Toward the Development of Northern Water Standards: Review and Evaluation of Approaches for Managing Water Use in Northern Canada

Discussion Paper

Prepared for:

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Prepared – *July 2006* – by:

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List of Acronyms

AEMPs	aquatic effects monitoring programs
AUAC	acceptable use of assimilative capacity
BKGD	background concentrations of COPCs in the waterbody
BC	background levels of the variables of concern
BAT	best available technology
BATT	best available treatment technology
BCT	best conventional pollutant control technology
BPT	best practicable control technology
CARD	Contaminants and Remediation Division
CEAA	Canadian Environmental Assessment Act
CEPA	Canadian Environmental Protection Act
COPC	chemical of potential concern
CWA	Clean Water Act
DDMI	Diavik Diamond Mines Inc.
DF	dilution factor
EF	effluent flow
EQC	effluent quality criteria
ENR	Enhanced Natural Remediation
EQOs	environmental quality objectives
GLWB	Gwich'in Land and Water Board
GLUPB	Gwich'in Land Use Planning Board
IDZ	Initial Dilution Zone
INAC	Indian and Northern Affairs Canada
LC_{50}	lethal dose affecting 50% of the population
MAC	maximum average concentration
MC	maximum concentration
MDF	minimum dilution factor
MMER	Metal Mining Effluent Regulation
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	Mackenzie Valley Resource Management Act
NPDES	National Pollution Discharge Elimination System
NSPS	new source performance standards
NTWA	Northwest Territories Water Act
NTWB	Northwest Territories Water Board
NWT	Northwest Territories
OAG	Office of the Auditor General of Canada
RAPP	Refuse Act Permit Program
RHA	Rivers and Harbors Act
RF	receiving waterbody flow

RPP	Report on Plans and Priorities
SLUPB	Sahtu Land Use Planning Board
SLWB	Sahtu Land and Water Board
TAC	technical advisory committee
TCA	tailings containment area
TF	total flow
USEPA	United States Environmental Protection Agency
WL	water licence
WPCA	Water Pollution Control Act
WQA	Water Quality Act
WQG	water quality guideline
WQO	water quality objective
WQS	water quality standard
WLWB	Wek'eezhii Land and Water Board

Executive Summary

Introduction

Recently, the Office of the Auditor General of Canada (OAG) conducted an audit of Indian and Northern Affairs Canada (INAC) relative to the development of non-renewable resources in the Northwest Territories (NWT). The results of this audit indicated that the existing framework for managing water resources does not provide project proponents with sufficient clarity regarding the water quality standards (WQS) that must be met to mitigate project impacts. This limitation of the framework was considered by the OAG to render the investment climate for non-renewable resource development uncertain. Accordingly, the OAG recommended that INAC establish regulations for water use and waste disposal in the NWT. In this way, applicants for licences or permits would be provided with the information needed to understand the standards for water that they need to meet to have their applications approved. This report was prepared to assist INAC in addressing the concerns raised by the OAG.

Summary

This study was conducted to evaluate the need for water standards for the Mackenzie Valley and identify options for managing water quality conditions that would meet the needs of northern residents and project proponents. To obtain the information needed to meet these study objectives, the current approach to water management in the Mackenzie Valley was reviewed, including the procedures that have been used in the Northwest Territories Water Act (NTWA) and the Mackenzie Valley Resource Management Act (MVRMA; Chapter 2). In addition, the key findings of the OAG were reviewed (Chapter 2). Subsequently, a number of historic and current water licences (WLs) were reviewed to select three case studies that would illustrate the approaches that are currently being used to manage water resources in the Mackenzie Valley (Chapter 3).

The approaches that have been used to manage water resources in other North American jurisdictions were also reviewed and evaluated (Chapter 4). The results of this review were used to select two jurisdictions (i.e., Saskatchewan and the United States) that have well-developed and scientifically-defensible water management frameworks that could be used as models for northern water management. The features of the selected frameworks are similar to those that are used in many other North American jurisdictions (i.e., Ontario, British Columbia, U.S. states, etc.). The results of this review, along with the OAG recommendations, were then used to identify a series of tools (Chapter 5) and options (Chapter 6) for managing water

quality conditions in northern Canada, including establishment of uniform WQS, establishment of uniform or industry-specific EQC, and establishment of project-specific EQC. Subsequent evaluation of these options indicated that, while any one of them could be applied in the north with sufficient resources, development of an integrated framework for water quality management was more likely to address the concerns identified by the OAG in the near-term.

To be effective, a framework for managing water quality conditions must meet the needs of Mackenzie Valley residents in terms of conserving the pristine nature of northern waters and protecting traditional water uses, while providing project proponents with the certainty that they need to develop and implement a developmental proposal. Ideally, such a framework would provide a means of integrating these interests in a way that supports sustainable development of natural resources in northern Canada, for the benefit of all Canadians. Based on our review of frameworks that have been successfully implemented elsewhere, the key elements of such a framework are:

- Long-term vision for the future;
- Integrated water management policy;
- Ecosystem goals and objectives for major river basins in the region;
- Indicators of ecosystem health and associated metrics;
- Ecosystem quality objectives;
- Guidelines for characterization of baseline conditions;
- General objectives for effluent discharges;
- Guidelines for establishing and regulating IDZs;
- Procedures for deriving EQC; and,
- Guidelines for aquatic effects monitoring.

Such a framework for managing water quality in northern Canada was described in Appendix 7.

Recommendations

While many of the elements of such a framework have already been incorporated into the current approach to water management in the north, the federal government and the MVRMA boards will need to collaborate on several important initiatives to develop the tools needed to effective manage water quality conditions in the future. The specific recommendations that emerged from the current investigation included:

- Review and summarize existing legislation and regulations applicable to water management in the north. This summary should be presented in a form useful to MVRMA Boards;
- Develop an integrated water management policy for the Mackenzie Valley;
- Define best management practices for key industries that are operating in northern Canada;
- Develop guidance on adaptive management in the north;
- Establish guidelines for developing site-specific water quality objectives (WQOs) that are consistent with existing federal, provincial, and territorial guidance documents;
- Establish guidelines for characterizing baseline conditions for water quality and other ecosystem components (e.g., sediment quality, biological community structure, etc.);
- Establish general objectives for effluent discharges (e.g., related to acute toxicity, etc.);
- Establish guidelines for defining the size of and regulating initial dilution zones (IDZ);
- Establish procedures for deriving numerical EQC;
- Establish guidelines for designing and implementing Aquatic Effects Monitoring Programs (AEMPs);
- Refine approaches to stakeholder involvement and community consultation in water management in the north; and,
- Develop a strategy for addressing cumulative effects in the water management framework.

While some of these initiatives are currently ongoing, others will need to be undertaken in the near-term to provide the MVRMA boards with the tools that they need to effectively manage water resources in the Mackenzie Valley.

Chapter 1 Introduction

1.0 Background and Context

The Northwest Territories (NWT) is renowned for the myriad lakes, rivers, streams, and wetland areas that lie within its borders, the vast majority of which are in pristine condition. Conservation of the exceptional quality of these unique ecosystems requires effective water management. In recognition of the need to provide a regulatory basis for managing water and other renewable resources in the north, the Government of Canada passed the Northwest Territories Water Act (NTWA) in 1992. Subsequent enactment of the Mackenzie Valley Resource Management Act (MVRMA) in 1998 and proclamation of Part IV of the MVRMA in 2000 [(which established the Mackenzie Valley Land and Water Board (MVLWB)] created an integrated co-management structure for public and private lands in the Mackenzie Valley, including establishment of a number of public boards to regulate the use of land and water, to develop land use management plans, and to carry out the assessment and review of proposed development projects (INAC 2001).

While implementation of the MVRMA has effectively transferred authority for managing land and water resources to various independent boards, a recent report by the Office of the Auditor General of Canada (OAG 2005) indicated that the existing framework for managing water resources does not provide project proponents with sufficient clarity regarding the water standards that must be met to mitigate environmental impacts (see Appendix 1). The OAG (2005) further indicated that the absence of direction on standards for water can raise confusion and uncertainty over the stringency of the requirements that applicants must meet in order to have their applications approved. INAC responded to the OAG (2005) report by committing to ascertain the information needs with respect to water standards used by the boards to set licence terms and conditions of water users and the best form to provide proponents with certainty.

1.1 Purpose of this Report

This report was prepared to assist INAC in addressing the concerns identified by the OAG related to water standards. More specifically, this report provides a review of the approaches that have been used to manage water quality conditions in the NWT and presents three case studies to illustrate how these approaches have been applied. The approaches and tools used in other jurisdictions for managing water quality conditions have also been reviewed, with two representative water quality management frameworks (Saskatchewan and the United States under the National Pollution Discharge Elimination System; NPDES) selected to illustrate these approaches. These jurisdictions were selected because their water management frameworks are well developed, well documented, and generally consistent with the approaches that are used in other Canadian jurisdictions, including those that share boundaries with the NWT. In addition, key water management tools have been identified and described. Finally, this report presents options for managing water quality conditions in northern Canada, based on the approaches, procedures, and tools that have been used historically by MVRMA boards and other jurisdictions. Accordingly, this report can be used as an information base on which to begin consultations with the boards for addressing the OAG's concerns.

Chapter 2 Background on Water Management in the North

2.0 Introduction

The NWT is characterized by an abundance of fresh water of exceptional quality. The responsibility for conserving these water resources, while facilitating the development and utilization of renewable and non-renewable resources, has been largely delegated from the Minister of INAC to a number of public boards through implementation of the MVRMA. The exception is that the Minister of INAC is responsible for approving the water licences (WLs) that are prepared by the public boards. In addition, INAC provides policy direction to the boards on issues related to water management.

This chapter briefly describes the existing water management process in the north and the challenges that have been identified by the Office of the Auditor General of Canada (OAG).

2.1 Water Management Under the Northwest Territories Water Act

On June 23, 1992, the NTWA was enacted by the Government of Canada to support water management in the Northwest Territories (NWT). More specifically, the NTWA established a legal and administrative framework for using water and depositing wastes in the NWT. Importantly, the NTWA also established the Northwest Territories Water Board (NTWB) to provide for the conservation, development, and utilization of territorial waters in a manner that would provide the optimum benefit for all Canadians and for the residents of the NWT.

The NTWB fulfills this mandate through the issuance of WLs in connection with the operation of an undertaking (e.g., developmental activity) that establish terms and conditions for use of water and/or deposition of waste into receiving waters. Such terms and conditions are intended to ensure that the use of waters and/or the deposit of waste proposed by an applicant will not adversely affect the use of waters within or outside the water management area to which the application relates. The water uses, explicitly identified in the NTWA, that require protection include: previous licencees, domestic water users, instream water users, authorized water users, authorized waste depositors, owners of property, occupiers of property, and holders of outfitting concessions, registered trapline holders, and holders of other rights of a similar nature. The NTWA further stipulates that any waste produced by an undertaking would be treated and disposed of in a manner such that any applicable water quality and effluent standards would be met.

The NTWB has the authority to issue two types of WLs for terms not to exceed 25 years. A Type A WL is generally required for undertakings that use more than 300 m^3/day of water, have water storage requirements of greater than 60,000 m^3, mill greater than 100 tonnes/day of ore, or deposit significant quantities of wastes into receiving waters. A Type B WL is generally required for smaller operations, although some exceptions also apply. The NTWB may issue a Type A WL only with the approval of the Minister of Indian and Northern Affairs Canada. A Type B WL can be issued with the approval of the chairperson of the NTWB if no public hearing is held by the Board in connection with the application or with the approval of the Minister if a public hearing is held by the Board in connection with the application.

2.2 Land and Water Management Under the Mackenzie Valley Resource Management Act

On December 22, 1998, the Mackenzie Valley Resource Management Act (MVRMA) was proclaimed, creating an integrated co-management structure for public and private lands throughout the Mackenzie Valley in the NWT (INAC 2001). A number of public boards were established under the MVRMA, including:

- Mackenzie Valley Land and Water Board (MVLWB);
- Mackenzie Valley Environmental Impact Review Board (MVEIRB);
- Gwich'in Land and Water Board (GLWB);
- Gwich'in Land Use Planning Board (GLUPB);
- Sahtu Land and Water Board (SLWB); and,
- Sahtu Land Use Planning Board (SLUPB).

These boards were established to regulate the use of land and water, to prepare regional land use plans to guide development, and to carry out environmental assessment and reviews of proposed projects in the Mackenzie Valley (INAC 2001). The MVRMA also includes provisions for monitoring cumulative impacts on the environment and for conducting independent environmental audits.

The process that has been developed to manage lands and waters in the Mackenzie Valley consists of three main elements, including land use planing, environmental impact assessment, and, land use permitting and water licensing. Each of these process elements are briefly described below.

2.2.1 Land Use Planning

In the first phase of the integrated environmental management process, land use planning boards (e.g., GLUPB, SLUPB) prepare comprehensive land use plans for their respective settlement areas. These plans are intended to guide the use of federal Crown, community, and private lands and provide direction for the conservation, development, and use of land, waters, and other resources (INAC 2001). These land use plans designate different areas for different land uses, thereby explicitly identifying the permitted and prohibited uses of all land within a settlement area. Such land use plans do not apply within municipalities or national parks. Land use plans are submitted to the First Nation of the settlement area, the appropriate territorial minister, and the appropriate federal minister for approval prior to implementation. Once approved, land use plans provide prospective land and water users with clear guidance on whether or not their specific development projects are appropriate for the area under consideration.

2.2.2 Environmental Impact Assessment

In the second phase of the integrated environmental management process, prospective development projects are evaluated to assess their potential impacts on the environment and human health. In the Mackenzie Valley, the MVEIRB is responsible for the environmental impact assessment process. There are three stages to the environmental impact assessment process: preliminary screening; environmental assessment; and, environmental impact review. All prospective development projects undergo preliminary screening to determine whether they must proceed to a full environmental assessment or go straight to the regulatory phase. During the screening process, a systematic approach is used to document the potential environmental effects of the project. The board then decides if these effects need to be mitigated, if the project plan should be modified, and if further assessment is required. Preliminary screening on land and water applications is conducted by the appropriate land and water board.

Projects that require further assessment are referred to the MVEIRB. Following referral, notices are placed in northern newspapers to provide the public with notice that the project is being assessed. Next, the developer prepares and submits a project description to the MVEIRB that describes the project and how it will be carried out. The public is then afforded an opportunity to comment on the project and identify issues that may require consideration. All of the submissions to the MVEIRB are placed on the public registry to provide all participants in the process with unfettered access to the information. In addition to the potential environmental effects of the project, cumulative effects, socio-cultural considerations, and alternate ways of carrying out the project are considered during the environmental assessment. An environmental impact review is conducted by a panel for projects for which significant environmental effects are anticipated and the results of that review are reported to the Minister of INAC. The Minister can accept the recommendations of the review panel (i.e. for rejection or approval of the project), refer the project back for further consideration, adopt the recommendations with modifications, or reject the assessment report.

2.2.3 Land Use Permitting and Water Licencing

In the final phase of the integrated environmental management process, the project is referred to the regulatory process for permitting and/or licensing. The MVLWB and its regional panels are responsible for regulating the use of land and waters and the deposit of waste so as to provide for the conservation, development, and utilization of land and water resources in a manner that will provide the optimum benefit of all Canadians and in particular for residents of the Mackenzie Valley. The MVLWB fulfills this mandate by issuing land use permits and WLs on land in unsettled claim areas within the Mackenzie Valley. In contrast, the regional land and water boards established under the MVRMA, including the GLWB, SLWA, and the recently established Wek'eezhii Land and Water Board (WLWB) are responsible for issuing land use permits and WLs in their respective areas on public and private land. The MVLWB processes applications for land use permits and WLs for projects that

cross settled or unsettled land claim boundaries (i.e., transboundary applications). The MVLWB is also responsible for ensuring consistency in the application of the legislation throughout the Mackenzie Valley and for administering land use permits and WLs that were issued prior to the MVRMA.

While the MVRMA defines the legal and administrative framework for managing land and waters in the Mackenzie Valley, it cannot be applied alone to address land and water use management issues in the north. In addition, the NTWA and Northwest Territories Water Regulations form part of the legal and administrative framework that was established for managing land and water use under the MVRMA. Accordingly, the procedures for determining if a WL is required for a particular activity, identifying the type of WL needed, and applying for a WL are consistent under the NTWA and the MVRMA. Opportunities for public involvement and consultation are similar under both water management frameworks. The Minister of INAC is responsible for approving all Type A WLs, while the chairperson of the relevant Board is responsible for approving most of the Type B WL applications. Inspectors employed by INAC are responsible for enforcing the provisions of the MVRMA and associated regulations. As was the case for the NTWA, the decisions of the land and water boards are subject to judicial review, by the Supreme Court of the NWT and by the Federal Court of Canada.

Under the MVRMA, development projects have been classified into several categories to facilitate the establishment of licensing criteria. Industrial undertakings include such activities as oil and gas exploration, water crossings (i.e., pipelines, bridges, and roads), watercourse training (i.e., channel and bank alterations, culverts, spurs, erosion control, and artificial accretion), flood control, diversions, flow alteration or storage (i.e., by dams or dykes), and deposition of wastes from industrial operations. Mining and milling undertakings include such activities as direct water use, watercourse crossings, flood control, diversions, alteration of flow or storage, and deposition of wastes associated with various mining activities. Municipal undertakings include such activities as direct water use, watercourse training, flood control, diversions, alteration of flow or storage, and deposition of wastes associated

with municipalities, settlements, camps, or lodges. Power undertakings include such activities as direct water use, watercourse crossings, watercourse training, flood control, diversions, and alteration of flow or storage by means of dams or dykes. Finally, agricultural, conservation, recreational, and miscellaneous undertakings include such activities as direct water use, watercourse crossings, watercourse training, flood control, diversions, alteration of flow or storage by means of dams or dykes, and deposition of waste.

The need for and type of WL required is dictated by the scope of the activity that is proposed, the type of watercourse affected, the quantity of water affected, the nature of the waste produced, and the procedure for disposing of the waste. A Type A WL is required for activities of broad scope, that have significant potential for adversely affecting human health or the environment, and/or require substantial volumes of water. A Type B WL is required for activities of limited scope, that have limited potential for adversely affecting human health or the environment, and/or require relatively small volumes of water. A WL may not be required for certain activities of small scope, that have little or no potential for adversely affecting human health or the environment, and/or require insignificant volumes of water. The licensing criteria for each of these general categories of undertakings are presented in Schedule IV, V, VI, VII, and VIII of the MVRMA, respectively.

Preparation of a Type A WL usually involves several steps. First, a WL application is developed by the proponent and reviewed by interested parties. For projects with substantial potential to adversely affect human health or the environment, a public hearing is convened to provide interested parties with an opportunity to make presentations to the board. Subsequently, a WL is drafted and distributed to interested parties for review and comment. The proponent is permitted to respond to any comments that are submitted to the board on the draft WL. Following finalization, the WL is submitted to the Minister of INAC for approval. While the Minister may not overturn a decision made by a land and water board, the Minister may attach terms and conditions such as a provision for a security deposit, a requirement for water quality and quantity measurements, and a requirement for

abandonment and restoration plans. The WL is provided to the proponent following ministerial approval.

2.3 Key Findings of the Audit of Indian and Northern Affairs Canada Relative to Development of Non-renewable Resources in the Northwest Territories

In 2005, the OAG conducted an audit of INAC to determine how well it has managed its responsibilities relative to the application and licensing process for the development of non-renewable resources in the NWT (Appendix 1). The audit was undertaken because non-renewable resources offer enormous potential economic development in the NWT and the OAG considered that the investment environment for this development is uncertain. In particular, the OAG concluded that INAC has not adequately managed its role in the process that considers development projects. Two areas of particular concern identified by the OAG included INAC's failure to provide guidance on some ambiguous terms in the governing legislation and its failure to establish water standards permitted by legislation.

The OAG noted that, with the signing of land claims agreements in the NWT and the passage of the MVRMA, the federal government has created a series of boards to regulate the use of land and water and to protect the environment. When the boards were created, INAC felt that the federal government's best course of action was to leave the boards to administer the process on their own in order to ensure that the Aboriginal people of the NWT understood that the federal government was sincere about relinquishing control. The OAG concluded that this decision has contributed to a regulatory environment that needs strengthening (see OAG 2005; Section 6.3.7 to 6.4.7).

Among other things related to the development of non-renewable resources in the NWT, the OAG recommended that INAC establish regulations for water use in the NWT. The OAG stated that "applicants for licences or permits should be able to know before they submit their proposals the standards for water use and waste disposal that they must meet." The Auditor General further stated that the current "absence of direction on standards for water can raise the risk of confusion and uncertainty over the stringency of the requirements that applicants must meet in order to have their applications approved."

The Department reviewed the OAG's report and agreed with all of the recommendations. In addition, INAC committed to taking actions to address the concerns that the OAG raised in its 2005 report. With respect to water standards, INAC indicated that the Department, in consultation with the MVRMA boards, would ascertain the information needs of water users with respect to water standards used by the boards to set licence terms and conditions and would identify the best form to provide proponents with greater certainty in the water licensing process. The Department committed to completing the report providing the requisite information by the end of 2006.

Chapter 3 Case Studies in Water Management Under Mackenzie Valley Resource Management Act Boards

3.0 Introduction

The NWT is characterized by an abundance of fresh water of exceptional quality. The responsibility for conserving these water resources, while facilitating the development and utilization of renewable and non-renewable resources, is shared by the Minister of INAC and a number of public boards, established through implementation of the MVRMA. Through the creation of the various boards and panels, the MVRMA has created an integrated framework for managing the uses of land and water in the Mackenzie Valley. Land use planning and environmental assessment both play important roles in this process. However, the water licensing process represents the principal regulatory instrument for managing water quality conditions in the vicinity of development projects that have been assessed and considered to be acceptable. More specifically, land and water boards issue WLs, under the authority of the NTWA and MVRMA, which require licencees to meet certain terms and conditions on the use of water and/or the deposition of waste. Such terms and conditions are intended to ensure that the potential impacts associated with construction, operation, and/or decommissioning of the project are effectively mitigated. The WLs also provide an effective means of implementing the mitigation required under the environmental assessment process.

