwest Territories (GNWT) is proposing to construct an all-season road from Highway 3 to the community of Whatì. This Project, led by the GNWT Department of Infrastructure (GNWT-INF), is named the Tłchq All-Season Road (Tłchq ASR or the Project).

The construction and operation of the Tłchq ASR will lead to changes in the local biological, physical and socio-economic environment. These changes will be managed through environmental management and monitoring plans, through the terms and conditions of the land use permit and water licence, implementation of developer's commitments and measures imposed by the Mackenzie Valley Environmental Impact Review Board (MVEIRB). Monitoring is underway or is proposed to identify the presence and measure the magnitude of these changes during the construction and operation phases of the Project.

This Framework outlines various adaptive management approaches that can be applied and evaluated to minimize the impact of the Tłchq ASR on the surrounding environment. Through adaptive management, responses to environmental changes are reviewed in a systematic manner, and the learnings can then be integrated back into the monitoring program. This iterative process allows for identification of project-related environmental changes while ensuring meaningful management actions are being taken to avoid adverse impacts on local resources throughout all phases of the Project. This document outlines approaches to applying adaptive management, and the considerations that must be made when selecting and applying different approaches.

In addition to providing transparency in environmental management and following best practices, the preparation of an Adaptive Management Framework is a suggestion in the MVEIRB Report of Environmental Assessment for the Tłchq All-Season Road EA1617-01 (Suggestion 14-1; MVEIRB 2018). This framework also considers the Wek'èezhì Land and Water Board (WLWB) Response Framework approach (WLWB 2010), which suggests a structure to assess aquatic monitoring results and apply appropriate management actions, if necessary. This document considers MVEIRB Measures and incorporates commitments made by the GNWT during the environmental assessment of the Tłchq ASR (Tables D-1 to D-3, MVEIRB 2018)

## **1.1 Objectives**

The objectives of this document are:

- To summarize the concept, components and approaches to adaptive management.
- To outline considerations when deciding on an appropriate adaptive management approach.
- To provide guidance on the inclusion of adaptive management in the Tłıchǵ ASR environmental monitoring plans.
- To provide references to other approvals, relevant standards, control plans and procedures for training, communications, investigation and corrective actions, and audits that are required under the GNWT - North Star Infrastructure (NSI) Project Agreement.
- To meet commitments made during the WLWB preliminary screening of the application and the Tłıchǵ ASR environmental assessment.

## **1.2 Relevant Environmental Management Plans**

The following Environmental Management Plans are currently being used for the construction and operation of the Tłıchǵ ASR:

- Archaeological Site Chance Find Protocol
- Conceptual Closure and Reclamation Plan
- Emergency Response Plan
- Erosion and Sediment Control Plan
- Fish and Fish Habitat Protection Plan
- Incineration Management Plan
- Quarry Operations Plan
- Spill Contingency Plan
- Waste Management Plan
- Water Monitoring Plan
- Wildlife Management and Monitoring Plan
- Permafrost Management Plan
- Engagement Plan

## **2 ADAPTIVE MANAGEMENT DISCUSSION**

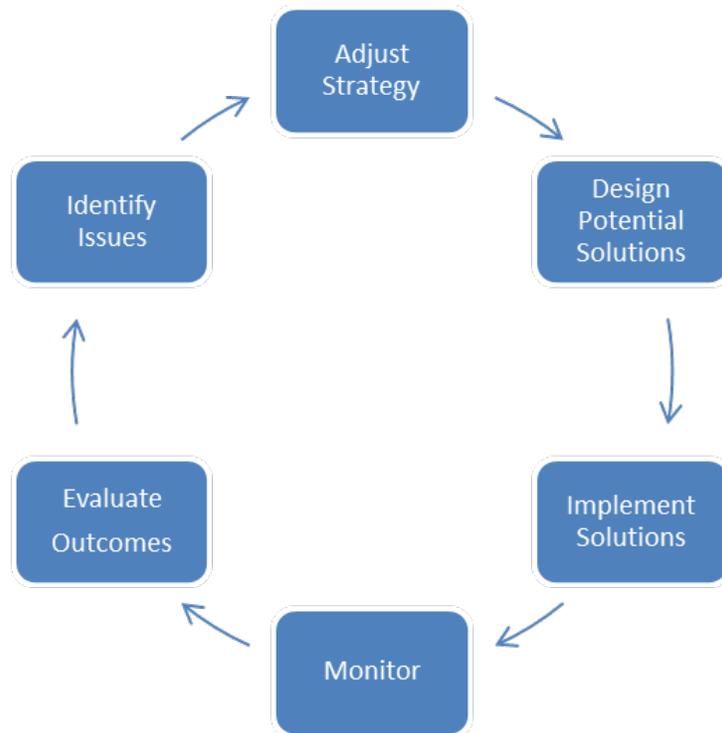
### **2.1 The Concept of Adaptive Management**

Adaptive management is a concept that has been defined in a variety of ways by both academia and government (see discussion in Appendix 1 in WLWB 2010). For the purpose of this document, the following definition is adopted: “Adaptive management is a formal process for continually improving management policies and practices by learning from their outcomes” (Taylor et al., 1997). In general, definitions of adaptive management include the following four themes (Greig et al. 2008; WLWB 2010):