Currently, neither the MVLWB nor any of its regional panels have established standard operating procedures for preparing WLs that provide project proponents a clear understanding of the standards for water use and waste disposal that they must meet. However, the NTWB previously produced guidelines on a variety of topics relevant to water licencing. In addition, the Metal Mining Effluent Regulations (MMER) and other federal regulations provide a relevant backdrop for the water

licensing process. Nevertheless, WLs are prepared on a project-by-project basis to address the specific issues and concerns that have been identified by the proponent and by other participants in the water licensing process. Importantly, the MVLWB has drawn on the extensive experience of its predecessor (NTWB) and the substantial knowledge and expertise of Aboriginal groups, government agencies, non-governmental organizations, and the public to craft WLs that meet the specific needs of the project. The legislation establishing the land and water boards did so to allow for traditional knowledge and local experience provided by board members to be utilized in developing licence terms and conditions specific to the location of the project. In addition, the expertise of the participants in the water licensing process is frequently harnessed through the establishment of a technical advisory committee (TAC) that provides specific recommendations to the board on the terms and conditions needed to mitigate project impacts. To fulfill its mandate, the MVLWB can include in a WL any conditions that it considers appropriate, including but not limited to:

- Conditions relating to the manner of water use permitted under the licence;
- Conditions relating to the quantity, concentration, and types of waste that may be deposited in any waters covered by the licencee;
- Conditions under which any such waste could be so deposited;
- Conditions relating to studies to be undertaken, works to be constructed, plans to be submitted, and monitoring programs to be undertaken; and/or,
- Conditions relating to any future closure or abandonment of the undertaking.

All of these categories of WL conditions are important for ensuring that a project is appropriately constructed, operated, and decommissioned. However, the development of EQC is particularly important from a water management perspective because they define the maximum and/or average concentrations of chemicals of potential concern (COPCs) in the effluent discharge that must be met by the project proponent.

Because neither the NTWB nor MVLWB have established uniform EQC, ambient WQS, or standardized procedures for developing EQC, the approaches that have been used to manage water quality conditions in the NWT are illustrated in a series of case studies. More specifically, three case studies were selected to illustrate the procedures that have been employed by the NTWB and MVLWB to establish WL terms and conditions that would be protective of the designated water uses identified in the NTWA and MVRMA (Table 1 provides a listing of the WLs that were reviewed to select these case studies), including:

- Diavik Diamond Mines Inc. (DDMI) diamond mine project on Lac de Gras (N7L2-1645);
- Indian and Northern Affairs Canada (INAC) reclamation project for the Colomac gold mine (MV2004L8-0001); and,
- City of Yellowknife municipal infrastructure project on Great Slave Lake (N1L3-0032).

The following sections of this document briefly describe the terms and conditions of the selected WLs, including the relevant guidance used in setting the terms and conditions. This discussion focuses on the elements of the licences that are most directly applicable to the management of the unique water quality conditions in the vicinity of these developments. These three WLs were selected because they cover the three major types of development projects in the north (i.e., diamond mining, metal mining, and municipal development) and because the reasons for establishing key WL conditions were well documented. Table 2 provides a summary of the processes that were used to establish WL conditions for all of the Type A WLs that have been issued in the last 31 years in the NWT. Additional background information and details regarding EQC derivation for the DDMI and INAC projects are included in Appendices 2 and 3 of this document.

3.1 Diavik Diamond Mines Inc. Type A Water Licence

The DDMI project is located on Lac de Gras, approximately 300 km northeast of Yellowknife, NT. The project involves construction of dykes around three kimberlite pipes in Lac de Gras, disposal and management of water within the dykes, removal and disposal of country rock surrounding the kimberlite pipes, mining and processing of the diamond-bearing ores, disposal of processed kimberlite, treatment and disposal of water from the mine and other sources, and construction and maintenance of the infrastructure needed to support mining activities. While other, related activities are conducted at the site, those listed above are the most important relative to the potential for adversely affecting the environment or human health through discharges of COPCs to receiving waters. Following the completion of mining activities, the site is to be reclaimed in a manner that minimizes the potential for ongoing impact on the environment.

On August 16, 2000, the NTWB issued a Type A WL (N7L2-1645) to DDMI to authorize water use and waste disposal at the Lac de Gras site. In addition to a series of general conditions, the WL included conditions applying to construction, water use, dewatering, waste management plans, waste disposal and waste facilities, modifications, contingency planning, aquatic effects monitoring, and abandonment and restoration. Many of these conditions specify the steps that must be taken to ensure that facilities are constructed, operated, and maintained in a manner that minimizes the potential for adverse effects on the environment, including the development of contingency plans that specify the steps that will be taken to mitigate environmental effects in the event that any facility fails to operate as it was designed to. In addition, the WL contains specific conditions for waste disposal and waste facilities that specify how to operate and maintain several key facilities for collecting, storing, and managing wastes produced at the site (e.g., Drainage Control and Collection System, Dredged Sediment Containment Facility, North Inlet Facility). Importantly, the WL also includes EQC that must be met in discharges from the water treatment facilities, discharges from the sewage treatment facilities and surface runoff from the site. These EQC specify the maximum concentration (MC) of each COPC

in any grab sample and the maximum average concentration (MAC) of each COPC calculated for any five samples collected within a 30 day period. In addition, the conditions of the WL specify that discharges from the water treatment facilities not be acutely toxic to aquatic organisms. Under the terms of the WL, the proponent was also responsible for developing and implementing a Surveillance Network Program (SNP) and an AEMP for assessing the characteristics of surface water runoff and wastewater discharged to the environment and for evaluating project-related effects on the aquatic ecosystem, respectively.

As a first step in the EQC derivation process, the NTWB established a series of guiding principles. More specifically, the following principles were established to guide the development of numerical EQC:

- Numerical EQC must be established at levels that are sufficient to protect the designated uses of Lac de Gras;
- Protection of the designated uses of Lac de Gras can be facilitated by developing and attaining the ambient water quality objectives (WQOs) for the lake;
- To be environmentally realistic, ambient WQOs must be established at levels that are similar to or higher than natural background concentrations of COPCs in Lac de Gras (BKGD);
- It is reasonable to establish IDZs in the vicinity of wastewater discharges from the mine;
- The dimensions of the IDZs should be restricted to avoid adverse effects on the designated uses of Lac de Gras;
- The IDZs should not impinge on critical fish habitats;
- Conditions outside the IDZs should be sufficient to support all of the designated uses of Lac de Gras;

- Numerical EQC can be calculated from the ambient WQOs and appropriate dilution factors (DFs) for the effluent (i.e., within the IDZ under consideration);
- The numerical EQC should not be higher than the levels that can be achieved through the application of best available treatment technologies (i.e., to minimize degradation of receiving waters);
- Discharges from the DDMI mine site should not be acutely toxic to fish or other aquatic organisms; and,
- Loadings of COPCs to Lac de Gras should be minimized through the use of best management practices and the timely implementation of various contingency plans.

As indicated in the Record of Decision for this WL, the NTWB had set standards for water quality in Lac de Gras for the COPCs relative to the construction and operation of a diamond mine at the DDMI site (i.e., the site-specific WQOs). These standards were based on existing water quality data for Lac de Gras and the Canadian Water Quality Guidelines (CCME 1999). The board also indicated that it was satisfied that, through the imposition of the effluent quality requirements set out in the WL, the board's mandate of protecting the water quality of Lac de Gras would be met (see Appendix 2 for a description of the procedures that were used to develop EQC). Furthermore, the board indicated that the EQC could be achieved through the application of best available technology (BAT). Importantly, the board recognized that establishment of site-specific standards for water quality represented an essential part of the overall water quality management process. Site-specific WQOs were considered to be more relevant than generic WQGs because they considered baseline water quality conditions and accounted for the specific uses of water within the study area.

3.2 Indian and Northern Affairs Canada Type A Water Licence for the Colomac Mine Remediation

The Colomac Site is located 220 km north of Yellowknife in the NWT, within the traditional territory of the Tlicho people. An open pit gold mine was operated at the site between 1990 and 1997, initially by Neptune Resources Corporation and subsequently by Royal Oak Mines. Because the site was abandoned and the company was not able to be held liable due to insolvency, INAC became responsible for remediating the site.

Currently, there are two main areas within which contaminated water is contained at the Colomac Site, and active discharge of wastewater from these containment areas is anticipated to occur as early as 2008 (CARD 2004). In anticipation of the need to actively discharge wastewater, INAC applied to the MVLWB for a WL that would facilitate discharge of wastewater from the Tailings Contaminant Area (TCA). As part of this application, INAC recommended candidate EQC for possible inclusion in the Type A WL for the Colomac Site. A step-wise process was used to derive these EQC, which included:

- Reviewing the various approaches that have been established for deriving numerical EQC;
- Establishing guiding principles for deriving EQC;
- Identifying chemicals of potential concern (COPCs);
- Establishing numerical water quality objectives (WQOs);
- Evaluating the dilution capacity of Watershed A;
- Calculating the water quality-based EQC;
- Determining the likely characteristics of wastewater post-treatment; and,

- Recommending candidate EQC that would be protective of water uses in receiving waterbodies in Watershed A, consistently achievable, and minimize of COPCs to Watershed A.

Three approaches were considered for deriving EQC for the Colomac mine site, including: 1) the non-degradation approach; 2) the use protection approach; and, 3) BAT approach. The EQC that were recommended to the MVLWB and ultimately incorporated into INAC's WL (issued in 2005) were established by calculating EQCusing each of the three approaches, and then comparing them for the purpose of identifying EQC that would be consistently achievable, protective of water uses in downstream waterbodies, and minimize COPC loadings to receiving waterbodies. Additional background information on the Colomac Mine and the procedures used by MVLWB to develop EQC is included in Appendix 3.

3.3 City of Yellowknife Type A Water Licence

The City of Yellowknife is located on the western shore of Yellowknife Bay on the North Arm of Great Slave Lake. With a population 19,000 in 2005 (roughly 45% of the population of the NWT), Yellowknife is the largest municipality in the NWT. The municipality obtains its drinking water from the Yellowknife River and distributes it to residents through a pressurized water distribution system. Water is also delivered by truck to areas not serviced by the piped water infrastructure. Sewage is collected in a network of gravity-fed sewage lines and, where necessary, the use of pump-out trucks. With the aid of lift stations, the sewage is pumped to a chain of lakes located about 10 km from the city. There, the sewage is held and allowed to decompose naturally. Bagged toilet wastes and solid wastes are disposed of in the Bagged Toilet Waste Disposal Facilities and Solid Waste Disposal Facilties. The decant from the Fiddlers Lake wastewater treatment system is discharged to Great Slave Lake. Storm water from the city is discharged directly to Great Slave Lake without treatment.

Over the past 29 years, the City of Yellowknife has been issued a total of four WLs. The current WL (N1L3-0032) was issued in 2002 and provides a number of conditions relative to the disposal of sewage, bagged toilet waste and solid waste. Importantly, numerical EQC have been established for discharges from the Fiddlers Lake Treatment System, which specify the MAC and MCs of faecal coliforms, BOD_5, pH, total suspended solids, and oil and grease in effluent from the facility. In addition, the EQC indicate that whole undiluted effluent from the facility shall be non-acutely toxic and achieve results equivalent to the no observed effect concentration (i.e., 100% survival for toxicity test organisms is required for each sample). The applicable monitoring requirements are also specified in the WL.

In the reasons for decision, the MVLWB indicated that participants in the public hearing expressed a number of water quality concerns. More specifically, concerns were expressed about the effectiveness of the Fiddlers Lake sewage disposal system, the impacts of stormwater discharges to Great Slave Lake, and the potential impact of sub-surface seepage and surface runoff from the Solid Waste Disposal Facility. The EQC included in the WL were established to protect the current water uses in the receiving waters (Great Slave Lake), to be consistent with those established in past WLs, and to be achievable based on the current level of treatment applied at the facility. However, insufficient information was provided in the Reasons for Decision to determine how the EQC were calculated. Importantly, the board also included terms and conditions in the WL requiring the applicant to develop information on treatment options that would reduce faecal coliform to levels consistent with the Canadian WQGs (CCME 2002) and reduce total phosphorus levels to 1 mg/L (MAC) and 2 mg/L (MAC) by 2008. The WL also requires the applicant to provide further information on stormwater management and on the quality of sub-surface seepage and surface runoff from the Solid Waste Disposal Facility.

3.4 Observations on the Development of Effluent Quality Criteria in the North

A total of 25 WLs were reviewed to obtain information on how EQC have been developed under the NTWA and MVRMA (Table 1). The results of this review indicated that the procedures that were used to derive EQC were not described in any of the WLs that were reviewed. In addition, the Reasons for Decision that were issued with these WLs described the rationale for establishing the EQC only infrequently. When such rationale was provided, it typically indicated that the EQC were established at levels that would:

- Protect water uses;
- Minimize contamination to receiving waterbodies;
- Be consistent with the levels that had been set in previous WLs;
- Be consistent with the levels that had been proposed by the applicant;
- Ensure that WQOs would be met in receiving waters;
- Ensure that chronic toxicity thresholds would not be exceeded in receiving waters; and/or,
- Be consistently achieved through the application of best available treatment technology (BATT).

Such rationale indicates that the boards have established guiding principles that are generally adhered to during the establishment of EQC. This rationale for the EQC also indicates that the NTWB and MVLWB have established WQOs (i.e., water standards) for certain waters within their jurisdiction and have used these management tools to establish EQC. However, the Water Boards generally have not provided explicit descriptions of the procedures that were used to establish WQOs or EQC. Nevertheless, it is clear that the Canadian WQGs (CCME 2002; see Appendix 4 for a description of the Canadian WQGs) and site-specific information on baseline

water quality conditions represent the primary tools that have been used to set ambient WQOs. Therefore, the MVRMA boards appear to have established a framework for establishing EQC that can protect designated water uses and minimize the degradation of receiving water quality. Explicit description of this framework in a guidance document would help project proponents to better understand the standards that they must meet relative to effluent discharges in the NWT.

Chapter 4 Approaches to Water Quality Management Practiced in Other Jurisdictions

4.0 Introduction

Jurisdictions throughout Canada and around the world face similar challenges regarding the management of water quality conditions. More specifically, water quality managers are challenged to manage human uses of water resources in such a manner as to optimize benefits for their constituents, to avoid or minimize conflicts over such uses, and to assure the long-term sustainability of the resource. While the challenges faced by water quality managers in various jurisdictions are similar, the approaches that have been applied to meet these challenges differ substantially. To determine if the approaches applied in other jurisdictions could be relevant to the north, a review of two representative water quality management frameworks was undertaken, including Saskatchewan and the United States (i.e., under the National Pollution Discharge Elimination System; NPDES). These jurisdictions were selected because their water management frameworks are well developed, well documented, and generally consistent with the approaches that are used in other Canadian jurisdictions (i.e., in terms of how effluent discharges are managed). The following sections of this document summarize the results of that review.

4.1 Water Quality Management in Saskatchewan

In Saskatchewan, authority for managing surface water quality is vested in the Saskatchewan Department of Environment and Public Safety. In fulfilling its mandate, the Department is guided by a water quality management policy that states that the departmental goals are to conserve water and to protect, maintain, and

improve its quality for the protection of public health and, within economic limits, for the following purposes:

- Preservation and protection of water supplies;
- Encouragement of economic development;
- Preservation of aesthetic values; and,
- Preservation of fish and wildlife.

The Department has developed a framework for managing water quality that enables it to meet these policy goals. Rather than setting uniform effluent quality standards, the Department has opted for examining each case of waste disposal and water pollution on its own merits (i.e., within the broader water quality management framework). Accordingly, decisions relative to the permitting of effluent discharges are made using information on water quality guidelines (WQGs) or WQOs, the uses of the waterbody under consideration, site-specific water quality data, the potential for adverse effects, and the practicality of wastewater treatment. In addition, some requirements that apply universally have been established, such as effluent standards for parts of the mining industry (i.e., MMERs) and general objectives for effluent discharges.

As indicated above, WQOs represent a key element of the water management framework. Two types of WQOs are developed in Saskatchewan, including general surface WQOs and specific surface WQOs. The general surface WQOs (functionally-equivalent to WQGs) define the basic quality characteristics of surface waters needed to afford a minimum level of protection for all beneficial uses. Both narrative and numerical values for various constituents and conditions are included in the general surface WQOs. By comparison, the specific surface WQOs (i.e., site-specific WQOs) define the concentrations or conditions needed to protect the specific water uses. The water uses that are considered in the development of specific surface WQOs for a waterbody include:

- Aquatic life and wildlife;
- Contact recreation;
- Non-contact recreation;
- Crop irrigation;
- Livestock watering;
- Potable water supply; and,
- Algae and aquatic nuisances.

For a specific waterbody, the WQOs that apply are determined in two ways. First, the general surface WQOs are adopted directly. Second, the beneficial water uses for the waterbody are determined and the specific surface WQOs for each of the uses are compared. The lowest of the specific surface WQOs for each water quality variable would then be adopted for that waterbody. Together, the general and specific surface WQOs represent the WQOs that apply to the waterbody under consideration.

The WQOs that apply to a waterbody are used in a number of ways in the water management process. First, they are used in project planning to determine the suitability of water for use in a project and for determining the effluent levels needed to protect downstream water uses. In addition, WQOs are used during project evaluation to determine if the proposed treatment system and facility operation are sufficient to support beneficial water uses. The WQOs are also used during the licensing phase of the process to support the development of effluent quality requirements, to establish the dimensions of the IDZ, and to determine monitoring requirements. Finally, the WQOs are used during project operation to evaluate project performance and the safety of downstream water users.

While WQOs represent a central element of the overall water management framework in Saskatchewan, there are a number of other tools that are applied to meet departmental goals. First, a number of general objectives have been established that

apply to all receiving waters that receive effluent discharges, including the mixing zones adjacent to effluent outfalls (i.e., the IDZs). These general objectives include:

- Waters must be free from substances in concentrations or combinations that are acutely toxic or may be harmful to human, animal, or aquatic life;
- Waters must be free from substances that settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect wildlife;
- Water must be free from debris, oil, grease, scum, or other materials in amounts sufficient to be noticeable in the receiving water;
- Waters must be free from color, turbidity, or odor-producing materials that would adversely affect aquatic life or wildlife, significantly alter the natural colour of the receiving water, or result in undesirable taste or odour in treated water;
- Waters must be free from nutrients in concentrations that create nuisance growths of aquatic weeds or algae, or that results in an unacceptable degree of eutrophication of the receiving water; and,
- Effluent discharges to surface waters should not utilize more that 30% of the assimilative capacity of the receiving waterbody when discharged via a diffused outfall or more than 10% of the assimilative capacity when discharged via a point source outfall.

For the purposes of determining the available assimilative capacity of a waterbody, a flow rate equal to or less than the average seven day low flow which occurs every 10 years at the outfall area should be used. It is intended that these objectives be applied during the design phase of projects involving effluent discharges.

Second, guidelines for effluent mixing zones (i.e., IDZs) have been established to support water management in the province. A mixing zone is a region within a waterbody in which an effluent discharge of quality characteristics different from

those of the receiving water is discharged. The effluent is considered to be progressively assimilated from the discharge location to the outer limits of the mixing zone. Portions of the mixing zone may be considered to be limit use zones with respect to water uses and, hence, not all water uses are necessarily protected within the mixing zone. However, the WQOs apply at the edge of the mixing zone. The Department has established a total of 14 guidelines for effluent mixing zones, as follows (SEPS 1997):

- The mixing zone should be as small as practicable and should not be of such size or shape as to cause or contribute to the impairment of existing or likely water uses;
- The existing General Objectives for Effluent Discharges (Section 3; SEPS 1997) should be achieved at all sites within the limited use zone;
- The limited use zone in streams and rivers should be apportioned no more than 25 percent of the cross-sectional area or volume of flow, nor more than one-third of the river width at any transect in the receiving water during all flow regimes which equal or exceed the 7Q10 flow for the area. Surface WQOs applicable to the area must be achieved at all points along a transect at a distance downstream of the effluent outfall to be determined on a case-by-case basis;
- In lakes and other surface impoundments, surface WQOs applicable to that waterbody must be achieved at all points beyond a radius of 100 metres from the effluent outfall. The volume of limited use zones in lakes should not exceed 10 percent of that part of the receiving waters available for mixing;
- The mixing zone should be designed to allow an adequate zone of passage for the movement or drift of all stages of aquatic life; specific portions of a cross-section of flow or volume may be arbitrarily allocated for this purpose;

- Mixing zones should not interfere with the migratory routes, natural movements, survival, reproduction, growth, or increase the vulnerability to predation, of any representative aquatic species, or endangered species;
- Mixing zones should not interfere with fish spawning and nursery areas;
- When two or more mixing zones are in close proximity, they should be so defined that a continuous passageway for aquatic life is available;
- When two or more mixing zones overlap the combination of the effluent plumes should not result in unacceptable synergistic or antagonistic effects on aquatic life or other water uses downstream of the mixing zone(s);
- Mixing zones should not cause an irreversible organism response or attract fish or other organisms and thereby increase their exposure period within the zone;
- The 96 hr lethal dose affecting 50% of the population (LC_{50}) toxicity criteria, for indigenous fish species and other important aquatic species should not be exceeded at any point in the mixing zones;
- Mixing zones should not result in contamination of natural sediments so as to cause or contribute to excursions of the WQOs outside the mixing zone;
- Mixing zones should not intersect domestic water supply intakes, bathing areas or other sensitive designated use areas; and,
- Specific numerical WQOs may be established by the Department for such variables or constituents thought to be of significance within the effluent mixing zone.

The SEPS (1997) has also established procedures for deriving EQC for wastewater discharges. These procedures are briefly described in Appendix 5.

Overall, the framework developed for use in Saskatchewan is well considered and scientifically defensible. The general and use-specific WQOs have been established on an *a priori* basis and require only minimal quantities of water quality data to adapt them to the waterbody under consideration. Importantly, guidelines for establishing the size and characteristics of mixing zones have been established. Furthermore, the general objectives for waters in the vicinity of effluent discharges have been explicitly identified, along with procedures for deriving numerical EQC. Accordingly, this framework provides proponents with clearly defined expectations regarding the quality of effluent that can be discharged into the environment, while retaining the flexibility to accommodate variability in water quality and water quality requirements at the site-specific level.

4.2 Water Quality Management in the United States

The following information on water management in the U.S. was abstracted from USEPA (2006). Passage of the Water Pollution Control Act (WPCA) in 1948 represented one of the first steps toward effective water quality management in the United States. The WPCA focussed almost exclusively on human health (rather than environmental protection) and provided funds to state and local governments for water pollution control. However, federal goals, objectives, limits, or guidelines were not established under the WPCA. In response to increasing degradation of surface water resources, Congress passed several laws to strengthen the federal role in water pollution control between 1956 and 1966, including WPCA Amendments of 1956 and WPCA Amendments of 1961.

In 1965, the Water Quality Act (WQA) was passed by Congress, requiring the States to develop water quality standards (WQS) for interstate waters by 1967. The WQA also called on the States to develop waste load allocations to quantify pollutant loadings that could be discharged into receiving waters without exceeding the WQS.

Despite increasing public concern and increased public spending, only about half of the States had developed such WQS by 1971.

The United States Environmental Protection Agency (USEPA) was formed in 1970. This new agency was mandated to enforce environmental compliance and to consolidate federal pollution control activities. A new permitting program to control water pollution was also established at this time under the Rivers and Harbors Act (RHA; i.e., the Refuse Act Permit Program; RAPP). Because effluent limits were determined on a more or less arbitrary basis under the RAPP, the program was struck down by a decision of the Federal District Court of Ohio in 1971. Nevertheless, the concept of a national permit control program was supported by Congress and codified in the Federal WPCA Amendments of 1972.

Establishment of the National Pollution Discharge Elimination System (NPDES) program marked a distinct change in the water pollution control philosophy pursued in the U.S. While the new program maintained the requirements for water quality-based controls, equal emphasis was placed on technology-based pollution control strategies . The NPDES program was based on four important principles, including:

- The discharge of pollutants to navigable waters is not a right;
- A discharge permit is required to use public resources for waste disposal and limits the amount of pollutants that may be discharged;
- Wastewater must be treated with the best treatment technology economically achievable, regardless of the condition of the receiving water; and,
- Effluent limits must be based on treatment technology performance, but more stringent limits may be imposed if the technology-based limits do not prevent violations of WQS in the receiving water.

The NPDES permitting process begins when a proponent submits an application for a permit. After receiving the application and making a decision to proceed with the

permit, a permit writer reviews the application for completeness and accuracy. Subsequently, the process of drafting the permit and developing the justification for the permit conditions is initiated.

Development of effluent limits represents the most challenging and time-consuming part of the permit drafting process. Under the NPDES program, effluent limits must be based on applicable technology-based and water quality-based standards. The first major step in this process involves establishing the technology-based effluent limits. In the first round of the NPDES permits (issued between 1973 and 1976), industrial facilities were required to meet two technology-based standards, including best practicable control technology currently available (BPT) and best available technology economically achievable (BAT). The USEPA defined BPT as the average of the best existing performance by well-operated plants within each industrial category. By comparison, BAT was defined as the performance associated with the best control and treatment measures that have been, or are capable of being, achieved. In addition, USEPA established new source performance standards (NSPS) as more restrictive requirements for new facilities that began construction following the promulgation of the proposed NSPS. The intent of the NSPS was to set the most stringent limits based on the performance of the BAT because new sources have the opportunity to install state-of-the-art treatment systems at the time of start-up. The 1997 amendments to the Clean Water Act (CWA) established technology-based standards for 126 toxic and non-conventional pollutants (i.e., BAT) and defined the best conventional pollutant control technology for conventional pollutants (i.e., BCT). The effluent limits that correspond to BAT and BCT are specified in the national effluent limit guidelines.

In the second step of the effluent limit development process, water quality-based effluent limits are derived. The water quality-based effluents limits are derived using the applicable State WQS (i.e., for the waterbody and COPCs under consideration), in conjunction with information on the dilution capacity within the IDZ. The State WQS are usually based on USEPA's national recommended water quality criteria (WQC; USEPA 2002); however, some states have established more restrictive

standards to provide a higher level of protection for certain waterbodies. Such WQC have been developed for several water uses, including freshwater aquatic life, saltwater aquatic life, human health, and nutrients. States generally establish WQS for each waterbody in their jurisdiction, based on the designated water uses that have been established and the level of protection that is to be afforded each of those water uses. Guidelines have also been established for deriving numerical aquatic site-specific WQC for modifying the national criteria (USEPA 1984).

The water quality-based effluent limits are intended to define the concentration of each COPC that must not be exceeded to prevent against aquatic toxicity (i.e., to protect against discharging toxic substances in toxic amounts). The water quality-based effluent limits are generally calculated using information on the flow of the receiving water system, the flow of the effluent discharge, the WQS, and the BKGD. Following their derivation, the water quality-based effluent limits are compared to the technology-based effluent limits, and the more stringent of the two are incorporated into the draft permit. In addition to the numerical effluent limits, narratives are often included in the permit to further define the requirements that must be met in the permit (e.g., relative to acute toxicity, etc.).

Following the development of effluent limits, the appropriate monitoring and reporting requirements, facility-specific special conditions, and standard conditions are incorporated into the draft permit. The permitting authority then provides the public with an opportunity to comment on the draft permit and these comments are used to finalize the permit. Careful attention is paid to documenting the procedures that were used and the decisions that were made during the permit preparation process (i.e., for the administrative record). The permit is then issued to the facility. Appendix 6 describes the key components of the NPDES permit that is issued to the facility.

Under the CWA, USEPA is authorized to implement the NPDES program directly. However, USEPA may authorize States, Territories, or Native American Tribes to implement all or part of the national program within their geographic region. In most

States and Territories, authority for issuing NPDES permits has been delegated to the appropriate State or Territorial agency. However, USEPA commonly administers other elements of the NPDES program, such as permitting of federal facilities, administering the National Pretreatment Program, and/or administering the Municipal Sewage Sludge Program. In all cases, USEPA retains the authority to review each permit that is issued and identify conditions that conflict with federal requirements. If the authorized agency fails to adequately address the points of objection, USEPA will issue the permit itself. Once issued, NPDES permits are enforceable by the approved federal, state, territorial, and tribal agencies, and by private citizens in federal court.

Recently, USEPA developed an initiative to further integrate the NPDES program into the concept of watershed planning. The goal of this initiative is to transition away from source-by-source permitting and promote community-based waster resource management. Under this new initiative, USEPA is exploring models for a watershed permitting program that effectively integrates watershed planning at the local level with appropriate management options for meeting watershed goals and CWA requirements (e.g., issuing a small number of watershed permits to replace a larger number of individual permits). While not fully developed, implementation of such watershed permitting approaches could enable regulatory agencies, regulated interests, and non-regulated sources to meet otherwise unattainable watershed objectives with potential cost savings relative to source-by-source permitting.

Overall, the water quality management framework used in the U.S. is well-considered and scientifically defensible. Development of national WQC establishes minimum standards for water quality that must be met in every waterbody in the country. In addition, establishment of procedures for deriving site-specific WQC provides a basis for generating greater certainty in the applicability of the tools that are used to establish effluent limits in the permit. Furthermore, the extensive research that USEPA has done on BAT provides permit writers with some of the best information available on the concentrations of COPCs and/or removal efficiency for various treatment technologies. Accordingly, this framework provides proponents with

clearly defined expectations regarding the quality of effluent that can be discharged into the environment, while retaining the flexibility to accommodate variability in water quality and water quality requirements at the site-specific level.

4.3 Observations on Approaches to Water Quality Management in Other Jurisdictions

As part of this investigation, the approaches to water management that are currently being used in various North American jurisdictions were reviewed and evaluated. Preliminary reviews of water management frameworks were conducted for several jurisdictions in Canada and the United States, including British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Indiana, Pennsylvania, New Jersey, Alabama, Florida, and Louisiana. From these, two representative case studies were selected to highlight the elements of these frameworks that may be applicable to the north. The results of this review indicated the following:

- Each of the jurisdictions examined have established a framework for managing water quality conditions that can be consistently applied to meet its policy goals;
- The water management framework that has been established for each jurisdiction is well defined to ensure that decisions can be made in a consistent and transparent manner;
- Most of the jurisdictions have established ambient WQOs or water quality standards that must be met in receiving water systems outside the IDZs and/or have established procedures for developing such WQOs. In general, such WQOs and WQS are based on generic WQGs (or WQC) and on information on baseline water quality conditions in receiving waters. A non-degradation policy has been established by the Canadian federal

government to protect waters of superior quality to ensure that the Canadian WQGs are not used as "pollute up to" numbers;

- Most of the jurisdictions have adopted the concept of establishing IDZs, within which certain conditions must be met and which allows effluents to mix with receiving water bodies. The guidelines for IDZs often represent a key element of the overall water quality management for a jurisdiction;
- All of the jurisdictions have established a permitting process which provides regulators with a means of establishing terms and conditions on discharges of wastewaters and related activities that can be used to ensure that policy goals are met relative to receiving water quality;
- Numerical EQC represent the primary tool that is used by North American jurisdictions to protect and conserve the quality of receiving waters;
- In general, EQC are derived by considering requirements for protecting the designated water uses and what can be achieved using BATT; and,
- Many of the jurisdictions have established procedures for deriving EQC that can be applied consistently for discharges to rivers, lakes, estuaries or the open ocean. In some cases, industry-specific regulations define the EQC that must be achieved by a facility.

Together, these observations provide relevant information for refining the water management framework that is being used in the north to provide greater certainty and transparency in the process (see Appendix 7). More information on the tools that are being used in various jurisdictions to support water management is provided in Chapter 5.

Chapter 5 Tools Available to Support the Management of Water Quality Conditions

5.0 Introduction

Jurisdictions throughout North America have developed an array of tools to support the management of water resources. This chapter of the discussion paper describes the ***key tools*** that have been used by the MVRMA boards and/or in other jurisdictions to manage discharges of wastewaters to receiving water systems. The advantages and limitations of each of these tools are also be briefly discussed.

5.1 Legislative Tools

In the NWT, a number of legislative tools have been established to support the management of water resources. The NTWA and the MVRMA represent two of the most important from a water licensing perspective. Importantly, the NTWA includes provisions for developing water quality standards and effluent standards in relation to any waters of the NWT. Such standards, if developed, could play a central role in the overall water quality management process. The other legislative tool that provides guidance on the management of water quality conditions is the Fisheries Act. Other federal legislation (e.g., Canadian Environmental Protection Act; CEPA) also bears consideration in the refinement of the existing water quality management system for the NWT, as they may be relevant to the decisions that are ultimately made regarding the management of renewable and non-renewable resources.

5.2 Regulatory Tools

There are a number of existing and potential regulatory tools that could be used to establish standards for water, thereby providing MVRMA boards with a consistent basis for managing water quality conditions in the NWT. First, the federal government has established regulations that apply to specific industry sectors. For example, regulations have been promulgated under the Fisheries Act that limit wastewater or effluent discharges from certain industrial facilities, including metal mines, pulp and paper mills, petroleum refineries, and meat and poultry processing plants. These tools should be applied, as appropriate, within the water management framework for northern Canada. Furthermore the Municipal Wastewater Effluent Regulation will also provide relevant guidance for managing water resources in the north. Because they are associated with federal statutes, all of the federal regulations could and should be applied, as appropriate, by the MVRMA boards. However, care should be taken to ensure that the regulations are not used inappropriately (i.e., applying MMER to diamond mines for example).

The regulations for effluent discharge that have been developed in other jurisdictions may also be relevant to the MVRMA boards as tools for managing water quality conditions. While no attempt has been made to conduct a thorough review of other Canadian or U.S. jurisdictions to identify potentially relevant regulations, it is noted that virtually all of the provinces have established regulations that limit discharges of effluent from one or more classes of industrial facilities or municipal wastewater treatment plants. If establishment of uniform or industry-specific effluent standards was identified as a preferred option for MVRMA boards, then a comprehensive review of existing federal, provincial, and territorial regulations should be undertaken to support the development of such standards.

5.3 Policy-Based Management Tools

Development of a Mackenzie Valley Water Management Policy could yield one of the most effective tools for ensuring consistency in decisions regarding the management of water resources in the north. Such a policy, if developed by the MVRMA boards and INAC, could be based on a shared long-term vision for the future, which would be developed in consultation with First Nations, regulated interests, government agencies, non-governmental organizations, and the public (see Appendix 8 for additional information on interests and needs related water management in the north). Accordingly, such a policy would encompass the interests and needs that are articulated by participants in the water management process.

5.4 Other Water Management Tools

In addition to the legislative, regulatory, and policy-based tools that were identified previously, a number of other tools are available to support effect water management in the Mackenzie Valley. Some of the key tools that can and should be integrated into the existing water management framework include:

- *Terms and conditions of historic and active water licences* - The NTWB and MVLWB (including its regional panels) have issued a substantial number of WLs to support non-renewable resource development in the Mackenzie Valley. In many ways, the terms and conditions of the WLs define the management approach that has been applied to northern waters to date. Accordingly, these terms and conditions provide relevant tools for informing the development of WQOs and EQC for existing and new projects in the Mackenzie Valley;
- *Best management practices* - Best management practices include any program, process, siting criteria, operating methods, measure, or device that controls, prevents, removes, or reduces pollution. While EQC provide

a basis for defining the characteristics of effluent discharges needed to protect aquatic ecosystems and associated water uses, the extent to which the EQC are met depends on the environmental management and wastewater treatment systems that are ultimately used by the project proponent. As such, effective use of best management practices is of fundamental importance for meeting the ecosystem goals, ecosystem health objectives, and WQOs that are established for watersheds in the Mackenzie Valley. Considering their importance, the federal government should consider cooperating with industry and others to better define best management practices relative to activities that have the potential to release COPCs into the environment (e.g., blasting, etc.);

- *Adaptive management strategies* - Selecting the best possible environmental management strategy is extremely important, yet it can be a complex and difficult problem due to limitations on our knowledge of the ecosystem and how human activities can adversely affect it. Adaptive management acknowledges this uncertainty at the outset and seeks to minimize this uncertainty by learning about the system being managed. The basic process involves selecting an action, monitoring the effect of that action, and adjusting the action based on the monitoring results. The concept of adaptive management has been integrated, to a certain extent, into the current water licensing process; however, more guidance is needed on how the results of monitoring conducted at or in the vicinity of facilities are to be used to improve environmental management at the site. The federal government should cooperate with the MVRMA boards to develop guidance for adaptive management that could be applied to water management in the Mackenzie Valley;
- *Stakeholder involvement and community consultation* - Consultation with stakeholders is of fundamental importance under the MVRMA. However, effective participation in the environmental assessment and water licensing processes currently requires substantial stakeholder resources. In some cases, stakeholder participation is being used by project proponents and the

MVRMA boards as a substitute for provision of the requisite guidance on key issues (e.g., design and evaluation of the DDMI AEMP) by the federal government and/or the MVRMA boards. If clear and effective guidelines (as described herein) are developed and approved by stakeholders and communities, the need for case-by-case public consultation would be greatly reduced. Therefore, the federal government and the MVRMA boards should cooperate in the development of a stakeholder involvement and community consultation strategy that provides stakeholders with meaningful input on key environmental assessment and water licensing issues, without overwhelming their capacity to participate. Such a strategy should involve the development of guidelines to support various aspects of water management;

- *Land use management plans* - Under the MVRMA, a number of boards have been established to develop comprehensive land use plans for their respective settlement areas. These land use plans guide the use of lands within each settlement area and provide direction on the conservation, development, and use of land, waters, and other resources. Hence, these land use management plans should continue to be a focal point of the overall water management framework in the Mackenzie Valley;
- *Water use designation* - Identifying the water uses that apply to waterbodies in the Mackenzie Valley represents an important component of the framework for managing water quality. It is anticipated that the land use plans for the various settlement areas will provide relevant information for designating water uses. Nevertheless, the water uses that will be considered in the water management process should be explicitly identified in the water management policy. For individual waterbodies, stakeholder consultation should be used to confirm the designated water uses that are identified;
- *Canadian water quality guidelines* - Development of numerical WQOs has been identified as a central element of the overall water management framework for the north. Development of such WQOs requires

information on the characteristics of water needed to support various water uses. Accordingly, WQGs and related tools are needed to support WQO development. Currently, the Canadian WQGs (CCME 1999; 2002), provincial WQGs and WQOs, and ambient WQC (USEPA 2002) provide the most relevant and readily-accessible sources of such information. However, other sources of such information are also available in the literature (e.g., AMEC 2001; MacDonald *et al.* 1999);

- *Procedures for deriving site-specific WQOs* - The Canadian WQGs provide relevant tools for establishing WQOs for receiving water systems. However, procedures for translating these WQGs into site-specific WQOs are needed to maintain consistency in the WQO-development process. Therefore, the federal government and the MVRMA boards should undertake to establish guidelines for deriving site-specific WQOs in the near-term. Such guidelines should be consistent with those established previously by the CCME and other Canadian jurisdictions;
- *Guidelines for initial dilution zones* - As IDZs are likely to be integrated into the framework for managing water quality in the north, development of guidelines for IDZs represents an important near-term priority. Such guidelines already exist in certain other Canadian jurisdictions (e.g., SEPS 1997) and can be used as a basis for developing such guidelines for the Mackenzie Valley. The guidelines should specify the procedures for determining the extent of IDZs and the general provisions that need to met within the IDZs;
- *BAT* - Information on the concentrations of COPCs that can be achieved in treated wastewater is essential to the EQC development process. While the responsibility of compiling and evaluating information on the efficacy of the various treatment technologies that could be used at a facility is primarily the responsibility of the project proponent, the federal government and the MVRMA should continue to cooperate in the development and periodic update of guidelines for discharge of wastewaters from various types of facilities (e.g., NTWB 1981; 1992). In

addition, relevant information on BAT should be made accessible to proponents when the federal government or MVRMA board have compiled relevant information on this topic (e.g., INAC 2003). Information compiled by other jurisdictions should also be accessed to help define BAT for various types of developments (e.g., USEPA's BPT, BAT, NSPS, etc.);

- *Effluent dispersion modelling* - Development of EQC using the non-degradation approach or the use-protection approach requires information on the extent to which wastewater discharges will be diluted within IDZs. While simple mass-balance calculations can be used under some circumstances to estimate minimum dilution factors (MDFs), more complicated effluent dispersion modelling is required in many others (i.e., in lake systems). Whenever possible, publically-available computer models (e.g, USEPA's CoreMix model) should be used to estimate MDFs within IDZ to maintain transparency in the EQC derivation process;
- *Procedures for calculation of effluent quality criteria* - Numerical EQC criteria represent a key tool for managing discharges of toxic and bioaccumulative substances into the environment. Because project proponents need to understand the requirements for effluent discharges, the federal government and the MVRMA boards should cooperate in the development of guidelines for deriving numerical EQC;
- *Effluent quality monitoring* - Effluent quality monitoring provides the information needed to determine if the characteristics of effluents discharged to the environment meet the EQC established in WLs. Therefore, effluent quality monitoring represents a key component of the overall water management framework. The Surveillance Network Programs that are developed as a condition of water licensing represents the primary mechanism for obtaining the requisite information. The MVRMA boards have established such monitoring requirements on a case-by-case basis and this approach has generally been effective;
- *Aquatic effects monitoring* - Aquatic effects monitoring is intended to provide the information needed to assess project-related impacts and

determine if specific measures are needed to mitigate such effects. Accordingly, aquatic effects monitoring represents an important element of an adaptive management system that is used at a facility to continuously improve environmental management. Due to the importance of aquatic effects monitoring and the current lack of guidelines for designing and implementing AEMPs, the federal government and the MVRNA boards should cooperate in the development of guidelines for aquatic effects monitoring. Considering the difficulties that have been experienced by certain licencees (i.e., DDMI) in this respect, this should be identified as a high near-term priority; and,

- *Cumulative effects assessment* - Currently, environmental assessment and water licensing conducted under the MVRMA is being conducted on a project-by-project basis. While this approach generally meets the near-term requirements identified by project proponents, it does not provide an effective basis for assuring the decisions regarding multiple projects within a watershed or a region do not have unanticipated cumulative effects. For this reason, it is recommended that the federal government and the MVRMA boards cooperate in the development of a strategy for managing water resources that effectively considers and mitigates the potential for unacceptable cumulative effects. One element of such a strategy involves determining the assimilative capacity of receiving waters on *a priori* basis (i.e., during the environmental assessment phase) and ensuring that only a percentage of this assimilative capacity is allocated to individual effluent dischargers (i.e., as is done in other North American jurisdictions; e.g., SEPS 1997).

The current review was not intended to identify and describe all of the tools that could be incorporated into a water management framework for the Mackenzie Valley. Rather, it was intended to identify some of the key tools that could be applied in northern water management and identify specific recommendations that could be pursued by the federal government, in collaboration with the MVRMA boards.

Nevertheless, the results of this evaluation indicate that substantially more effort will be required to provide the boards with the tools that they need to assure the long-term sustainability of water resources in the Mackenzie Valley.

Chapter 6 Options for Managing Water Quality Conditions in the North

6.0 Introduction

In its recommendations to INAC, the OAG indicated that, in order to establish regulations for water use in the NWT, the federal government should develop standards for water and direct the MVRMA boards to use the resultant standards. While this recommendation represents one viable option for providing project proponents with greater certainty relative to the requirements that must be met to have their applications approved, there are several other options that ought to be considered to support integrated water management in the north. This chapter describes several options that could be pursued to facilitate non-renewable resource development, while providing the necessary level of protection for sensitive northern ecosystems. These options include:

- Establishing water quality standards that apply to northern waters (e.g., adopting Canadian WQGs as water quality standards or developing site-specific WQOs);
- Setting uniform EQC that apply to all development projects or industry-specific EQC (e.g., metal mining effluent regulations; MMERs); and,
- Establishing a framework for deriving and application of project-specific EQC.

The advantages and disadvantages of each of these options are briefly discussed in the following sections of this document.

6.1 Establishment of Water Quality Standards

In the United States, under the provisions of the CWA, each of the States, Territories, and/or Tribes are required to establish water quality standards for the surface waters within their jurisdiction. Such water quality standards must be, at minimum, as stringent as ambient water quality criteria that have been promulgated by the USEPA. However, the authorized jurisdictions may establish water quality standards that are more stringent than those represented by the ambient water quality criteria.

This model represents one option for providing proponents with greater certainty in the water licensing process. That is, implementation of blanket water quality standards or waterbody-specific standards could be established that would provide proponents with a clear understanding of the water quality conditions that must be met outside the IDZ for their project. Establishment of such water quality standards or water-body specific WQOs, would require designation of water uses in receiving water systems, identification of the concentrations of COPCs that would be protective of each designated water use (i.e., using Canadian WQG and/or similar tools) and determination of baseline water quality conditions. Integration of such information would provide a means of establishing water quality standards that would prevent degradation of surface waters or protect the designated uses of northern waters. Such standards could then be used, in conjunction with information on MDFs within the IDZ and other site specific information, to determine the concentrations of COPCs that must not be exceeded in effluent for a facility to ensure that the standards are met.

The principal benefit of this approach is that it would provide water managers in the north with a tool for defining minimum standards for the quality of receiving water systems. Accordingly, the MVRMA boards could apply these standards in the assessment and licensing of non-renewable resource development projects within their jurisdiction. In water licensing, the boards could use such water standards, along with other relevant information, to develop EQC that would protect all possible downstream water uses or prevent degradation of surface waters. Hence, the boards

could direct a greater proportion of their limited resources to developing appropriate EQC, rather than focussing on the development of WQOs or WQS for receiving water systems. Currently, the MVRMA boards are using the Canadian WQGs in much the same way that uniform water standards would be used to derive EQC.