- Systematic learning to reduce management uncertainties
- Using knowledge gained to change policy and practice
- Focusing on improved management
- Applying a structured approach to resource management

The cyclical process of adaptive management (illustrated in Figure 1) includes evaluation of monitoring results, identification of issues, then the design and implementation of mitigative solutions. To complete the cycle, monitoring is continued to evaluate the solutions, with the bulk of the learning coming from the evaluation stage (Greig et al. 2008; WLWB 2010; DeBeers 2013). In this way, management is responsive to the results of monitoring programs, and information learned through applying various solutions can then be integrated back into the monitoring program (Greig et al. 2008).

**Figure 1: Adaptive Management Cycle**



As described above, adaptive management involves systematic learning to reduce or minimize uncertainties in management decisions (Nyberg 1998). Systematic learning can occur through either:

- Experiential learning, which involves experimentation and personal experience; and
- Social learning, which is the formal sharing of experiences and observations (Armitage et al. 2008).

New knowledge gathered through evaluating experimental results, observations and past experiences should be incorporated into policy and practices to improve management decision-making (Medema et al. 2014).

## **2.2 Considerations for Adaptive Management**

The adaptive management process has limitations, and in some situations cannot be applied. When deciding on whether to use adaptive management and on the most appropriate approach, the following should be considered (adapted from Greig et al. 2008, Murray et al. 2008):

- 1) If the environmental change is irreversible, adaptive management cannot be applied (Gunderson 1999).
- 2) If the cause and solution for the environmental changes are known, then adaptive management is not required.
- 3) Adaptive management is limited or may not be appropriate if an immediate response is required. Designing potential solutions takes time and results are not often known in the short-term.
- 4) Adaptive management is most appropriate when there is uncertainty in the potential solution and there is sufficient time to determine the efficacy of changes in the monitoring program. If a solution is required or is considered best practice, then adaptive management may not be necessary. This is occasionally referred to as passive adaptive management.
- 5) Opportunities to incorporate traditional knowledge and stakeholder concerns when designing a solution.
- 6) Costs associated with each solution.
- 7) The social and environmental implications associated with each solution. Some solutions are not environmentally or socially acceptable, limiting the opportunity to implement adaptive management.

### **3 ADAPTIVE MANAGEMENT APPROACHES**

Adaptive management approaches can be categorized by the strategy used to evaluate outcomes, design solutions and implement the solutions. The categories described here are:

- Active Adaptive Management
- Passive Adaptive Management
- Adaptive Co-Management
- Impromptu Adaptive Management

These management approaches all contain different types of learning, incorporate varying amounts of traditional and scientific knowledge, address different levels of uncertainty and have varying costs associated with their application. Each are described below in further detail.

#### **3.1 Active Adaptive Management**

Active adaptive management involves taking an experimental approach to learn which mitigation actions will best address the environmental change (Greig et al. 2008). Experiments often involve applying various solutions in different treatment areas and/or times with statistical designs that allow for strong contrasts to be made between the solutions (Greig et al. 2008). Active adaptive management involves experiential learning, or “learning by doing” through experimentation (Armitage et al. 2008, Kolb 1984). These experiments are applied and evaluated simultaneously, so often a conclusion can be drawn on the most effective mitigation from the experiment group upon its completion (Greig et al. 2008). The experiment would be designed and applied during the “design potential solutions” and “implement solutions” steps outlined in Figure 1. As described by Murray et al. (2008), regulatory agencies should understand the true nature and intent of active adaptive management before deciding if this is a tool that should be used.

Often, active adaptive management is applied to situations in which there is a large degree of uncertainty surrounding which solutions will best address the environmental change. This management type will produce a large amount of new information and is most appropriate when there is little understanding of the cause of the change and how the mitigation may change the outcome (Greig et al. 2008, Armitage et al. 2008), and the flexibility to experiment with mitigation. In the context of environmental monitoring, active adaptive management is likely to be socially unacceptable and the results may be irreversible. Additionally, active adaptive management is an expensive, time-consuming endeavour, and may not be

feasible from a financial or practical standpoint for certain infrastructure and resource development projects (Greig et al. 2008, Murray et al. 2008).

### **3.2 Passive Adaptive Management**

Passive adaptive management is the application of the guideline or best practice solution to an environmental change. It effectively skips the “Design Potential Solutions” stage of Figure 1. Instead of conducting simultaneous experiments on which solution is the best, passive adaptive management applies experimentation to one solution at a time (Greig et al. 2008, Murray et al. 2008). The solution is designed, implemented, evaluated and issues with the solution are identified. If the first solution did not reverse the environmental change, then another solution is applied and run through the steps of the adaptive management cycle.

Passive adaptive mitigation is linked to the response framework described by WLWB (2010), as it proposes specific and pre-defined solutions before monitoring begins. The major components of a response framework are outlined in Section 4.

This type of adaptive management is best suited to situations where there is a low degree of uncertainty about which solution is the most appropriate, as the solution may be agreed to by all parties in advance and implemented quickly.