While the water quality standards approach has a number of advantages, it also has a number of disadvantages that influence it potential applications in the north. First, waters within the Mackenzie Valley exhibit a great deal of variability in terms of water quality conditions, both on temporal and spatial bases. Accordingly, it may be difficult to establish a single set of water quality standards that apply uniformly across all waterbodies (i.e., Lac de Gras vs. Mackenzie River) and/or within a single waterbody at all times of the year (i.e., during freshet, low flow conditions, under ice, etc.). In addition, the concentrations of various COPCs that are protective of designated water uses (e.g., fish and aquatic life) are dependent on ambient water quality conditions. For example, the toxicity of many metals is dependent on water hardness. Likewise, the toxicity of ammonia is dependent on temperature and pH. Furthermore, different waterbodies can have different water uses, which means that uniform water standards would need to be set at levels protective of the most sensitive water use in the region. This could unnecessarily restrict development of non-renewable resources under certain circumstances.

The above challenges make it difficult to establish a single set of water quality standards that would apply to all waterbodies. While these limitations could be overcome by establishing site-specific water quality standards for all of the watersheds within the Mackenzie Valley on an *a priori* basis, it is unlikely that the data and resources required to do so would be readily available to INAC, without adversely affecting other program priorities and would not likely assist the water management process substantively. Therefore, the concept of establishing blanket or water-body-specific water quality standards throughout the Mackenzie Valley is not recommended in the near-term. Nevertheless, the CCME has developed Canadian WQGs that are intended to define the concentrations of COPCs and other water quality variables needed to protect water uses. In addition, the CCME supports the

development of site-specific WQOs and has developed a process to guide the derivation of such WQOs (MacDonald 1997; MESL 2002). The MVRMA boards and their predecessors have used these WQGs to develop site-specific WQOs that consider background water quality conditions, the factors that influence the toxicity of COPCs, and the uses of water within the watershed under consideration. These WQGs and those that have been developed by other jurisdictions represent powerful tools for managing water quality conditions and should continue to be used by MVRMA boards. Moreover, the approach that has been used by the MVRMA is cost-effective and efficient. It could be improved by establishing guidelines that describe the recommended methods for deriving WQOs (see Appendix 4 for more information).

6.2 Establishment of Uniform or Industry-Specific Effluent Quality Criteria

Another water management option for providing proponents with greater certainty in the water licensing process is to establish uniform or industry-specific EQC that could be incorporated directly into all WLs. This option could be pursued in the near-term by compiling all of the industry-specific regulations that have been established to date in other jurisdictions (e.g., MMERs, established by the Canadian government under the Fisheries Act). In addition, information could be compiled on the effluent limits that have been established for various discharges and/or industries in other jurisdictions. Furthermore, information on the concentrations of COPCs in effluent discharges that can be achieved through implementation of best available treatment technologies could be assembled from the literature and other sources (Note the USEPA's BPT, and NSPS represent useful resources in this process). Together, this information could be used to establish uniform or industry-specific standards for effluent quality that must be met by anyone applying for a WL.

One of the main benefits of this option is that it would provide proponents with a clear understanding of the maximum and/or average concentrations of each COPC that could be discharged to the environment from a facility. This information would be useful to proponents who are assessing the viability of a project by providing a better understanding of the wastewater treatment that would be required to meet the EQC and the associated costs of implementing that technology. This option could also be attractive to the MVRMA boards, as it would greatly reduce the level of effort required to establish EQC for individual projects, where such criteria exist.

While the concept of developing uniform or industry-specific effluent quality standards is appealing, there are a number of disadvantages that ought to be considered prior to pursuing this option. First, it is unlikely that effluent quality standards could be developed that apply uniformly to the various types of non-renewable resource developmental activities that occur within the Mackenzie Valley. Differences in the COPCs that are relevant, the concentrations of COPCs in wastewaters, volumes of water requiring treatment, treatment technologies that could be used, and other factors are likely to render the concept of establishing uniform effluent quality standards untenable. Environment Canada and its partners have addressed this challenge by developing effluent quality standards for a limited number of industries (e.g., metal mining, pulp and paper, poultry processing). While the MMERs are already being used in the licensing process in the NWT, industry-specific effluent quality standards have not been established for several key types of developmental activities in the north (e.g., diamond mining, quarrying, oil and gas development, municipal developments, etc.). Therefore, substantial time and resources would need to be dedicated to the collection, collation, and evaluation of the information needed to set industry-specific effluent quality standards for the Mackenzie Valley. As evidenced by the MMERs, which required nearly 10 years to develop, establishment of such standards is not a trivial exercise. Furthermore, application of uniform or industry-specific effluent quality standards would not provide a basis for ensuring that water uses are adequately protected or that water quality conditions are not being unnecessarily degraded within specific watersheds. Therefore, development of uniform or industry-specific effluent quality standards is

not recommended in the near-term. However, INAC and the boards should continue to support broader efforts directed at establishing regulations for additional industry sectors (e.g., municipal wastwater effluent regulations, etc.).

6.3 Development of a Framework for Establishing Project-Specific Effluent Quality Criteria

While establishing water quality standards or industry-specific regulations represent two viable options for managing water quality in the north, a better approach involves development of a consistent framework that the MVRMA boards can use to establish EQC for development projects. Such a framework is described in detail in Appendix 7. The following provides an overview of the procedures that can be used to established EQC.

Our review of the WLs that have been issued by the NTWB and the MVRMA boards indicates that a variety of methods and procedures have been used to derive EQC. The results of this review also indicated that the procedures that were used to derive the EQC were only rarely described in sufficient detail to enable informed readers to fully understand and replicate the process. While the EQC that have been incorporated into the various WLs that were reviewed may well be reasonable, internally consistent, and scientifically defensible, the lack of appropriate documentation makes it difficult for prospective applicants to clearly understand the requirements for effluent discharges that are likely to be applicable to their project. This is a significant source of uncertainty in the water licensing process and one that must be addressed in a water management framework for the north.

Based on the results of our review of the procedures that have been used in other jurisdictions and our experience in this field, it is recommended that the federal government, in consultation with the MVRMA boards, establish a formal procedure for deriving EQC that can be applied consistently to development projects throughout

the Mackenzie Valley. More specifically, a multi-stepped approach to the development of EQC is recommended (Figure 1). The first step of this process involves the establishment of ambient WQOs that would protect the designated uses of the receiving water system under consideration. Again, ambient WQOs may be established using the non-degradation or use-protection approach, depending on the long-term ecosystem goals and objectives that have been established for the watershed (see Appendix 4 for more information).

The next step in the EQC derivation process involves estimation of MDFs for each wastewater source for the proposed facility under consideration. Determination of MDFs requires information on the location of proposed wastewater discharges, the dimensions of the IDZ, the rate of the wastewater discharge, and various physical and chemical data for the wastewater and the receiving water. Effluent dispersion modelling or mass balance modelling is used, to estimate MDFs for each wastewater source.

Subsequently, numerical EQC can be derived by back-calculating from the WQOs using the most appropriate DFs and information on background concentrations of the variables of concern (BCs). The following equation is used to develop these effects-based EQC (also, see Appendix 5):

$$EQC = (WQO - BC) \times DF$$

The effects-based EQC provide a basis for defining the characteristics of the effluent that are required to protect the designated uses and/or relatively pristine nature of the receiving water system.

In addition to the effects-based EQC, it is also useful to determine treatment technology-based EQC for the project. For metal mining, the MMERs represent the most relevant source of treatment technology-based EQC. For pulp and paper mills, the pulp and paper effluent regulations should be consulted to establish treatment technology-based EQC. BAT for sewage treatment in the north (INAC 2003)

represents a useful source of information for defining technology-based EQC. For industries for which specific effluent regulations have not established, the concentrations of COPCs that are considered to be achievable through the implementation of BATT can be determined by reviewing the information contained in the published literature or various reviews of the literature sources.

In the final step of the EQC derivation process, the water quality-based EQC are compared to the treatment technology-based EQC. The lower of the two values would be adopted as the EQC for each COPC. Adoption of such an approach to EQC derivation would provide project proponents with the certainty that they need regarding the requirements for wastewater discharge that they need to meet. At the same time, adoption of consistent procedures for deriving EQC will provide stakeholders with the certainty that they need relative to the protection of designated water uses and the pristine nature of northern ecosystems.

The principal advantage of establishing clearly defined procedures for deriving the EQCs is that everyone involved in the regulation and management of development projects would be able to determine the standards that would need to be met by a project proponent. In addition, it would simplify the water licensing process because the MVRMA boards would not need to appoint a TAC to recommend EQC. Accordingly, the resources required by regulators and interveners to participate in the water licensing process would be reduced. Moreover, project proponents would have a clear understanding of the work that they need to complete to support EQC development. This would help streamline the baseline data collection process.

The main limitation of this type of framework is that it does not provide project proponents, on an *a priori* basis, with the information on the specific conditions that they need to meet to proceed with a developmental proposal. Rather, it defines the process that will be used to evaluate the suitability of a project for siting within a watershed and for determining the water quality conditions that must be maintained outside the IDZ. When used together with information on the nature of the development, the likely characteristics of wastewaters from the site, and ambient

environmental quality conditions, proponents are likely to be able to assess the potential impacts of the project and to determine the level of treatment required to mitigate those impacts. Additionally, the costs associated with collecting baseline environmental quality data, conducting the environmental assessment, deriving environmental quality objectives (EQO), and for determining effluent quality requirements would be borne by the project proponent (i.e., instead of the government, other stakeholders, and the proponent, as is currently the case). This latter limitation could be viewed as a benefit by many participants in the environmental assessment and water licensing process, however. Nevertheless, the MVRMA boards, regulators, and others would still need to commit resources to carefully review the EQC and related information submitted by project proponents.

It is important to note that derivation of scientifically-defensible EQC represents only one element of an effective water management approach. To assist INAC and the MVRMA Boards, a recommended framework for water management in northen Canada has been developed (Appendix 7). This framework identifies and describes the key elements of the water quality management process. In addition, recommendations to expedite perusal of this option are offered.

Chapter 7 Summary and Recommendations

7.0 Introduction

Recently, the OAG conducted an audit of INAC relative to the development of non-renewable resources in the NWT. The results of this audit indicated that the existing framework for managing water resources does not provide project proponents with sufficient clarity regarding the water quality standards that must be met to mitigate project impacts. This limitation of the framework was considered by the OAG to render the investment climate for non-renewable resource development uncertain. Accordingly, the OAG recommended that INAC establish regulations for water use and waste disposal in the NWT. In this way, applicants for licences or permits would be provided with the information needed to understand the standards for water that they need to meet to have their applications approved. This report was prepared to assist INAC in addressing the concerns raised by the OAG.

7.1 Summary

This study was conducted to evaluate the need for water standards for the Mackenzie Valley and identify options for managing water quality conditions that would meet the needs of northern residents and project proponents. To obtain the information needed to meet these study objectives, the current approach to water management in the Mackenzie Valley was reviewed, including the procedures that have been used in the NTWA and the Mackenzie Valley Resource Management Act (MVRMA; Chapter 2). In addition, the key findings of the OAG were reviewed (Chapter 2). Subsequently, a number of historic and current WLs were reviewed to select three case studies that would illustrate the approaches that are currently being used to manage water resources in the Mackenzie Valley (Chapter 3).

The approaches that have been used to manage water resources in other North American jurisdictions were also reviewed and evaluated (Chapter 4). The results of this review were used to select two jurisdictions (i.e., Saskatchewan and the United States) that have well-developed and scientifically-defensible water management frameworks that could be used as models for northern water management. The features of the selected frameworks are similar to those that are used in many other North American jurisdictions (i.e., Ontario, British Columbia, U.S. states, etc.). The results of this review, along with the OAG recommendations, were then used to identify a series of tools (Chapter 5) and options (Chapter 6) for managing water quality conditions in northern Canada, including establishment of uniform water quality standards, establishment of uniform or industry-specific EQC, and establishment of a framework for deriving project-specific EQC. Subsequent evaluation of these options indicated that, while any one of them could be applied in the north with sufficient resources, development of a framework for water quality management was more likely to address the concerns identified by the OAG in the near-term.

To be effective, a framework for managing water quality conditions must meet the needs of Mackenzie Valley residents in terms of conserving the pristine nature of northern waters and protecting traditional water uses, while providing project proponents with the certainty that they need to develop and implement a developmental proposal. Ideally, such a framework would provide a means of integrating these interests in a way that supports sustainable development of natural resources in northern Canada, for the benefit of all Canadians. Based on our review of frameworks that have been successfully implemented elsewhere, the key elements of such a framework are:

- Long-term vision for the future;
- Integrated water management policy;
- Ecosystem goals and objectives for major river basins in the region;
- Indicators of ecosystem health and associated metrics;

- Procedures for deriving WQOs;
- Guidelines for characterization of baseline conditions;
- General objectives for effluent discharges;
- Guidelines for establishing and regulating IDZs;
- Procedures for deriving EQC; and,
- Guidelines for aquatic effects monitoring.

Such a framework for managing water quality in northern Canada was described in Appendix 7. Several aspects of this framework (i.e., procedures for developing WQOs, general objectives for effluents, guidelines for establishing and regulating IDZs, and procedures for deriving EQC), if pursued, would respond directly to the OAG (2005) recommendations.

7.2 Recommendations

While many of the elements of such a framework have already been incorporated into the current approach to water management in the north, the federal government and the MVRMA boards will need to collaborate on several important initiatives to develop the tools needed to effective manage water quality conditions in the future. The specific recommendations that emerged from the current investigation included:

- The Reasons for Decision documents that were prepared following issuance of WLs should include more explicit descriptions of how site-specific WQOs, EQC, and related terms and conditions were established;
- Review and summarize existing legislation and regulations applicable to water management in the north. This summary should be presented in a form useful to MVRMA Boards;
- Develop an integrated water management policy for the Mackenzie Valley;

- Define best management practices for key industries that are operating in northern Canada;
- Develop guidance on adaptive management in the north;
- Establish guidelines for developing site-specific WQOs that are consistent with existing federal, provincial, and territorial guidance documents. The Canadian WQGs represent a primary tool for establishing such WQOs and should be used by the MVRMA boards. WQGs from other jurisdictions should be used, with a tiered framework, to supplement the Canadian WQGs;
- Establish guidelines for characterizing baseline conditions for water quality and other ecosystem components (e.g., sediment quality, biological community structure, etc.);
- Establish general objectives for effluent discharges (e.g., related to acute toxicity, etc.). The objectives that have been established in other jurisdictions should be reviewed and evaluated to support the establishment of objectives for use by the MVRMA boards;
- Establish guidelines for defining the size of and regulating IDZs. The guidelines that have been established in other jurisdictions should be reviewed and evaluated to support the establishment of guidelines for use by the MVRMA boards;
- Establish procedures for deriving numerical EQC. The procedures that have been established in other Canadian and U.S. jurisdictions represent relevant models that can be applied in the north;
- Establish guidelines for designing and implementing AEMPs;
- Refine approaches to stakeholder involvement and community consultation in water management in the north; and,
- Develop a strategy for addressing cumulative effects in the water management framework.

While some of the recommended actions have been initiated, others will need to be undertaken in the near-term to provide the MVRMA boards with the tools that they need to effectively manage water resources in the Mackenzie Valley.

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Table 1. Water licences reviewed to evaluate approaches used by the MacKenzie Valley Resource Management Act boards to establish effluent quality criteria.

Applicant	Site	Water Licence	Type	Applicable Period	Status	Responsible Board
Diavik Diamond Mines Inc.	Lac de Gras	N7L2-1645	A	2000-2004	Lapsed	NTWB
Diavik Diamond Mines Inc.	Lac de Gras	N7L2-1645	A	2004-2007	Active	MVLWB
Imperial Oil Resources		S03L1-001	A	2004-2014	Active	SLWB
Town of Inuvik	Inuvik	N3L4-0036	ND	1983-1993	Lapsed	NTWB
Town of Inuvik	Inuvik	N3L4-0036	A	1993-1996	Lapsed	NTWB
Town of Inuvik	Inuvik	N3L3-0036	A	1996-2006	Active	NTWB
DeBeers Canada Mining Inc.	Snap Lake	MV2001L2-0002	A	2004-2012	Active	MVLWB
Canada Tungsten Mining Corporation Ltd.	Prarie Creek/Flat River	N3L3-0004	ND	1975-1978	Lapsed	NTWB
Canada Tungsten Mining Corporation Ltd.	Prarie Creek/Flat River	N3L2-0004	A	1995-2002	Lapsed	NTWB
North American Tungsten Corporation Ltd.	Prarie Creek/Flat River	MV2002L2-0019	A	2003-2008	Active	MVLWB
City of Yellowknife	Yellowknife	N1L4-0032	ND	1977-1982	Lapsed	NTWB
City of Yellowknife	Yellowknife	N1L4-0032	ND	1982-1992	Lapsed	NTWB
City of Yellowknife	Yellowknife	N1L3-0032	A	1995-2001	Lapsed	NTWB
City of Yellowknife	Yellowknife	N1L3-0032	A	2002-2010	Active	MVLWB
Royal Oak Mines Inc.	Colomac Mine	N1L2-1563	A	1995-1999	Lapsed	NTWB
Royal Oak Mines Inc.	Colomac Mine	N1L2-1563	A	1999-2002	Lapsed	NTWB
Contaminated Sites Office - INAC	Colomac Mine	MV2000L2-0018	A	2001-2006	Active	MVLWB
Contaminants and Remediation Directorate, INAC	Colomac Mine	MV2004L8-0001	A	2005-2010	Active	MVLWB

Table 1. Water licences reviewed to evaluate approaches used by the MacKenzie Valley Resource Management Act boards to establish effluent quality criteria.

Applicant	Site	Water Licence	Type	Applicable Period	Status	Responsible Board
Cominco Ltd. - Con Mine	Con Mine	N1L3-0040	ND	1977-1980	Lapsed	NTWB
Cominco Ltd. - Con Mine	Con Mine	N1L3-1187	ND	1983-1988	Expired 1986	NTWB
Cominco Ltd. - Con Mine	Con Mine	N1L3-0040	ND	1986-1990	Lapsed	NTWB
Nerco Con Mine	Con Mine	N1L3-0040	ND	1990-1995	Lapsed	NTWB
Con Exploration Ltd. Miramar Con Mine Ltd.	Con Mine	N1L2-0040	A	1995-2000	Lapsed	NTWB
Miramar Con Mine Ltd.	Con Mine	N1L2-0040	A	2000-2006	Active	NTWB
Miramar Con Mine Ltd.	Con Mine	N1L2-0040	A	2000-2008	Active	NTWB

MVLWB = Mackenzie Valley Land and Water Board; NTWB = Northwest Territories Water Board; SLWB = Sahtu Land and Water Board.

Table 2. Summary of approaches used by various water boards to establish effluent quality criteria in the Northwest Territories.

Applicant	Water Licence	Applicable Period	COPCs	Site-Specific WQOs Derived?	Basis for WQOs	EQCs Derived?	Approach Used	Tools Applied
Diavik Diamond Mines Inc.	N7L2-1645	2000-2004	Ammonia, Total metals (aluminum, arsenic, copper, cadmium, chromium, lead, zinc, nickel), Nitrite, TSS, Turbidity, Total Phosphorus, BOD, Oil and Grease, Faecal coliforms	Yes	CCME WQGs	Yes	UPA/NDA/ BATA	S-S WQOs; IDZ; CCME WQGs
Diavik Diamond Mines Inc.	N7L2-1645*	2004-2007	Same as above, with emphasis on Ammonia	Yes	CCME WQGs	Yes	UPA (for ammonia)	S-S WQOs; IDZ; CCME WQGs
Imperial Oil Resources	S03L1-001	2004-2014	Oil and Grease, Phenols	UNK	NA	Yes	Not specified	CCME WQGs
Town of Inuvik	N3L4-0036	1983-1993	Faecal coliforms, BOD, Suspended solids, Oil and Grease, pH	UNK	NA	Yes	Not specified	Not specified
Town of Inuvik	N3L4-0036	1993-1996	Faecal coliforms, BOD, Suspended solids, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Town of Inuvik	N3L3-0036	1996-2006	Faecal coliforms, BOD, Suspended solids	UNK	NA	Yes	Not specified	Not specified
DeBeers Canada Mining Inc.	MV2001L2-0002	2004-2012	Ammonia, Total metals (aluminum, arsenic, copper, cadmium, chromium, lead, zinc, nickel), Nitrite, Nitrate, TSS, BOD, Oil and Grease, Faecal coliforms	Yes	CCME WQGs	Yes	NDA/UPA	S-S WQOs; IDZ; CCME WQGs; USEPA WQC

Table 2. Summary of approaches used by various water boards to establish effluent quality criteria in the Northwest Territories.

Applicant	Water Licence	Applicable Period	COPCs	Site-Specific WQOs Derived?	Basis for WQOs	EQCs Derived?	Approach Used	Tools Applied
Canada Tungsten Mining Corporation Ltd.	N3L3-0004	1975-1978	Total metals (tungsten, cyanide, arsenic, copper, lead, nickel, zinc, iron), Suspended Solids, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Canada Tungsten Mining Corporation Ltd.	N3L2-0004	1995-2002	Total metals (arsenic, copper, lead, nickel, zinc), TSS, Oil and Grease, Unionized Ammonia	UNK	NA	Yes	Not specified	Not specified
North American Tungsten Corporation Ltd.	MV2002L2-0019	2003-2008	Total metals (arsenic, cadmium, copper, lead, nickel, zinc), TSS, Total Ammonia, EPH, Benzene, Ethyl benzene, Toluene, BOD, Faecal coliforms	UNK	NA	Yes	NDA	Not specified
City of Yellowknife	N1L4-0032	1977-1982	Total coliforms, Faecal coliforms, Phenols, BOD, TSS, Oil and Grease, pH	UNK	NA	Yes	Not specified	Not specified
City of Yellowknife	N1L4-0032	1982-1992	Total coliforms, Phosphorous, BOD, TSS, Oil and Grease, pH	UNK	NA	Yes	Not specified	Not specified
City of Yellowknife	N1L3-0032	1995-2001	Faecal coliforms, BOD, TSS, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
City of Yellowknife	N1L3-0032	2002-2010	Faecal coliforms, BOD, TSS, Oil and Grease	UNK	NA	Yes	NDA/UPA	S-S WQOs; CCME WQGs

Table 2. Summary of approaches used by various water boards to establish effluent quality criteria in the Northwest Territories.

Applicant	Water Licence	Applicable Period	COPCs	Site-Specific WQOs Derived?	Basis for WQOs	EQCs Derived?	Approach Used	Tools Applied
Royal Oak Mines Inc.	N1L2-1563	1995-1999	Total metals (arsenic, cadmium, copper, lead, nickel, zinc), Cyanide, TSS, Total Ammonia, BOD, Faecal coliforms, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Royal Oak Mines Inc.	N1L2-1563	1999-2002	Total metals (arsenic, cadmium, copper, lead, nickel, zinc), Cyanide, TSS, Total Ammonia, BOD, Faecal coliforms, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Contaminated Sites Office - INAC	MV2000L2-0018	2001-2006	Total metals (arsenic, copper, lead, nickel, zinc), Cyanide, WAD cyanide, TSS, Total Ammonia, BOD, Faecal coliforms, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Contaminated Sites Office - INAC	MV20012-0018	2001-2006	Total metals (arsenic, copper, lead, nickel, zinc), Cyanide, WAD cyanide, TSS, Total Ammonia	UNK	NA	Yes	NDA/UPA	NTWB sewage regulations; MMER; Background WQ; CCME WQGs; S-S WQO
Contaminants and Remediation Directorate, INAC	MV2004L8-0001	2005-2010	Total metals (aluminum, arsenic, copper, lead, nickel, selenium, zinc), Cyanide, WAD cyanide, Thiocyanate, TSS, Total Ammonia, Nitrite, Nitrate, Total Phosphorous, BOD, Faecal coliforms, Oil and Grease	Yes	CCME WQGs	Yes	NDA/UPA	NTWB sewage regulations; MMER; Background WQ; CCME WQGs; S-S WQO

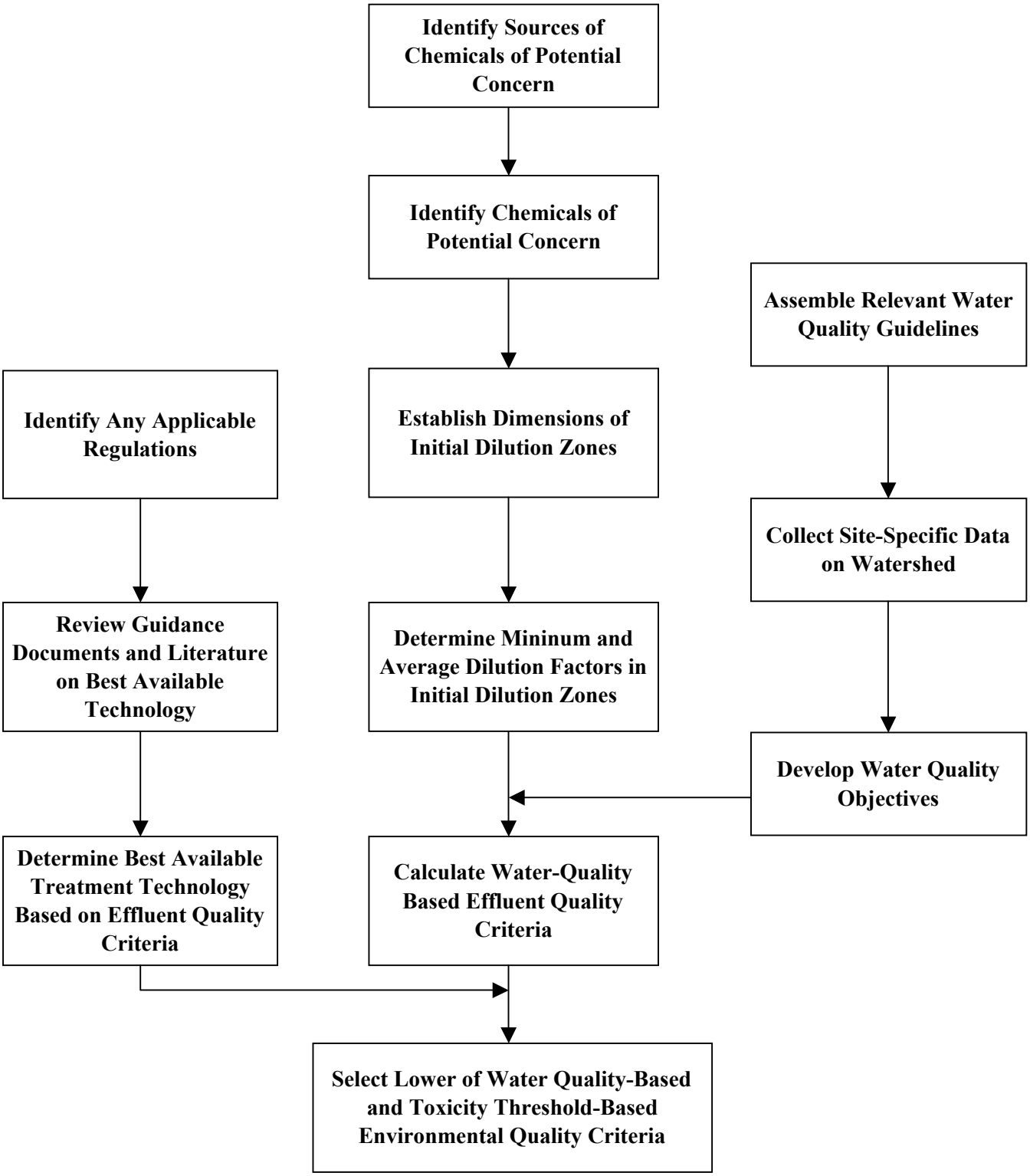
Table 2. Summary of approaches used by various water boards to establish effluent quality criteria in the Northwest Territories.

Applicant	Water Licence	Applicable Period	COPCs	Site-Specific WQOs Derived?	Basis for WQOs	EQCs Derived?	Approach Used	Tools Applied
Cominco Ltd. - Con Mine	N1L3-0040	1977-1980	Total metals (arsenic, copper, lead, nickel, zinc), Total Cyanide, TSS, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Cominco Ltd. - Con Mine	N1L3-1187	1983-1988	Total arsenic, TSS, pH	UNK	NA	Yes	Not specified	Not specified
Cominco Ltd. - Con Mine	N1L3-0040	1986-1990	Total metals (arsenic, copper, lead, nickel, zinc), Cyanide (available and total), TSS, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Nerco Con Mine	N1L3-0040	1990-1995	Total metals (arsenic, copper, lead, nickel, zinc), Cyanide, TSS, Oil and Grease, BOD, Faecal coliforms	UNK	NA	Yes	Not specified	Not specified
Con Exploration Ltd. Miramar Con Mine Ltd.	N1L2-0040	1995-2000	Total metals (arsenic, copper, lead, nickel, zinc), Cyanide, TSS, Oil and Grease	UNK	NA	Yes	Not specified	Not specified
Miramar Con Mine Ltd.	N1L2-0040	2000-2006	Total metals (arsenic, copper, lead, nickel, zinc), Cyanide, TSS, Oil and Grease	UNK	NA	Yes	Not specified	Not specified

CCME = Canadian Council of Ministers of the Environment; BATA = Best available technology approach; MMER; Metal Mining Effluent Regulations; NA = not applicable; NDA = Non-degradation approach; S-S = site-specific; TSS = Total Suspended Solids; UPA = Use Protection approach; WAD = weak acid dissociable; WQ = water quality; WQO = water quality objectives; WQG = Water Quality Guidelines.

*Amendment

Figure 1. Overview of the recommended process for developing effluent quality criteria.



Appendix 1 Report of the Auditor General - Indian and Northern Affairs Canada – Development of Non-Renewable Resources in the Northwest Territories (Chapter 6; OAG 2005; Downloaded from website http://www.oag-bvg.gc.ca/domino/reports.nsf/html/20050406ce.html; July 2006).

6.1 Non-renewable resources offer enormous potential for economic development in the Northwest Territories (NWT). Yet the investment climate for this development is uncertain, in part because Indian and Northern Affairs Canada (INAC) has not adequately managed its role in the process that considers development projects.

6.2 This includes not providing guidance on some of the ambiguous terms in the governing legislation or on establishing water standards permitted by legislation. It also includes not requiring boards to be accountable for managing their role in the process without impinging on the decisions they take as quasi-judicial bodies.

Background and other observations

6.3 Our audit examined how well INAC has managed its responsibilities that form part of the application and licensing process for the development of non-renewable resources in the NWT.

6.4 With the signing of land claim agreements in the NWT and the passage of the Mackenzie Valley Resource Management Act (MVRMA), the federal government created a series of boards to regulate the use of land and water and protect the environment. When these boards were created, the Department felt that the federal government's best course of action was to leave the boards to administer the process on their own in order to ensure that the Aboriginal peoples of the NWT understood that the federal government was sincere in relinquishing control. That decision seven years ago has contributed to a regulatory environment that, today, needs strengthening.

6.5 As the federal government continues negotiating the transfer of responsibilities to the NWT, it is important for Canadians that the process for developing non-renewable resources that the NWT may inherit is well managed.

6.6 Furthermore, seven years since the passage of the Act, it is timely for the Department to re-examine its approach to managing the process and strengthen it in the areas described in this report to ensure that it is sufficiently robust to meet the challenges and realize the opportunities of the coming decade.

The Department has responded. INAC agrees with all the recommendations and has committed to taking action to address the concerns we raise in this chapter.

Introduction

Historical overview of non-renewable resources in the North

6.7 The development of non-renewable resources is vital to the economic development of Canada's North. In the NWT, this means the development of, primarily, minerals and natural gas.

6.8 While the discovery of metals goes back to the 18th century, modern mining began with the Yukon gold rush in the late 1800s. Oil was later found at Norman Wells, NWT, in 1918. Fifty years later, gas was discovered in the Mackenzie-Beaufort Delta; however, it has remained inaccessible to North American markets because there has been no way to bring it south. Today, 30 years later, a new application has been made to build a pipeline.

6.9 On the mining side, in addition to gold, lead and zinc are the two metals most commonly extracted in the NWT. But diamonds represent the new mining frontier.

6.10 In 2003, the gross domestic product of the NWT was $3,332 million, about 13 percent higher than the year before. Since 2000, about two years after miners extracted the first diamonds, the NWT economy has grown annually by about 10 percent. In the same period, the share of the economy represented by mining (excluding gas and oil) grew from just under 24 percent to about 42 percent, and the size of the mining industry more than doubled. The industry will get another boost once a third diamond mine is up and running, expected in 2006. The other potential impetus to the NWT economy is natural gas in the Arctic, which will depend on the construction of the proposed Mackenzie Valley pipeline.

An evolving regulatory framework for developing resources

6.11 The environmental consequences of resource development have been a matter of growing concern in Canada since the late 1960s. With the federal government's commitment in 1974 to review the environmental effects of federal decisions throughout Canada, all development projects on federal lands or in areas under federal jurisdiction became subject to screening to ensure the least possible damage to the environment. In 1984, the Environmental Assessment and Review Process Guidelines Order codified what had been a largely unwritten process arising from the 1974 Cabinet policy.

6.12 In 1995, the Canadian Environmental Assessment Act (CEAA) replaced the Order and became the basis for conducting environmental assessments in areas of federal jurisdiction.

6.13 The devolution of federal responsibilities to the territorial governments and the existence of Aboriginal land claim settlements have made environmental assessments in the North more complex. On 1 April 2003, the Government of Yukon took over the management of its non-renewable resources, except in areas where transboundary development is proposed. However, environmental assessment responsibilities will remain under federal authority, but with significant participation from the Yukon First Nations. In Nunavut, the land claim settlement established a process for issuing land use permits and water licences (WLs) as well as a process for dealing with environmental concerns. In the NWT, except in the Inuvialuit land claim area, environmental considerations and the issuing of licences and permits fall under the 1998 Mackenzie Valley Resource Management Act (MVRMA) and the Sahtu and Gwich'in land claims legislation (Exhibit 6.1). As other claims are settled, such as the Tlicho claim, where the ratifying legislation is before Parliament, and the Deh Cho claim, which is currently being negotiated, the MVRMA will be amended to incorporate them into the process.

6.14 The MVRMA was created to meet a federal obligation under the Sahtu and Gwich'in land claim agreements and implementing legislation. It called for the creation of public boards to manage the application process for the development of renewable and non-renewable resources in the Mackenzie Valley.

Parties involved in resource development

6.15 The application for non-renewable resources development begins when a developer applies to a MVRMA-created board for a land use permit and/or WL (there are two types of WL—Type A and Type B; Type A is for larger and/or more complex projects). Once an application is received, several organizations become involved.

6.16 Minister for INAC. The MVRMA assigns to the Minister several responsibilities for resource management in the Mackenzie Valley. These include operational and governance responsibilities. At the operational level, responsibilities include

* adopting, with or without modifications, or rejecting recommendations of the Mackenzie Valley Environmental Impact Review Board (MVEIRB); and
* approving Type A WLs issued by the land and water boards.

6.17 At the governance level, section 82 of the MVRMA sets out the principal responsibility of the Minister for INAC in relation to land and water regulation; it gives the minister the authority, after consultation with a board, to give written policy directions binding on that board regarding its responsibilities for land and water regulation. Other responsibilities include

* making regulations about water quality, after consultation with the Mackenzie Valley Land and Water Board (MVLWB);
* appointing board members where, except for the chair, half are selected from First Nation nominations and the other half from government nominations;

* appointing the board chairs; and
* specifying the form of the annual report that the boards must submit to the Minister.

6.18 Gwich'in, Sahtu, and Mackenzie Valley land and water boards. These federally created boards are responsible for regulating the use of land and water and the deposit of waste in the Mackenzie Valley, for the benefit of NWT residents and all Canadians. The boards receive applications for the land permits and/or WLs needed before such projects can proceed. If a project is limited to Gwich'in or Sahtu land, the board for the region in question manages the application process. If the project crosses boundaries or is on land not covered by a settled land claim, the MVLWB is responsible.

6.19 Gwich'in and Sahtu land use planning boards (SLUPB). Created by the federal government in 1998, these boards are responsible for preparing land use plans and overseeing land use in the Gwich'in and Sahtu settlement areas. When a developer submits an application for development on Gwich'in or Sahtu land, the proposal is forwarded to the planning board for the region in question to ensure that the application complies with the land use plan for the area.

6.20 Parties affected by the development proposal. Before the land and water board can proceed with an application, it must notify any organization or individual affected by the proposal. This could include any number of federal and territorial organizations and local governments, as well as organizations associated with the Gwich'in, Sahtu, or Tlicho land claims.

6.21 Mackenzie Valley Environmental Impact Review Board (MVEIRB). The federal government created this board in 1998 to conduct environmental assessments and reviews of resource development applications referred to it by other boards and organizations or on its own motion.

Process for approving resource development applications

6.22 The steps in the approval or rejection of an application for a permit or licence are set out in the MVRMA.

6.23 The boards are key to making the process work. This process involves four boards: the MVLWB; its two panels, the Gwich'in Land and Water Board (GLWB) and the Sahtu Land and Water Board (SLWB); and the MVEIRBReview Board.

6.24 In the past, INAC and the Northwest Territories Water Board (NTWB) had primary authority over resource development. With the Inuvialuit land claim agreement in 1984, the Sahtu and Gwich'in land claim agreements in the early 1990s, and the passage of the MVRMA, the creation of a number of boards in the NWT changed the Department's role by introducing a new way of managing resource development in the NWT. The federal government no longer directly controlled the issuing of permits and licences for land and water use. Nor was it responsible for assessing the potential

environmental impacts of development. This meant that the First Nations and Inuvialuit obtained what they had been seeking for some time: participation in regulating the use of resources on their lands, with the boards being the vehicle for that participation.

6.25 The boards have become the filter through which must pass every application for resource development that requires a land use permit or WL. There are no exceptions; the Minister cannot bypass the process unilaterally or intervene before the process has run its course and reports have been issued.

6.26 Timelines are established. At the beginning of the process, a board will formally acknowledge that it has received an application only when it is satisfied that the application is complete. This acknowledgement establishes the period within which the applicant can expect a response, ranging from 42 days for a land use permit to up to 90 days for a WL, unless the application is referred to the MVEIRB for an environmental assessment.

6.27 Applications must conform to land use plans. Land use plans provide for the conservation; development; and use of land, water, and resources in an area covered by a settled land claim. Once an application is complete, the board will check whether it conforms to the land use plan that applies; if it does not, and cannot be amended, it is rejected.

6.28 Applications must go through a preliminary screening. The first stage in the review of a complete application is a preliminary screening by the appropriate land and water board or any other regulatory authority that has a power to issue a license or permit. If any of these bodies determines that the proposed project "might have a significant impact on the environment or might be a cause for public concern," it refers the application to the MVEIRB for an environmental assessment.

6.29 The land and water boards must send the application to various expert reviewers for their comments on the likelihood of environmental impact and public concern. These reviewers include various departments and agencies of both the federal government and the Government of the NWT, as well as the First Nation communities affected.

6.30 If the proposed development is unlikely to cause a significant public concern or adverse environmental impact, either the Gwich'in, Sahtu, or MVLWBs decides whether the licence or permit should be issued and establishes the terms of the licence.

6.31 The MVEIRBReview Board manages the environmental assessment process. When any one of the preliminary screening bodies identified by the MVRMA believes that a proposed development outside of a local government boundary might cause a significant adverse impact on the environment or might be a cause of public concern, the Review Board is required to do an environmental assessment even without a referral from a land and water board. If the proposed development is inside a local government boundary, the condition for conducting an environmental assessment

changes from "might" to will "likely" cause a significant adverse impact on the environment. The Review Board can also decide on its own to conduct an environmental assessment.

6.32 On completing an environmental assessment, the Review Board will determine whether, in its opinion, the project is likely to have a significant adverse impact on the environment or to be the cause of significant public concern. If the Board finds that a project does not give rise to one of these conditions, then it can determine that no further review need be done. If it finds that the proposal does meet one of these conditions, it can order a more extensive environmental impact review. It can also recommend approval, subject to sufficient mitigating conditions, or it can recommend that the Minister reject the proposal without any further review.

6.33 The course of action open to the Minister upon receiving a report from the Review Board is limited. He or she can adopt the recommendations, refer them back to the Board for further consideration, reject them, or after consulting the Board, adopt the recommendation with modifications. The Minister cannot modify the recommendations without consulting the Board.

Focus of the audit

6.34 Our audit examined how well INAC is managing its responsibilities for the process set out in the MVRMA for the development of non-renewable resources in the NWT (apart from the Inuvialuit Settlement Region). We looked at the process from the point at which one of the regulatory and environmental assessment boards receives an application for a permit and/or licence until a decision by one of those boards is made.

6.35 We did not audit any of the boards' responsibilities for their practices, procedures, or internal administration; nor did we examine the roles that other federal departments and agencies play in the process. However, we did interview officials from the boards to understand how the Department is managing its responsibilities.

6.36 Further details on our audit objectives, scope, approach, and criteria are presented in About the Audit at the end of the chapter.

Observations and Recommendations
Governance of resource development
A reduced operational role for the Department in regulating development

6.37 With the signing of land claims, the creation of the boards, and the passage of the MVRMA, the federal government effectively transferred part of its existing responsibilities for managing the development of non-renewable resources—regulating the use of land and water and examining the environmental impacts of non-renewable development proposals—to several boards in the NWT.

Those boards are the MVLWB; its two panels, the GLWB and the SLWB; and the MVEIRBReview Board.

6.38 The Act provides an overall framework for that process that includes a series of discrete steps. All the parties we spoke to understood the framework, the steps in the process, and the decisions that must be made at each of the points.

6.39 Having transferred this regulatory authority to the boards, the Department retained several responsibilities that need to be managed well if the process is to work as intended. It maintained those responsibilities because it recognized that the investment climate in the NWT could be influenced by how well the process worked. Accordingly, we looked at how the federal government is managing its responsibilities associated with the process for the development of non-renewable resources in the NWT.

6.40 In managing those responsibilities, we expected the Department to have provided adequate direction to ensure that the details to make the process run smoothly were in place. We also expected the Department to have determined that the boards had the required resources, both financial and non-financial, to carry out their functions. Finally, we expected the Department to have managed its responsibilities and authorities in a way that demonstrated that the roles, capacities, and accountabilities of those involved in the process are clear and fulfilled.

The Department needs to take a more active role to fulfill its responsibilities

6.41 While INAC has transferred some of its operational responsibilities for resource development in the NWT, it continues its governance role in several areas. Through the audit, we identified four areas where the decision the Department took some seven years ago regarding its scale of its involvement needs revisiting. These include

* providing guidance on key terms in the legislation,
* establishing regulations for water quality,
* ensuring the boards have the necessary resources to carry out their functions, and
* requiring the boards to be accountable not only for financial performance but also for the way in which they manage their responsibilities for the process.

6.42 According to INAC officials, the Department decided to keep its involvement to a minimum given the need to assure Aboriginal peoples of the NWT that the federal government was sincere in relinquishing control. Seven years later, that decision has resulted in ambiguity surrounding the regulation of non-renewable resources, which has raised the uncertainty that the process will be applied consistently. It would seem timely today for the Department to address the issues we raise to help ensure that the process is sufficiently robust to meet the challenges and to realize the opportunities of the coming decade.

Guidance on key terms in the legislation needs to be provided

6.43 Under the MVRMA, a land and water board or any regulatory authority must conclude at the preliminary screening of a proposal whether it "might have a significant impact on the environment or might be a cause for public concern." If the authority believes the proposal might have a significant impact, it will refer the application to the Mackenzie Valley Environmental Review Board for an environmental assessment.

6.44 Interested parties we interviewed indicated that before submitting an application or registering a matter that could cause public concern, they should be entitled to guidance on how key terms such as "might have a significant impact on the environment" or "may be a cause for public concern" are to be interpreted. In this regard, the Department has given the land and water boards no such guidance, nor do applicants for permits receive any direction on how the land and water boards might interpret the terms. Yet, in other similar legislation such as the CEAA, Environment Canada has issued draft guidelines that are being used for assessing the role of public participation in similar processes under its jurisdiction.

6.45 In 2004, the Review Board issued guidance on how the word "might" could be applied in practice, and there are several environmental publications that provide direction on interpreting the word "significant." But the boards, or any party in a similar position, are not required to use this guidance or any particular interpretation.

6.46 Consequently, any of the land and water boards or any regulatory authority can require the Review Board to conduct an environmental assessment without having to be accountable for that decision. Environmental assessments, which by their nature take time and increase costs, are an important component in the regulatory process and should only be used when justified.

6.47 Recommendation. INAC, in consultation with the boards under the MVRMA, should develop guidelines for clarifying key terms in the legislation.