An example of passive adaptive management for the Tłchq ASR is the response framework triggered if turbidity is elevated during work at stream crossings, described in the Water Monitoring Plan.

### **3.3 Adaptive Co-Management**

Adaptive co-management is a community-based management type that involves cooperation by stakeholders to find consensus on a solution. Learning in a collaborative setting is paramount to this management type (Armitage et al. 2008). This type of learning, termed “social learning,” is a process of reflection that occurs when ideas, experiences and opinions are shared with others (Keen et al. 2005). Group learning and collaboration in this nature is used in all professions and at all levels to correct errors in practices and refine policies (Armitage et al. 2008). This management approach requires collaborative consensus to decide on how to design and implement a solution (Figure 1).

Adaptive co-management is best suited to management problems that require stakeholder input and agreement and collaboration to implement the solution. For example, the management of wildlife often has many societal impacts, and all stakeholders should be actively involved in any management decision involving wildlife. To implement adaptive co-management, collaborative meetings are held with all Project stakeholders where information on project-related environmental

effects is shared. At these meetings the environmental monitors, technical experts and traditional knowledge holders may share their observations of environmental change with other stakeholders to ensure all learned knowledge is informing best management practices and policies.

This management approach can be used in situations where there is uncertainty surrounding solution outcomes and learning is required, and there is time to collaborate on solutions. The cost associated with this management approach is very broad, yet this approach best fulfills social aspects of development projects.

In the context of the Tłıchǫ ASR, the Corridor Working Group will provide a venue for adaptive co-management.

### **3.4 Impromptu Adaptive Management**

When a situation requires immediate response, and if the risk is low, solutions may be implemented on an impromptu basis by experienced environmental staff. Examples include implementing additional waste management procedures at a location where scavenging wildlife are observed or closing access to an area where sensitive wildlife are present.

This mitigation should be documented, evaluated by Project environmental staff, and reported back to stakeholders. This management approach is best used when a quick response is needed and relies heavily on the expertise and experience of the environmental staff. The cost associated with this management approach is low and it meets social expectations of making quick, informed decisions when addressing a management problem. Impromptu adaptive management is frequently used but is often poorly documented and reported.

## **4 RESPONSE FRAMEWORK COMPONENTS**

A response framework is a system of pre-determined thresholds, which trigger actions when exceeded. A response framework can be used in passive adaptive management as it involves applying one mitigation action at a time. The following components of a response framework are described below: thresholds, action levels, and management actions.

### **4.1 Thresholds**

Thresholds, also termed “significance thresholds” in adaptive management literature, represent the ultimate limit, or endpoint, of environmental changes that should not be exceeded (WLWB 2010). Changes to the environment are unavoidable for most infrastructure and resource development projects, yet there may be a pre-determined acceptable limit to these changes, which is represented by a threshold (WLWB 2010). Changes to the environment are detected through monitoring programs, which monitor specific measurable indicators (e.g., turbidity at water crossings) against a threshold. Therefore, thresholds are specific to certain monitoring measures, and can be site-specific.

Thresholds can either be numerical, whereby they use regulatory values such as standardized detection limits, or they can be statistical. Often when there is limited background data and no regulatory values, statistical thresholds are used (Munkittrick et al. 2009). These thresholds are confirmed by stakeholders and regulators prior to commencement of the Project and are stated within the monitoring plans for each monitoring measure or indicator.

### **4.2 Action Levels**

Often environmental changes increase in magnitude (and severity) over time and space. Action levels are used to increase the intensity of mitigation with the magnitude of the change to avoid reaching a threshold. Monitoring tracks the changes for each measure or indicator, and when certain magnitudes are reached, certain management actions must be taken. Action levels thus demarcate levels (Low to High) of a given environmental change when certain actions must be applied (WLWB 2010). Moderate and high action levels can be decided upon once a low action level is surpassed.

Action levels must have a description of the magnitude of environmental change associated with them. This magnitude must be quickly and accurately measurable and can be described using statistics that calculate a given amount of statistical variance from baseline conditions. For example, a low action level may be set for when a monitoring result rises above 1 standard deviation from the mean (baseline condition) with a given sample size (Munkittrick et al. 2009). As with thresholds,

action levels are specific to certain monitoring measures, and can be site-specific. In situations where an action level has been exceeded, a Monitoring Response Plan may be required (WLWB 2010). Initially, the goal of the MRP is to document the monitoring activities, describe the setting of the moderate and high action levels, and identify potential mitigative actions (WLWB 2010).

### **4.3 Management Actions**

Management actions are applied when pre-determined action levels for environmental changes are reached to avoid reaching a threshold. These actions often involve notifying appropriate stakeholders/regulatory boards, investigating the environmental change further and re-evaluating the baseline condition (DeBeers 2013, WLWB 2010). Management actions also include mitigative actions, such as stopping all in-stream activity at a certain site until the condition improves. If the source of the environmental change is not successfully identified (i.e., environmental change may be due to natural variability and not anthropogenic impact) during the evaluation phase initiated by the low action level, then no mitigative actions will be taken.

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