Department's response. The Department, with the boards throughout the NWT, has developed a process known as the NWT Board Forum. Through this forum, the Department will work with the boards to develop guidelines to clarify key terms of the legislation. These will be based on the precedent work already completed through the CEAA. A working draft for external consultation will be completed by 1 April 2006.

Regulations for water should be established

6.48 When the land and water boards issue WLs under the authority of the Northwest Territories Waters Act (NTWA)and the MVRMA, they require the licensees to meet certain conditions such as measures to mitigate the environmental impacts of the use of water or the deposit of waste. Applicants for licences or permits should be able to know before they submit their proposals the standards for water use and waste disposal that they must meet. In that way, they would be able to demonstrate in their project plans how they will meet those standards.

6.49 In fact, the NTWA provides for the Minister for INAC, working with the boards, to make regulations governing the quality of water. Similarly, the MVRMA gives the Minister the authority to provide written policy directions regarding land and water regulations.

6.50 However, the Department has chosen not to exercise these authorities. Consequently, when completing an application for a WL, applicants do not know whether they are to meet an international standard of water quality, a national or territorial standard, a standard specific to the development site's environment, or the highest standard established by science.

6.51 This absence of direction on standards for water can raise the risk of confusion and uncertainty over the stringency of the requirements that applicants are to meet in order to have their applications approved.

6.52 Recommendation. INAC, in consultation with the boards under the MVRMA, should develop standards for water and the Minister should direct the boards to use the standards.

Department's response. In consultation with the boards and water users, the Department will ascertain the information needs (with respect to water standards used by the boards to set licence terms and conditions) of water users and the best form to provide proponents with certainty. A report on information needs will be completed by the end of 2006.

In consultation with the boards, the Department will develop water standards and set them out in codes, guidelines, policy, or regulations, as best fits the need. A completion date will be determined as part of the consultation.

The Department will improve the system for notification to the boards of various standards. This will be an ongoing process.

The Department needs to establish an effective process to ensure that the boards have the appropriate resources

6.53 The land and water boards are to conduct their business at arm's length from government and the First Nations that nominate them. Their business includes deciding on the use of land and water and protecting the environment. The business of the MVEIRBReview Board also includes recommending the approval of projects, subject to taking measures to mitigate significant adverse environmental impacts.

6.54 It is important that the boards have the resources to carry out their functions, because their decisions and recommendations, once the Minister has accepted them, are binding. There is no appeal except to the courts. Given the significant consequences of the boards' decisions, we expected the Department to have made every effort to ensure that the boards had the resources to make informed decisions. Such resources are not only financial but also include appropriate guidance to ensure that the boards

are well versed in the most appropriate techniques and approaches needed to carry out their tasks. They also include the kind of policy directives discussed earlier and clear direction on their roles and responsibilities. However, we saw no evidence that the Department carried out this responsibility.

6.55 The lack of clarity in the roles and responsibilities is evident in a letter the Minister wrote the Review Board to question the relevance of some of its recommendations and to indicate the need to define roles and responsibilities as well as a process for consultation on future projects. He wrote that in all future environmental assessments, the Review Board should explain how each recommendation would prevent the environmental impacts identified in the assessment.

6.56 When the boards were created, the federal government left them to determine how they would conduct their business. It provided no systematic orientation programs for board members and staff so they would understand, for example, the powers and procedures of federal boards with administrative tribunal responsibilities, the responsibility of federal boards to comply with federal requirements such as contracting policies, the various laws that govern resource management in the NWT, and the extent of board members' responsibilities. Currently, the Minister's letter of offer to newly appointed board members says nothing about their responsibilities and duties as board members; it comments only on the requirement to comply with a code of conduct.

6.57 We noted that the September 2004 report to the government by the External Advisory Committee on Smart Regulation, Smart Regulation: A Regulatory Strategy for Canada, addressed some of these issues.

6.58 We believe that INAC can help the boards to carry out their functions if it develops a way for boards to share information with each other regularly and receive updates on federal expectations and recent legal rulings and interpretations. Yet the Department has not made sufficient effort to ensure that a means of sharing information is in place.

6.59 Recommendation. INAC should work with the boards under the MVRMA to identify best practices and to assess training needs and provide for them, where appropriate.

6.60 Recommendation. INAC should work with the boards under the MVRMA and other boards in the NWT to develop a permanent process for sharing best practices and solutions to the challenges they face.

Department's response. The Department has already met with some boards to discuss outstanding issues (for example, best practices, training needs, etc.) and has developed a process, which includes the NWT Board Forum, for ongoing dialogue to resolve those issues. This will become an ongoing agenda item at the next NWT Board Forum, scheduled for fall 2005.

The Department will research and compile, as a starting point, best practices of other institutions of public government or expert organizations. The Department will prepare a preliminary report by fall 2005.

The boards and government will utilize the NWT Board Forum as a key vehicle for discussing best practices and to assess training needs. The Board Forum meets regularly during each year. The Department expects that changes to the boards' operations resulting from these discussions will start to be reflected in 2006–07 strategic, business, and expenditure plans of the boards.

Renewing the Department's role

The Department needs to hold the boards accountable for managing the process

6.61 The MVLWB, the Sahtu and the GLWBs, and the Mackenzie Valley Environmental Impact Assessment Board were all created by federal legislation and are wholly funded by the federal government. The Minister for INAC also appoints all board members.

6.62 The boards are required to produce audited financial statements of their operations each year, and they do. Beyond that, the annual reports of each board contain little information to demonstrate the board's accountability for managing their responsibilities in the best interests of the residents of the Mackenzie Valley and all Canadians. Nor has the Department requested that they do so.

6.63 The Department has the responsibility to request such accountability reporting from the boards, because the federal government funds them through flexible transfer agreements. Under the Policy on Transfer Payments, the federal government calls for a results-based management and accountability framework. Specifically, it calls for a written agreement between the department and the recipient that identifies the expected results. Furthermore, it requires the recipient to account for and report on the results actually achieved. It also identifies the flexible transfers INAC uses for funding the boards as being covered by this policy.

6.64 These boards are not accountable for decisions they make when acting in a quasi-judicial capacity.

6.65 One vehicle for demonstrating accountability for results is an annual report. A good annual report provides information that stakeholders can use to hold management accountable for performance against the organization's responsibilities. A good report also indicates what is working and what is not.

6.66 The Smart Regulation report provides further support for such an accountability framework:

When taking regulatory action, regulators should announce the results they wish to attain, the manner in which they intend to measure them, as well as when and at what frequency they will report on them. They must demonstrate their progress in achieving these results and be prepared to modify their approach if necessary. Evidence of performance is essential to sustain public trust.

6.67 Annual reporting to the Minister could be, for example, the vehicle whereby a board establishes and reports on the kind of service any applicant or intervener should expect to receive and how well the board is meeting those standards. In effect, it could become an accountability report that includes information on finances and on the way the board manages its responsibilities for the process.

6.68 Recommendation. INAC should require that boards include in their annual reports to the Minister information not only on the board's financial performance but also on the way they manage their responsibilities for the process.

Department's response. All boards currently report on their financial performance annually.

The Department will continue discussions with the boards to implement changes to their reporting requirements to reflect not only their financial performance but also on the way in which they manage responsibilities for the process. Changes to the boards' reporting documentation will be evident by the 2005–06 reports.

This initiative will be linked to the development or improvement of strategic plans.

6.69 Recommendation. INAC should require that reporting on financial and non-financial performance begin with the annual reports for 2005–06 and the Minister should make the reports public.

Department's response. Discussions regarding changes to the reporting requirements are already underway. The Department will work with the boards to expand and strengthen the content of the annual reports. Initial changes will be evident in time to be reflected in the 2005–06 annual reports.
Good reporting begins with a clear understanding of the accountability relationship

6.70 Before the boards can develop appropriate accountability reports, there is a need for clear direction from the government on the roles and responsibilities of the boards.

6.71 The Act provides a start; it indicates that the objective of the MVLWB is to regulate land and water use to provide optimum benefit to residents of the Mackenzie Valley and to all Canadians. It also specifies that the MVEIRBReview Board is to protect the environment from significant adverse impacts of development and to protect the social, cultural, and economic well-being of people in the Valley.

6.72 These objectives represent high-level outcomes of the Act. They are primarily the responsibility of the Department and are difficult to report against except through

periodic evaluations. Moving from these high-level intentions to an operational level means developing a working management framework for the boards' operations. Such a management framework would require a clear statement of the boards' roles and responsibilities. It also would require strategic plans that include annual operational plans that describe how the boards are to carry out their responsibilities and appropriate indicators to hold them accountable for doing so.

6.73 The American Society for Quality defines strategic planning as "the process by which an organization envisions its future and develops strategies, goals, objectives, and action plans to achieve that future." We expected that with the creation of these boards, or relatively soon after, the Department would have provided direction on their roles and responsibilities and the role of strategic planning in reporting performance. But this was not the case.

6.74 We found that the Review Board, on its own initiative, has made some progress by developing a strategic plan that includes possible performance measures and recognizes the need to develop service standards.

6.75 Demonstrating performance could include establishing and reporting against service standards. It could also include working with such organizations as the American Society for Quality or the International Organization for Standardization to develop service standards and demonstrate levels of quality achieved. In this regard, we do not mean measures that relate to any quasi-judicial functions of the boards.

6.76 Recommendation. INAC, in consultation with the boards under the MVRMA, the Aboriginal communities in the NWT, and other stakeholders, should clarify the roles and responsibilities of the boards.

Department's response. Bilateral discussions on roles and responsibilities with some of the boards are already underway and replies to our invitation from the others are pending. In addition, this will become an agenda item for the NWT Board Forum. The Department will also initiate discussions with the representatives of groups with settled claims to ensure that roles and responsibilities reflect the claims agreements and legislation. This is an ongoing process of updating, renewal, and evolution. First results will be evident by April 2006.

6.77 Recommendation. INAC should work with each board under the MVRMA to develop a strategic plan that includes a statement about the board's mandate, vision, and mission; strategies for achieving them; and measures to demonstrate performance.

Department's response. Discussions with some boards on the development of, or strengthening existing, strategic plans is already under way and will continue. Other boards will be contacted for bilateral discussions. In addition, this will become an ongoing agenda item for the NWT Board Forum. All the boards will be requested to develop a strategic plan by April 2006.

The Department recognizes that strategic plans and performance measurements are not static and improvements will be ongoing.

6.78 Recommendation. INAC should include in its Report on Plans and Priorities (RPP) for 2005–06 a section that indicates how it plans to address the recommendations in this chapter. In subsequent performance reports, it should demonstrate its performance against these plans.

Department's response. The Department will include in its RPP an action/work plan that indicates how it plans to address the recommendations in this chapter and report on progress. The action/work plan will be completed by April 2006. Future RPPs will report progress and achievements.

The Department needs to establish an effective working relationship with the boards

6.79 We observed little formal communication between the boards and the Department to identify common challenges and find common solutions, as reported earlier in the chapter. We saw little indication that the Department, whose Minister has the authority to consult with the boards in providing policy direction, has worked with the boards to develop a shared interpretation of key terms in the legislation. We saw no indication that the Department has made any effort to establish reasonable standards for water quality. We also saw no evidence of any kind of accountability reporting except for financial reporting.

6.80 INAC has a responsibility to improve the state of resource management in the NWT. In our view, the Department needs to strengthen its relations with the boards in order to meet its responsibilities over the coming decade. This includes exercising its authority under the MVRMA and consulting more closely with the boards.

6.81 We noted that the Department has made some effort in the last two years to improve its relationship with the boards. For example, it established a Board Relations Secretariat in Yellowknife. The Secretariat's purpose is to improve communication between the Department and the boards, to help resolve operational issues and interpretation differences that arise in implementing the Act, to administer board appointments by the Minister and funding arrangements for the regional boards, and to provide day-to-day advice and support to the boards.

6.82 We saw, however, no evidence of the Department going beyond developing a relationship at the operational level. For example, we saw little effort by the Department to develop an ongoing relationship among the chairs and executive directors of the boards and senior officials in the Northern Affairs branch of the Department.

6.83 Recommendation. INAC should establish an ongoing process of consultation between the heads of the boards under the MVRMA and the senior officials of the Department.

Department's response. The Department has requested that the boards increase and regularize their consultation with the government on key issues and will undertake bilateral meetings as required. In addition, the NWT Board Forum will be utilized as a key vehicle for ongoing consultation with the heads of the boards and senior departmental officials.

Conclusion

6.84 We believe that INAC is not adequately managing its responsibilities that form a key part of the process for approving the development of non-renewable resources in the NWT.

6.85 It has not yet exercised its authority under the MVRMA to provide adequate direction to the public boards that manage the application process for the development of renewable and non-renewable resources in the Mackenzie Valley. Such direction would ensure that the details to make the process run smoothly are in place. These include standards for water quality and guidance on key terms in the legislation.

6.86 The Department has not taken steps to ensure that the boards have the appropriate management foundation and ongoing assistance to help them carry out their responsibilities.

6.87 The Department also has not obliged the boards to comply with the requirement to be accountable for managing their responsibilities under the process in the best interests of the residents of the Mackenzie Valley and all Canadians.

6.88 These matters are important for two reasons. First, while we recognize that the boards and the federal government need time to iron out their working relationships in this relatively new process, the continued absence of policy direction in crucial areas, the lack of support for effective knowledge building, and the lack of an appropriate accountability model have put the investment climate in the NWT at risk. Second, in the current negotiations to devolve federal responsibilities to the territories, control over non-renewable resources is high on the agenda.

6.89 In the INAC and Canadian Polar Commission Performance Report for the period ending March 31, 2003 the Department noted that the investment climate in the North is influenced by the efficiency, transparency, and fairness of regulatory frameworks and the new powers of public institutions to manage land and resources. It also noted the concerns expressed by industry that uncertainty, instability, and inefficiencies are constraining investment and limiting business opportunities. We believe that implementing our recommendations will contribute to remedying these concerns.

About the Audit
Objectives

The objective of the audit was to determine how well the federal government is managing its responsibilities associated with the process for the development of non-renewable resources in the NWT, other than the Inuvialuit Settlement Region.

Scope and approach

We audited the process that was established by the MVRMA (1998), and focussed mainly on INAC.

In particular, we looked INAC's responsibilities that form part of the process beginning with the application for a land permit and/or WL and ending with the decision on the application.

We conducted the audit mainly through interviews of officials and review of documents from the departments involved, primarily INAC. We also reviewed publicly available documents associated with resource development applications. In addition, we interviewed key stakeholders, including representatives of the mining companies and industry, the Government of the NWT, and Aboriginal groups.

This process for development involves four boards: the MVLWB; its two panels, the GLWB and the SLWB; and the MVEIRBReview Board. We did not audit any of the boards' practices, procedures, or internal administration associated with their responsibilities; nor did we examine the roles that other federal departments and agencies play in the process. We did however interview officials from the boards to understand how INAC is managing its responsibilities.

Criteria

We expected that INAC would manage the process by the following:

* communicating the process to stakeholders in a way that is timely, transparent, understandable, and predictable;
* conducting periodic reviews and making adjustments where necessary;
* ensuring that the process has timelines that are clear, managed, and reviewed;
* ensuring that the process has service standards that are clear, managed, and reviewed; and
* developing and managing a risk management process.

We expected that INAC would manage the need for appropriate capacity in all steps, including

* conducting periodic reviews to determine if there are any gaps in resources needed to carry out its responsibilities, and
* preparing and implementing a plan for filling any gaps.

We expected that INAC would ensure accountability for the organizations involved in the process, including having

* a clear understanding by all federal entities involved in the process of their roles, responsibilities, and accountability relationships;
* a clear leadership role for the process in the government;
* an appropriate accountability framework between the various organizations involved in the process and with Parliament;
* a clear understanding by participants that the process is fair; and
* a process for assessing performance.

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Appendix 2 Diavik Diamond Mines Inc. Type A Water Licence - Effluent Quality Criteria (EQC) Derivation

A2.0 Introduction

The NTWB developed EQC for chemicals of potential concern (COPCs) at the Diavik Diamond Mines Inc. (DDMI) project on Lac de Gras as part of the water licencing (WL) process (NTWB 2000). These EQC were derived using a process that would satisfy the guiding principles described in Section 3.1 of this report. This appendix describes the procedures that were used to derive the EQC (NTWB 2000).

A2.1 Options for Deriving Effluent Quality Criteria

The NTWB considered three distinct options for developing EQC that would be consistent with the established guiding principles, including:

- Non-degradation approach;
- Use protection approach; and,
- Best available technology approach (BAT).

Application of the non-degradation approach would ensure that environmental quality conditions in Lac de Gras would not be degraded due to the activities that are conducted at the DDMI mine site. In contrast, the use protection approach can be employed to develop numerical EQC would protect the designated uses of Lac de Gras and downstream areas. Finally, application of the BAT approach can be used to establish EQC based on the predictions of the concentrations of COPCs in the wastewater stream and on the efficacy of wastewater treatment technologies.

A2.2 Procedures for Deriving Effluent Quality Criteria

The NTWB recognized that, to establish EQC that were consistent with the guiding principles, it would be necessary to integrate all three approaches into the EQC derivation process (NTWB 2000). Accordingly, the procedures that were used to derive the EQC involved a number of steps, including:

- Identification of the members of the Technical Advisory Committee (TAC) that would like to participate on the subcommittee to derive EQC;
- Establishment of a draft terms of reference and study approach for the subcommittee;

- Identification of contaminant sources (effluent discharge streams) at the DDMI mine site (i.e., based on the project description and supporting documentation);
- Identification of the COPCs for each of the contaminant sources at the DDMI mine site (based on the project description, WL application, supporting documentation, and professional judgement);
- Determination of the level of protection that is to be afforded to water uses in Lac de Gras and in downstream areas (e.g., sensitive life stages of all aquatic and aquatic-dependent species that occur in Lac de Gras should be protected);
- Determination of ambient water quality objectives (WQOs) for Lac de Gras and for downstream reaches of the Coppermine River Basin (i.e., using the Canadian water quality guidelines (WQG) and information on baseline water quality conditions in Lac de Gras);
- Determination of the areal extent of the initial dilution zones (IDZs) for each of the effluent discharge streams from the DDMI mine site (i.e., an IDZ of 60m radius was selected) and calculation of minimum dilution factors (MDFs) in the IDZ (i.e., using effluent dispersion modelling techniques);
- Development of preliminary EQC that would ensure that the ambient WQO are met outside the IDZ for each effluent discharge stream (i.e., using WQOs and MDFss);
- Evaluation of the efficacy of a variety of wastewater treatment technologies, including those identified by the proponent and those that have been applied elsewhere;
- Comparison of the preliminary EQC for each COPC to baseline concentrations in Lac de Gras and to the levels that could be achieved through application of best available treatment technology (BATT) to determine if it is possible and practicable to achieve the preliminary EQC that were developed;
- Preparation of recommendations to the NTWB regarding the establishment of EQC, which included options for establishing EQC, evaluation of the risks that are posed to the environment and human health by the various options that are presented, and the level of uncertainty associated with the various options presented. Information on the potential for meeting the recommended EQC using existing wastewater treatment technologies or those that could be readily developed for use at an operational scale were also provided to the board; and,
- Selection of the final EQC for inclusion in the WL by the board.

Therefore, the EQCs that were ultimately selected for inclusion in the WL (2000-2004) were derived using all these methods. Soon after DDMI initiated mining activities, the company recognized that levels of ammonia production (produced during blasting activities) were much higher than predicted in the Environmental Assessment. Consequently, the company applied for a WL amendment that would permit it to discharge effluent to Lac de Gras with concentrations of ammonia as high as 20 mg/L (compared to the original WL conditions of 2 mg/L average and 4 mg/L maximum; MVLMB 2004). Many stakeholders raised objections to this application on the basis that the effects of the project has been evaluated

based on the information provided by DDMI and the proposed amendment would permit the discharge of a toxic substance in quantities that could adversely affect water quality conditions. To facilitate resolution of this issue, the MVLWB convened a mediation process between DDMI and the stakeholders. The resultant Record of Agreement paved the way for issuance of an amended WL that allowed the company to discharge up to 20 mg/L on an interim basis and gave them two years to develop an ammonia management plan that would enable the company to meet the original WL conditions for ammonia or the lowest EQC possible. These amended EQC for ammonia were derived using the use protection approach and did not address stakeholder's concerns relative to minimizing the degradation of water quality on Lac de Gras. The amended WL also included provisions for increased toxicity testing to ensure that the elevated ammonia levels did not result in the discharge of an acutely toxic effluent or create conditions within the IDZ that would cause chronic toxicity.

Appendix 3 Indian and Northern Affairs Canada Type A Water Licence - Background and EQC Derivation

A3.0 Introduction

The Colomac Site is located 220 km north of Yellowknife in the NWT, within the traditional territory of the Tlicho people. An open pit gold mine was operated at the site between 1990 and 1997, initially by Neptune Resources Corporation and subsequently by Royal Oak Mines. During that period, roughly 16.7 tonnes of gold (535,000 troy ounces) were recovered from approximately 11.2 million tonnes of milled ore. The mine tailings (including solids and contaminated water) were discharged to the Tailings Containment Area (TCA), which consisted of three natural headwater lakes (Spruce Lake, Fuscum Lake, and Tailings Lake). Three containment structures were built to manage the tailings solids and water, including Dam 1, Dam 2, and Dyke 7. In addition, some 35.1 million tonnes of waste rock were mined and placed in two waste rock piles that are located in the vicinity of the open pits (i.e., the North and South Piles). The site also includes a number of infrastructural elements to support mine operations.

For the purposes of remediation planning, the Colomac Site can be considered as a collection of inter-related components (CARD 2004). Ten major site components have been identified, including the TCA, open pits, waste rock piles, roads and storage yards, airstrip, quarries and soil borrow areas, sewage lagoon, buildings and equipment, spilled materials, and waste materials. There are specific issues and concerns associated with each of these components that must be addressed during remediation planning for the site. To address these issues and concerns, the Contaminants and Remediation Division (CARD) of INAC developed a Remediation Plan for the site (CARD 2004). In addition, the CARD has commissioned a number of consulting firms to collect relevant data and information on the site, to conduct human and ecological risk assessments of the site under baseline conditions and consider various remedial alternatives, to conduct various geotechnical and related studies to support remediation planning, and to design monitoring plans to assess the efficacy of the remediation plan (SRK 2003a; 2003b; 2004a; 2004b; EBA 2001; Rescan 2003a; 2003b; Senes 2004; Botz and Mudder 2003; URS 2002; Whyte *et al.* 2001; Macdonald 2003; 2004).

Currently, there are two main areas within which contaminated water is contained at the Colomac Site, including the TCA and Zone 2 Pit. While storage capacity still exists within both of these containment structures, rainfall and snowmelt will eventually fill the TCA and Zone B Pit. When these storage areas are full, it will be necessary to release water to the surrounding environment (CARD 2004). Based on the available water balance information, active discharges of wastewater from the TCA may be necessary as soon as 2008, while passive releases of wastewater discharges from the Zone 2 Pit may become necessary at that time or several years thereafter (CARD 2004).

A3.1 Options for Deriving Effluent Quality Criteria

In anticipation of the need to actively discharge wastewater, INAC applied to the MVLWB for a WL that would facilitate discharge of wastewater from the TCA. As part of the application, INAC recommended candidate EQC for possible inclusion in the Type A WL for the Colomac Site.

Three approaches were considered for deriving EQC for the Colomac mine site, including: 1) the non-degradation approach; 2) the use protection approach; and, 3) BAT approach. The EQC that were recommended to the Mackenzie Valley Land and Water Board (MVLWB) and ultimately incorporated into INAC's WL were established using each of the three approaches, and then comparing them for the purpose of identifying EQC that would be consistently achievable, protective of water uses in downstream waterbodies, and minimize COPCs loadings to receiving waterbodies.

A3.2 Procedures for Deriving Effluent Quality Criteria

A step-wise process was used to derive EQC for the Colomac Mine Remediation Project, which included:

- Reviewing the various approaches that have been established for deriving numerical EQC;
- Establishing guiding principles for deriving EQC;
- Identifying COPCs;
- Establishing numerical water quality objectives (WQOs);
- Evaluating the dilution capacity of Watershed A;
- Calculating the water quality-based EQC;
- Determining the likely characteristics of wastewater post-treatment; and,
- Recommending candidate EQC that would be protective of water uses in receiving waterbodies in Watershed A, consistently achievable, and minimize loadings of COPCs to Watershed A.

As indicated above, three approaches were considered for deriving EQC for the Colomac mine site. In the non-degradation approach, EQC were set at levels that would ensure that environmental quality conditions in Watershed A and B would not be degraded due to discharges of wastewater from the Colomac mine site. The development of numerical EQC using this approach involved three main steps. In the first step of the process, the COPCs in wastewater from the site were identified. Next, background levels of the COPCs in the receiving waterbodies in the vicinity of the mine site were determined and used to establish the WQO. Such background concentrations of COPCs were expressed as the normal range of background concentrations (i.e., 95% prediction limits; MacDonald *et al.* 2002). As the receiving waterbody was considered to be a river-like system, the numerical EQC were

subsequently determined using information on the flow of the effluent (EF), the flow of the receiving waterbody (RF), total flow after mixing (TF), average background concentrations of COPCs in the waterbody (BKGD), and the WQOs, as follows:

$$WQO = [(BKGD*RF) + (EQC*EF)] / TF$$

or, isolating the EQC term:

$$EQC = [(WQO*TF) - (BKGD*RF)] / EF$$

Using the use protection approach, numerical EQC were developed that would be protective of the designated uses of receiving waterbodies. The designated uses of waterbodies in Watershed A in the vicinity of the Colomac Site included raw water for drinking water supplies, fish and aquatic life, wildlife watering, and recreation and aesthetics. In many ways, the procedures used to derive EQC based on the use protection approach were similar to those used in the non-degradation approach. The main difference was that the Canadian water quality guidelines (WQGs; CCME 2002) or equivalent values for the COPCs were used to establish the WQOs for the receiving waterbody (i.e., instead of background levels). More specifically, the WQG for the most sensitive designated use were first identified for each COPC. These WQGs were adapted to conditions at the site using the baseline water quality data for the site (i.e., information on water hardness was used to adapt the WQGs for metals, data on water temperature and pH were used to adapt the WQGs for ammonia, etc.). The numerical EQC were then determined using the same procedures that were used for deriving EQC using the non-degradation approach (i.e., the equations presented above).

The BAT approach differs markedly from the first two approaches that have been discussed. Application of this approach relies on the predictions of the concentrations of COPCs in the wastewater stream and on the efficacy of wastewater treatment technologies. At the Colomac site, this approach was applied by calculating the probable concentration of each COPC in the effluent following treatment using the BAT that is economically achievable. INAC evaluated a range of wastewater treatment options at the site and ultimately selected enhanced natural removal to decrease levels of cyanide (and other COPCs) to levels acceptable for discharge to the environment. The results of monitoring conducted in the TCA and water quality modelling provided the information needed to predict the concentrations of conventional variables, nutrients, cyanide, and metals in 2008 (the year that the TCA was anticipated to fill and discharge would be required). The technology-based numerical EQC were established by calculating selected summary statistics that define the distribution of the concentrations of COPC in the effluent stream from the TCA (e.g., mean, median, percentiles, maximum, etc.).

The EQC that were recommended to the MVLWB and ultimately incorporated into INAC's WL were established by comparing the water quality-based EQC (i.e., derived using the use-protection approach) to predicted water quality characteristics in 2008. These candidate EQC were also compared to the risk-based EQC that had been generated using an alternate approach (Senes 2004). The water quality-based EQC identify the average concentrations of COPCs that would need to be achieved in wastewater discharges from the Colomac site to protect downstream water uses. The predicted water quality characteristics in 2008

represent the condition that were expected in Tailings Lake through the application of Enhanced Natural Remediation (ENR; as presented by SRK at the July 22, 2004 Colomac Team meeting). The risk-based EQC represent maximum average concentrations (MACs) and maximum concentrations (MCs) that had been included in one or more WLs issued by the NTWB or the MVLWB.

The results of these comparisons were used to recommend EQC for discharges from Tailings Lake that would be consistently achievable, protective of water uses in waterbodies located downstream of L-Shaped Lake, and minimize loadings of COPCs to Watershed A. These comparisons also provide a means of identifying the COPCs that could occur at elevated concentrations (i.e., in excess of the WQOs) in the waterbodies downstream of L-Shaped Lake. Additional treatment options (e.g., pre-treatment in a constructed wetland) could be implemented to reduce these concentrations to acceptable levels if ENR does not reduce COPC concentrations to levels below those predicted based on water quality modelling.

Appendix 4 Description of the Canadian Water Quality Guidelines

A4.0 Introduction

In its recent audit of how well INAC has management it responsibilities relative to the development of non-renewable resources in the NWT, the Office of the Auditor General of Canada (OAG) recommended that the department, in consultation with the MVRMA boards, should develop standards for water and that the Minister should direct the boards to use the standards. Such standards would define the conditions that prospective water licensees would need to meet to mitigate the environmental impacts of the use of water or the deposit of waste before they submit their project plans.

Standards can be established as the maximum and/or average concentrations of COPCs in an effluent discharge and/or in the receiving water body outside the IDZ (termed effluent quality standards and receiving WQS, respectively). Establishment of both types of standards requires information of the effects of COPCs on various water uses, among other things. The following description of the Canadian Water Quality Guidelines is provided to emphasize the potential applications of these management tools in the development of WQS. This overview was abstracted from CCME (2002).

A4.1 Development of Canadian Water Quality Guidelines

In 1987, the Canadian Council of Ministers of the Environment (CCME), formerly the Canadian Council of Resource and Environment Ministers (CCREM), released Canadian Water Quality Guidelines. The document included guidelines for the protection of freshwater life, agricultural water uses for irrigation and livestock, raw water for drinking water supply, recreational water quality and aesthetics, and industrial water supplies (CCREM 1987). This publication represented the first time that national, science-based guidelines were developed collaboratively among provincial, territorial, and federal jurisdictions. It also demonstrated that Canada was a leader in the development of national guidelines for environmental quality. The Canadian Water Quality Guidelines were regularly updated with newly developed and revised guidelines that were focussed specifically on priority water quality issues.

Environmental concerns have grown over the past 10 years, along with our understanding of the multiple threats to ecosystem health. Canadians have recognized the need to protect components of the ecosystem in a more holistic manner. Consequently, the development of environmental quality guidelines (EQGs) in Canada has evolved to also address the protection of other atmospheric, aquatic, and terrestrial resources, including air quality, marine water quality, marine and freshwater sediment quality, tissue quality for the protection of wildlife consumers of aquatic life, and soil quality for agricultural, residential/parkland, commercial, and industrial land uses.

Canadian EQGs are nationally endorsed, science-based goals for the quality of atmospheric, aquatic, and terrestrial ecosystems. Environmental quality guidelines are defined as numerical concentrations or narrative statements that are recommended as levels that should result in negligible risk to biota, their functions, or any interactions that are integral to sustaining the health of ecosystems and the designated resource uses they support. Canadian EQGs are recommended for parameters of national concern that are found in the ambient environment. As national benchmarks or indicators of environmental quality, Canadian EQGs are intended to protect, sustain, and enhance the quality of the Canadian environment and its many beneficial uses.

Although the EQGs are nationally endorsed, provincial and territorial jurisdictions may have or may develop their own science-based environmental assessment tools (e.g., criteria, guidelines, objectives, and standards), which may be implemented within their respective jurisdictions. In many cases, the CCME EQGs form the scientific basis upon which further site-specific criteria, guidelines, objectives, or standards are developed within the various jurisdictions. The legislative authority for implementation of Canadian EQGs and other environmental assessment tools lies primarily with each provincial or territorial jurisdiction, with the exception of federal lands.

Since the release of Canadian Water Quality Guidelines (CCREM 1987), science-based guideline derivation procedures have been established and approved nationally for specific media and resource uses. These procedures have been documented as national scientific protocols (CCREM 1987; CCME 1991, 1993, 1995, 1996b, 1998; Health Canada 1989; WGAQOG 1996). Regardless of the resource uses to be protected, guideline development for individual substances is founded on the same set of guiding principles and follows a consistent process, although specific elements of these protocols may necessarily differ. Three guiding principles are fundamental to the development and implementation of Canadian EQGs:

(1) EQGs embody a national goal for environmental quality of no observable adverse effects on atmospheric, aquatic, and terrestrial ecosystems over the long term.

(2) EQGs are developed for major atmospheric, terrestrial, and aquatic resource uses in Canada.

(3) EQGs are generic recommendations that are based on the most current scientific information (i.e., they do not directly consider site-specific or management factors that may influence their implementation).

All national protocols include minimum requirements for the quality and quantity of toxicological data to ensure the guidelines derived are protective of specific resource uses. In addition, the use of national protocols ensures consistency, transparency, and scientific defensibility in the guideline development process.

A4.2 Applications of Canadian Water Quality Guidelines

Environmental quality guidelines should not be regarded as blanket values for national environmental quality. Variations in environmental conditions across Canada will affect environmental quality in different ways. Therefore, the users of EQGs may need to consider local conditions and other supporting information (e.g., site-specific background concentrations of naturally occurring substances) during the implementation of EQGs. Science-based site-specific criteria, guidelines, objectives, or standards may therefore differ from the Canadian EQGs recommended in this document. For ecosystems of superior quality, impairment to guideline concentrations is not advocated.

EQGs have a number of functional uses within various environmental assessment and management strategies. The general effectiveness and endorsement of such uses, however, are dependent on initiatives at the local, national, and international levels. Applications of EQGs include:

- National benchmarks to assess potential or actual impairment of socially-relevant resource uses;
- The scientific basis for the development of site-specific criteria, guidelines, objectives, or standards;
- Indicators for state-of-the-environment reporting;
- Science-based goals or performance indicators for regional, national, or international management strategies for toxic substances;
- Interim management objectives for persistent, bioaccumulative, and toxic substances to track progress toward their virtual elimination;
- Scientific tools for assessing risks associated with existing concentrations of persistent, bioaccumulative, and toxic substances in the ambient environment
- Indicators of ecotoxicologically-relevant concentrations of persistent, bioaccumulative, and toxic substances for the purposes of improving analytical detection and quantification capabilities;
- Tools to evaluate the effectiveness of point-source controls;
- The scientific basis for environmental regulations;
- Scientific benchmarks or targets in the assessment and remediation of contaminated sites; and,
- Science-based assessments and tools for consideration in the development of Canada-wide standards under the *Canada-wide Accord on Environmental Harmonization*.

The *Canada-wide Accord on Environmental Harmonization*, signed in January 1998 by all CCME members with the exception of Quebec, provides the framework and mechanisms for governments to cooperatively achieve the highest level of environmental quality for all Canadians. The accord provides an additional focus for EQG activities primarily through the *Canada-wide Environmental Standards Sub-agreement*. Canada-wide environmental

standards encompass qualitative or quantitative standards, guidelines, objectives, and criteria for protecting the environment and human health. The primary focus of this subagreement is on Canada-wide ambient environmental standards for the quality of air, water, soil, biota, other media, and other components of ecosystems, as well as ecosystems themselves. Standards for products and discharge, as well as performance standards, may also be developed. Therefore, Canadian EQGs will play a key role in the development of priority Canada-wide environmental standards.

Canadian EQGs are used by federal, provincial, and territorial governments to achieve the highest levels of environmental quality across Canadian jurisdictions. Provincial and territorial governments may use EQGs in developing point-source licenses and permits for discharges, while at the federal level, the guidelines support various legislative acts, such as the Canadian Environmental Protection Act (CEPA 1985). In addition, Canadian EQGs have been widely endorsed internationally by the United Nations and the World Health Organization. Canadian EQGs also support international conventions such as the Great Lakes Water Quality Agreement and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (also known as the 1972 London Convention).

A4.3 Establishment of Procedures for Deriving Ambient Environmental Quality Objectives

WQO are science-based tools that provide an effective basis for managing the resources in aquatic ecosystems. These tools describe conditions that environmental managers have agreed should be met to protect the most sensitive designated uses of freshwater, estuarine, and marine ecosystems. More specifically, WQO are numerical concentrations or narrative statements that establish the conditions necessary to support and protect the most sensitive designated use of water, sediment, and biota at a specified site. Objectives are typically based on generic environmental quality guidelines and criteria, which may be modified to account for local environmental conditions or other factors.

In general, WQOs are prepared only for those waterbodies and water quality variables that may be affected by human activities, either now or in the future. WQO have no legal standing at this time and, therefore, are not enforced directly. Nevertheless, they are used in conjunction with other management tools, such as effluent controls and best available or practicable technology, to achieve environmental conditions that support sustainable resource use. While the mechanism has not been formalized, the WQOs are often used in the permitting and licensing processes in the NWT.

WQO form a cornerstone of the Federal Water Policy (Minister of Environment 1987). In addition, the need for WQOs is explicitly recognized in the CEPA [Section 8(1)]. To guide federal government staff, Environment Canada and Fisheries and Oceans Canada jointly developed a policy statement on the use and application of WQOs. In the federal policy, a WQO is defined as a numerical concentration or narrative statement that has been established to support and protect the designated uses of water at a specified site (CCREM 1987). Such

objectives are based on the best scientific information available. When insufficient information exists, provisional WQOs are applied until the data required to develop scientifically-defensible objectives are available. Provisional WQOs are deliberately conservative and implemented with due caution.

WQO are developed to conserve and protect the designated water uses in the waterbody under consideration. The designated water uses recognized in the federal policy include:

- Raw water for drinking water supply;
- Recreation and aesthetics;
- Freshwater, estuarine, and marine fish;
- Migratory birds and other aquatic life;
- Agriculture (including irrigation and livestock watering); and,
- Industrial water supplies.

The federal government has also adopted a non-degradation policy to guide the management of water resources. This policy states that all reasonable and preventative measures should be taken to maintain existing conditions when they are better than the conditions specified by the WQOs. Hence, the existing conditions should be adopted as the objectives for waters of superior quality. For waters with impaired quality, the objectives may be used as a basis for improving water quality.

The federal policy identifies a number of applications for the WQOs. For example, evaluation of compliance with the objectives provides a useful means of predicting and assessing whether effluent standards (which are based on best available or practicable technology) provide adequate protection for a designated water use. However, the objectives cannot be used to derive allowable effluent contaminant concentrations, if they result in relaxation of effluent treatment requirements such that legislated effluent standards (e.g., Metal Mining Effluent Regulations, MMERs) are no longer met. These objectives would also provide a basis for identifying emerging water quality problems resulting from multiple point and diffuse sources and determining the need to address such problems.

The development of WQO represents one component of an integrated process for implementing ecosystem-based natural resource management in Canada. Two distinct strategies are commonly used to establish WQO in Canada. For waterbodies with aquatic resources of national or regional significance, the WQOs are established to avoid degradation of existing water quality. For all other waterbodies, the WQOs are established to protect the designated uses of the aquatic ecosystem. As long as the designated water uses are protected, some degradation of existing water quality is considered to be acceptable in these waterbodies.

Appendix 5 Procedures for Deriving Effluent Quality Criteria in Saskatchewan

In Saskatchewan, numerical EQC are derived using consistent procedures that are intended to ensure that ambient WQOs are met in receiving waters (SEPS 1997). Once the WQOs have been established, the locations of the mixing zone has been determined, and the proportion of the available assimilative capacity that can be used by a project has been fixed, numerical EQC are developed for an effluent discharge. Such EQC are calculated using the following equation:

$$EQC = [(WQO*TF) - (BKGD*RF)] / EF * AUAC$$

Where:

WQO	=	Water quality objective;
TF	=	Total flow after mixing;
BKGD	=	Average background concentrations of COPCs in the waterbody;
RF	=	Flow of the receiving waterbody prior to receiving the discharge;
EF	=	Flow of the effluent; and
AUAC	=	Acceptable Use of Assimilative Capacity (i.e., 0.1 or 0.3 for point source and diffuse source discharges, respectively).

SEPS (Saskatchewan Environment and Public Safety). 1997. Surface water quality objectives. WQ110. Regina Saskatchewan.

Appendix 6 Components of a National Pollution Discharge Elimination System Permit

Under the National Pollution Discharge Elimination System (NPDES) program, all facilities that discharge pollutants from any point source into waters of the U.S. are required to obtain a permit. The following information on water management in the U.S. was abstracted from USEPA (2006). All NPDES permits consist, at minimum, of at least five general sections, including:

- Cover Page - The cover page typically contains the name and location of the permittee, a statement authorizing the discharge, and the specific locations for which the discharge is authorized;
- Effluent Limits - The effluent limits represent the primary mechanism for controlling discharges of pollutants to receiving waters;
- Monitoring and Reporting Requirements - This section of the permit outlines the monitoring that must be conducted to characterize wastewaters and receiving waters, to evaluate the efficacy of wastewater treatment systems, and to assess compliance with the conditions of the permit;
- Special Conditions - This section of the permit outlines any additional measures that must be undertaken to protect water quality conditions in the vicinity of the facility, including best management practices, additional monitoring activities, ambient stream surveys, and toxicity reduction evaluations; and,
- Standard Conditions - This section outlines the legal, administrative, and procedural requirements of the permit.

More information on the NPDES permitting process can be obtained in USEPA (2006) or by visiting the USEPA web site (http://cfpub.epa.gov/npdes/home.cfm?program_id=45).

Appendix 7 A Recommended Framework for Water Quality Management in Northern Canada

A7.0 Introduction

The Office of the Auditor General (OAG) conducted an audit of INACs performance in terms of managing its responsibilities that form part of the application and licensing process for the development of non-renewable resources in the NWT. One recommendation that emerged from that audit was that INAC should, in consultation with the MVRMA boards, develop standards for water and the Minister should direct the boards to use those standards. Development and implementation of blanket WQS for northern waters (i.e., establishment of conditions that must be met outside initial dilution zones; IDZs) represents one option for providing proponents with greater certainty in the water licensing process. Establishment of uniform environmental quality criteria (EQC) and/or industry-specific EQC represents additional options that could be pursued to achieve the same goal. While either of these may represent viable options for establishing water standards, it is likely that development of an integrated framework (including procedures for deriving WQOs and EQC) would provide a more reliable and flexible basis for managing water quality in the Mackenzie Valley and elsewhere in the NWT.

Jurisdictions throughout North America and around the world are transitioning toward an ecosystem-based or watershed-based approach to water management. Such approaches are intended to provide a basis for addressing long-term goals and objectives for the watershed as a whole, within a framework that accommodates assessment and licensing of individual development projects. In this way, long-term land and water use planning, rather than the needs of individual projects, can drive decision making relative to water quality management. This chapter provides a brief description of the ecosystem approach and identifies the key elements of a framework for managing water resources in the north.

A7.1 Background

The results of the current review of the water management frameworks that are being used in other jurisdictions and our interactions with resource managers throughout Canada and the United States indicate that many jurisdictions have incorporated water permitting/licensing activities into broader water resources management frameworks. In addition, these activities are now commonly undertaken within an ecosystem-based management or watershed planning system that enables water managers to implement legislation, regulations, policies, and plans in a manner that supports their long-term vision for the future. Such frameworks are typically dependent on the establishment of ecosystem goals and objectives, indicators of environmental quality conditions and associated metrics, and environmental quality objectives. In turn, these management tools can be used to develop EQC that address the broader water management goals that have been established for a watershed, while providing proponents

with the certainty that they need to plan and implement a non-renewable resource development project.

The advantages of establishing such an integrated water management framework are numerous. First, the ecosystem goals and objectives that are established at the outset of the process provide the information needed to develop land and water use plans that directly respond to the interests and needs of watershed residents. This is particularly important in the north, where consultation with affected stakeholders has been assigned a high priority. The broader interests and needs of Canadians can also be incorporated into such land and water use plans by engaging the appropriate people in the ecosystem goals and objectives development process. These management tools then provide a basis for selecting a relevant approach to water management in the watershed (e.g., non-degradation vs. use protection). Such land and water use plans also provide information that is directly relevant for evaluating the acceptability and suitability of individual project proposals (i.e., in environmental assessment). In addition, this type of framework supports the development of site-specific water quality objectives (WQOs) that define the characteristics of water, sediment, and biota that need to be maintained to satisfy the interests and needs of watershed residents. The WQOs can be used directly for assessing the potential impacts of a development project (i.e., in the environmental assessment stage) and for establishing licence conditions relative to effluent quality conditions, monitoring requirements, and IDZs. Importantly, this type of framework is also useful for evaluating project performance and safety of downstream water users.

The main limitation of this type of framework is that it does not provide project proponents, on an *a priori* basis, with the information on the specific conditions that they need to meet to proceed with a developmental proposal. Rather, it defines the process that will be used to evaluate the suitability of a project for siting within a watershed and for determining the water quality conditions that must be maintained outside the IDZ. When used together with information on the nature of the development, the likely characteristics of wastewaters from the site, and ambient environmental quality conditions, proponents are likely to be able to assess the potential impacts of the project and to determine the level of treatment required to mitigate those impacts. Additionally, the costs associated with collecting baseline environmental quality data, conducting the environmental assessment, deriving environmental quality objectives, and for determining effluent quality requirements would be borne by the project proponent (i.e., instead of the government, other stakeholders, and the proponent, as is currently the case). This latter limitation could be viewed as a benefit by many participants in the environmental assessment and water licensing process, however.

A7.2 An Overview of the Ecosystem Approach to Renewable and Non-Renewable Resource Management

The ecosystem approach to planning, assessment and management is the most recent phase in an historical succession of environmental management approaches. Previously, humans had been considered to be separate from the environment in which they lived. This *egocentric*

approach viewed the external environment only in terms of human uses. However, overwhelming evidence from many sources indicates that human activities can have significant and far-reaching impacts on the environment and on the humans who reside in these systems. Therefore, there was a need for a more holistic approach to environmental management, in which humans were considered as integral components of the ecosystem. The ecosystem approach provides this progressive perspective by integrating the *egocentric view* that characterized earlier management approaches, with an *ecocentric view* that considers the broader implications of human activities.

The primary distinction between the environmental and ecosystem approaches is whether the system under consideration is external to (in the environmental approach) or contains (in the ecosystem approach) the population under study (Vallentyne and Beeton 1988). The identifying characteristics of the ecosystem approach include (Vallentyne and Hamilton 1987):

- A synthesis of integrated knowledge on the ecosystem;
- A holistic perspective of interrelating systems at different levels of integration; and,
- Actions that are ecological, anticipatory, and ethical.

This expanded view then shapes the planning, research, and management decisions that are made within and pertaining to the ecosystem. Importantly, the ecosystem approach also provides a basis for integrating social, economic, and environmental interests into a decision-making framework that embraces the concept of sustainable development (Figure A7.1). The ecosystem approach is superior to the approaches to environmental management that have been used previously for a number of reasons. First, the ecosystem approach provides a basis for the long-term protection of natural resources, including threatened and endangered species. In the past, management decisions were typically made with a short-term vision (i.e., within a single political mandate). Second, the ecosystem approach provides an effective framework for evaluating the real costs and benefits of developmental proposals. Third, the ecosystem approach enhances the multiple use of natural resources. Fourth, the ecosystem approach provides a basis for focussing environmental research and monitoring activities by establishing very clear management goals for the ecosystem. Fifth, in the ecosystem approach, the functional relationships between human activities, changes to the physical and chemical environment, and alterations in the biological components of the ecosystem are established before making important management decisions. The ecosystem approach also facilitates the restoration of damaged and degraded natural resources. Finally, one of the most important benefits of the ecosystem approach is that it directly involves the public in decision-making processes.

Implementation of the ecosystem approach requires a framework in which to develop and implement management policies for the ecosystem. In general, this framework is comprised of three functional elements (CCME 1996a). The first element of the framework is a series of broad management goals (i.e., ecosystem goals), which articulate the long-term vision that has been established for the ecosystem. These goals must reflect the importance of the ecosystem to the community and to other stakeholder groups. The second element of the

framework is a set of *objectives* for the various components of the ecosystem which clarify the scope and intent of the ecosystem goals. These objectives should include target schedules for being achieved. The final elements of the framework are a set of *ecosystem indicators* (including specific *metrics and targets*), which provide an effective means of measuring the level of attainment of each of the ecosystem goals and objectives. To be effective, these management tools need to be integrated into the policies and plans that are used to manage natural resources (Figure A7.2, A7.3, and A7.4).

A7.3 Recommended Framework for Water Management in the North

To be effective, a framework for managing water quality conditions must meet the needs of Mackenzie Valley residents by conserving the pristine nature of northern waters and protecting traditional water uses, while providing project proponents with the certainty that they need to develop and implement a development proposal. Ideally, such a framework would provide a means of integrating these interests in a way that supports sustainable development of natural resources in northern Canada, for the benefit of all Canadians. Based on our review of frameworks that have been successfully implemented elsewhere, the key elements of such a framework are:

- Development of a long-term vision for the future;
- Translation of the long-term vision into a clearly articulated water management policy;
- Development of ecosystem goals and objectives for major river basins in the region;
- Identification of indicators of ecosystem health and associated metrics;
- Establishment of procedures for developing water quality objectives;
- Establishment of guidelines for characterizing baseline conditions;
- Establishment of general objectives for effluent discharges;
- Establishment of guidelines for establishing and regulating IDZs;
- Establishment of procedures for deriving EQC; and,
- Establishing guidelines for aquatic effects monitoring and associated research requirements.

Each of these elements of the recommended framework for water quality management is briefly described below.

A7.3.1 Development of a Long-term Vision for the Future

The first step in the ecosystem management process is intended to provide all participants in the process with a common understanding of the key issues and the existing knowledge base

for the ecosystem under investigation. While various types of information are collected, reviewed, evaluated, and collated at this stage of the process, emphasis is placed on assembling the available information on historic land and resource use patterns, on the structure, function, and status of the ecosystem, and on the socioeconomic factors that can influence environmental management decisions. Both contemporary scientific data and traditional knowledge are sought to provide as complete an understanding as possible on the ecosystem. The information assembled at this stage of the process should be readily accessible to all participants in the process (i.e., by completing and distributing a state of the knowledge summary report, preparing and making available a detailed technical report, and disseminating the underlying data). The information that is disseminated to participants at this stage of the process is intended to support development of a long-term vision for the future.

Multi-stakeholder workshops and community meetings represent the most reliable means of providing participants with an opportunity to describe the desired future state of the ecosystem (i.e., the long-term vision for the future). It is of fundamental importance to the ecosystem management process because it provides a mechanism for diverse interest groups to define their common interests and, in so doing, lays the groundwork for working together to achieve their common goals. Typically, these workshops and meetings are organized to enable participants to access key elements of the existing knowledge base (i.e., through presentations and hand-outs). Then, various workshop techniques (e.g., guided imagery, image recollection, small group discussions, group presentations) can be used to identify the elements of their vision for the future. Then, workshop participants are asked to identify the common elements of their shared vision for a healthy ecosystem (i.e., the vision elements to which most or all stakeholders can agree). Much of the required work to support such a long-term vision has already been completed in the Northwest Territories.

A7.3.2 Development of a Water Management Policy to Guide Decision-Making

Establishment of a water management policy to guide decision-making represents an essential element of the overall water management framework. A clearly articulated policy, perhaps more than any other factor, provides proponents with the certainty that they need to pursue various development proposals and stakeholders with the certainty that they require to be confident that water managers are adequately protecting and conserving their interests. Such a policy should be consistent with the long-term vision for the future that was developed in consultation with stakeholders and identify the approaches that will be used to manage water quality conditions (i.e., non-degradation, use protection, etc.). In addition, the policy should identify the designated water uses that will be protected and conserved. By establishing such a policy that applies universally throughout the Mackenzie Valley, the government's expectations will be clearly articulated to the MVRMA boards, thereby eliminating one of the factors that could lead to inconsistency in the assessment and licensing of development projects.

A7.3.3 Development of Goals and Objectives for Aquatic Ecosystems

Development of ecosystem goals and ecosystem health objectives for major river basins represents the third step in the recommended water management framework. In the north, stakeholders generally share a common vision for aquatic habitats, which could be stated as follows:

- Maintenance of the pristine nature of northern waters;
- Maintenance of traditional land and water uses;
- Self-maintenance or self-sustainability of the ecological systems;
- Sustained use of the ecosystem for economic or other societal purposes; and,
- Sustained development to ensure human welfare.

These broad vision elements provide a basis for developing ecosystem goals that provide guidance for managing human activities in a manner that assures the long-term sustainability of aquatic ecosystems. More specifically, these vision elements provide a relevant basis for defining ecosystem goals for managing aquatic ecosystems that applies broadly to freshwater ecosystems and can be modified for use in specific areas, as follows:

- *To protect the pristine nature of northern waters to the greatest extent possible; and,*
- *To protect, sustain, and, where necessary, restore healthy, functioning, and structurally-stable aquatic ecosystems that are capable of supporting current and future uses*.

While these long-term management goals effectively articulate the long-term vision for the management of aquatic ecosystems, they are too general to directly guide management decisions on a site-specific basis. To be useful, ecosystem goals must be further clarified and refined to establish *ecosystem health objectives* (Harris *et al.* 1987). In turn, the ecosystem health objectives support the identification of indicators and metrics that provide direct information for specifically assessing the health and integrity of the ecosystem.

Habitats that support the production of fish and wildlife are of fundamental importance for maintaining the uses of aquatic ecosystems. In recognition of the importance of aquatic habitats, the following ecosystem health objectives are recommended to provide guidance on the protection of aquatic ecosystems:

- *Maintain environmental quality conditions such that waters of superior quality are not unnecessarily degraded;*
- *Maintain environment quality conditions such that the health of aquatic plant and invertebrate communities (including species that are consumed by fish) is protected;*

- *Maintain environmental quality conditions such that the health of fish populations is protected;*
- *Maintain environmental quality conditions such that the health of aquatic-dependent wildlife populations is protected; and,*
- *Maintain environmental quality conditions such that human health is protected and the human uses of the aquatic ecosystem are conserved.*

These objectives explicitly recognize that there are multiple uses of aquatic ecosystems that can be affected by environment quality conditions and, hence, need to be considered in the assessment and management of water resources. Therefore, an effective framework for managing water quality conditions must provide a means of integrating multiple uses of water resources in a manner that assures their long-term sustainability.

A7.3.4 Identification of Indicators of Environmental Conditions and Associated Metrics

The ecosystem goals developed cooperatively by interested stakeholder groups describe the desired future state of an ecosystem (Bertram and Reynoldson 1992). Ecosystem health objectives further clarify these goals by expressing them in terms of the ecological characteristics and human uses of the ecosystem. Such ecosystem goals and ecosystem health objectives provide a basis for establishing ecosystem health indicators that guide the assessment and management of freshwater ecosystems. Adherence to this ecosystem-based approach enhances the likelihood that water management activities that are undertaken within a watershed (e.g., issuance of WLs) will be consistent with, and support, the broader management initiatives that have been established for the ecosystem.

Identification of candidate ecosystem health indicators represents an important step in the ecosystem-based management process. Candidate ecosystem health indicators encompass all of the ecosystem components and functions that could be used to provide information on the health of the ecosystem as a whole (i.e., to track progress toward the ecosystem goals and ecosystem health objectives). The existing knowledge base that was compiled as the first step of the process provides a summary of what is known about the structure and function of the ecosystem under investigation. As such, the existing knowledge base provides an effective basis for identifying candidate ecosystem health indicators for the system under investigation. In cases where the existing knowledge base is limited, information on similar ecosystems may be useful for identifying candidate ecosystem health indicators. The suite of indicators that are ultimately selected for assessing ecosystem health will be drawn from the candidate ecosystem health indicators that are identified at this stage of the process.

Initially, a broad suite of candidate indicators of ecosystem health are identified and evaluated to determine their applicability. Typically, selection criteria are established and applied on an *a priori* basis to provide a consistent means of identifying the indicators that are most relevant to the assessment and/or management initiative. A number of approaches have been used to evaluate candidate ecosystem health indicators. For example, the International Joint

Commission has developed a framework for evaluating and selecting biological indicators of ecosystem health (IJC 1991). This framework provides detailed guidance on the development of ecosystem goals, on the identification of physicochemical, biological, and sociological indicators of ecosystem health, and on the establishment of monitoring programs to assess attainment of these goals. Likewise, Environment Canada has proposed a national framework for developing biological indicators for evaluating ecosystem health, as well as specific guidance on their application (Environment Canada 1993; 1996; 1997; CCME 1996a). Both of these frameworks indicate that identification of the purpose of the resultant monitoring data is a central consideration in the selection of ecosystem health indicators. The IJC (1991) recognized five distinct purposes for which environmental data are collected, including:

- *Assessment:* evaluating the current status of the environment to determine its adequacy for supporting specific uses (i.e., fish and aquatic life). That is, monitoring the attainment of the ecosystem health objectives;
- *Trends:* documenting changes in environmental conditions over time. That is, monitoring the degradation, maintenance, and/or rehabilitation of the ecosystem under consideration;
- *Early warning:* providing an early warning that hazardous conditions exist before they result in significant impacts on sensitive and/or important components of the ecosystem;
- *Diagnostic:* identifying the nature of any hazardous conditions that may exist (i.e., the specific causes of ecosystem degradation) in order to develop and implement appropriate management actions to mitigate against adverse impacts; and,
- *Linkages:* demonstrating the linkages between indicators to improve the effectiveness and efficiency of monitoring programs and to reinforce the need to make environmentally sound management decisions.

Identification of the ultimate purpose of the monitoring data is important because no single indicator will be universally applicable in every application. For this reason, selecting a suite of indicators that most directly addresses the requirements of the monitoring program is necessary. Each of the selected ecosystem health indicators must be supported by specific metrics and targets, which identify the acceptable range for each of the variables that will be measured in the monitoring program (Figure A7.3). Such metrics and targets can be captured in the environmental quality objectives that are developed for a watershed. For example, environmental conditions in the vicinity of a hard mine site could be evaluated, in part, using information on water quality conditions (i.e., an indicator of ecosystem health). In this example, the total concentration of copper in surface water could be selected as a water quality metric and 2 ug/L could be selected as the water quality target if the waterbody has low hardness (i.e., < 60 mg/L of $CaCO_3$). Such a target represents the water quality objective for copper in the watershed. Development of such site-specific WQO represents an integral part of the recommended water management framework. Guidance on the identification of ecosystem health indicators and associated metrics is provided in MacDonald and Ingersoll (2003).

A7.3.5 Establishment of Procedures for Deriving Ambient Water Quality Objectives

WQO are science-based tools that provide an effective basis for managing the resources in aquatic ecosystems. These tools describe conditions that environmental managers have agreed should be met to protect the most sensitive designated uses of freshwater, estuarine, and marine ecosystems. More specifically, WQO are numerical concentrations or narrative statements that establish the conditions necessary to support and protect the most sensitive designated use of water, sediment, and biota at a specified site. Objectives are typically based on generic environmental quality guidelines and criteria, which may be modified to account for local environmental conditions or other factors.

In general, WQOs are prepared only for those waterbodies and water quality variables that may be affected by human activities, either now or in the future. WQO have no legal standing at this time and, therefore, are not enforced directly. Nevertheless, they are used in conjunction with other management tools, such as effluent controls and best available or practicable technology, to achieve environmental conditions that support sustainable resource use. While the mechanism has not been formalized, the WQOs are often used in the permitting and licensing processes in the NWT.

WQO form a cornerstone of the Federal Water Policy (Minister of Environment 1987). In addition, the need for WQOs is explicitly recognized in the CEPA [Section 8(1)]. To guide federal government staff, Environment Canada and Fisheries and Oceans Canada jointly developed a policy statement on the use and application of WQOs. In the federal policy, a WQO is defined as a numerical concentration or narrative statement that has been established to support and protect the designated uses of water at a specified site (CCREM 1987). Such objectives are based on the best scientific information available. When insufficient information exists, provisional WQOs are applied until the data required to develop scientifically-defensible objectives are available. Provisional WQOs are deliberately conservative and implemented with due caution.

WQO are developed to conserve and protect the designated water uses in the waterbody under consideration. The designated water uses recognized in the federal policy include:

- Raw water for drinking water supply;
- Recreation and aesthetics;
- Freshwater, estuarine, and marine fish;
- Migratory birds and other aquatic life;
- Agriculture (including irrigation and livestock watering); and,
- Industrial water supplies.

The federal government has also adopted a non-degradation policy to guide the management of water resources. This policy states that all reasonable and preventative measures should be taken to maintain existing conditions when they are better than the conditions specified by

the WQOs. Hence, the existing conditions should be adopted as the objectives for waters of superior quality. For waters with impaired quality, the objectives may be used as a basis for improving water quality.

The federal policy identifies a number of applications for the WQOs. For example, evaluation of compliance with the objectives provides a useful means of predicting and assessing whether effluent standards (which are based on best available or practicable technology) provide adequate protection for a designated water use. However, the objectives cannot be used to derive allowable effluent contaminant concentrations, if they result in relaxation of effluent treatment requirements such that legislated effluent standards (e.g., MMERs) are no longer met. These objectives would also provide a basis for identifying emerging water quality problems resulting from multiple point and diffuse sources and determining the need to address such problems.

The development of WQO represents one component of an integrated process for implementing ecosystem-based natural resource management in Canada. Two distinct strategies are commonly used to establish WQO in Canada. For waterbodies with aquatic resources of national or regional significance, the WQOs are established to avoid degradation of existing water quality. For all other waterbodies, the WQOs are established to protect the designated uses of the aquatic ecosystem. As long as the designated water uses are protected, some degradation of existing water quality is considered to be acceptable in these waterbodies.

The use protection strategy provides a consistent scientific basis for establishing WQO that accommodate multiple water uses of aquatic ecosystems. Using this strategy, ambient WQO can be derived using three separate approaches, including:

- Adoption of *generic* water quality guidelines (WQGs);
- Derivation of *site-adapted* WQOs; and,
- Development of *site-specific* WQOs.

For most waters, the generic WQG (e.g., CCME 1999; 2002) provide an appropriate basis for establishing the WQOs. However, such generic guidelines may require modification before they are directly applicable to certain sites, especially those with atypical water quality conditions or resident species assemblages. Also, it may be necessary to develop WQOs on a *de novo* basis in some cases, particularly when a high level of precision in the values is required.

Development of numerical WQOs from the generic water quality criteria and guidelines involves a number of steps (Figure A7.5). The first step in this process involves identification of the designated uses of the aquatic ecosystem. Next, a list of COPCs is prepared using information on the existing and proposed developments in the basin. Screening the data on wastewater and receiving water quality using the generic WQG and criteria also supports the identification of COPC contaminants of concern. However, it may be necessary to utilize more sophisticated methods to identify the contaminants that represent significant hazards to

aquatic organisms when complex mixtures of contaminants are present in wastewaters or receiving waters (e.g., toxicity identification evaluation procedures; Ankley and Thomas 1992).

Once the contaminants of concern are identified, the available WQG for each substance and each water use are compiled and modified to account for the ambient water quality characteristics of the waterbody (e.g., pH, water hardness, etc.). For each substance, the water quality guideline for the most sensitive water use is selected as the preliminary WQO. The preliminary WQOs are then compared to the natural background concentrations of each substance, and the higher of the two values is selected as the WQO for that substance.

While adoption of generic water quality criteria and guidelines represents the primary procedure for establishing numerical WQOs, the presence of unique water quality characteristics or species assemblages at certain sites may necessitate the derivation of site-adapted WQOs. For example, the receiving water at a site could have high levels of dissolved organic carbon, which has the potential to complex dissolved metals and reduce their toxicity. Alternatively, the receiving water system could contain only a warmwater fish assemblage, which may be less sensitive to certain contaminants than salmon and trout. In both of these situations, the development of site-adapted WQOs would be appropriate. Therefore, procedures are needed for deriving of WQOs that consider the sensitivities of resident species and/or the effect of site water characteristics on contaminant toxicity.

At a few sites, it might be necessary to develop very accurate WQOs that are directly applicable to the receiving water system under investigation. For example, it might be necessary to develop such site-specific WQOs when insufficient toxicological data are available to develop generic WQG and criteria for a substance. Alternatively, insufficient information on the physical, chemical, and biological characteristics of the receiving water system may also be available to modify the generic WQG to consider site conditions. While the development of manufacturing processes that reduce the production of waste products and improvement of the performance of wastewater treatment systems are normal research and development activities that are actively pursued by all responsible corporations and government organizations, it is possible that the costs associated with implementing the remedial measures necessary to comply with the WQOs could be substantial. In such cases, more certainty in the WQOs may be required before such expenditures are authorized by the regulated interest. Such site-specific WQOs should account for the sensitivities of resident species and the effects of site water on contaminant toxicity simultaneously.

A number of procedures have been developed to support the derivation of WQO. While many of these are risk-based or technology-based, several procedures have been developed that provide a basis for assessing the hazards to aquatic organisms associated with exposure to water-borne contaminants, including:

- Background concentration procedure;
- Recalculation procedure;
- Indicator species procedures; and,

- Resident species procedure.

Descriptions of each of these procedures for deriving site-specific WQOs are provided in *Methods of Deriving Site-Specific Water Quality Objectives in British Columbia and Yukon* (MacDonald 1997).

A7.3.6 Establishment of Guidelines for Characterizing Baseline Conditions

Determination of water quality conditions in a watershed under baseline (i.e., pre-development) conditions represents an important element of the overall water management process. However, neither the federal government nor the MVRMA boards have established guidance that defines requirements for collecting, evaluating, and compiling baseline water quality data and related information to support environmental assessments and subsequent water licensing. As such, project proponents do not have a clear understanding of the data and information requirements for either of these processes. As a result, the data that have been collected are frequently inadequate for characterizing baseline conditions. Limitations on the quality and quantity of data available have the potential to compromise decisions made during the environmental assessment and undermine the water licensing process. Importantly, such limitations also have the potential to severely affect the integrity of aquatic effects monitoring programs (AEMP), which are implemented to evaluate project-related effects and identify conditions requiring mitigation. Therefore, the development of guidance on baseline water quality and related monitoring should be identified as a high priority for the federal government and the MVRMA boards.

A7.3.7 Establishment of General Objectives for Effluent Discharges

Many project proponents have a need to understand the requirements for waste discharges that apply to their developmental project. One way to reduce uncertainty associated with these requirements is to establish general objectives for effluent discharges that apply universally to all waste discharges. Such general objectives would be expressed as a series of narrative statements that establish regulatory policy relative to waste discharges. The general objectives for effluent discharges that have been established by the Saskatchewan Department of Environment and Public Safety (SEPS 1997; Section 4.1 of this document) provide a good example of such objectives. It is recommended that the federal government review the provisions of the Northwest Territories Water Act (NTWA) and, MVRMA in conjunction with other federal statutes and policies, to establish an appropriate regulatory policy for effluent discharges. While such a regulatory policy has been tacitly applied in existing WLs, it would be beneficial to make such a policy more readily apparent to project proponents and to stakeholders.

A7.3.8 Establishment of Guidelines for Establishing and Regulating Initial Dilution Zones

The concept of IDZs is firmly entrenched in the water management frameworks that are applied in most North American jurisdictions. Briefly, the IDZ provides an area within the receiving waterbody within which an effluent is assimilated into receiving waters. In general, IDZs represent limited water use zones. That means, that water quality conditions may not be sufficient to support all of the designated uses of a watershed within the IDZ. However, the ambient WQOs must be met at the mixing zone boundary. Establishment of an IDZ permits a wastewater discharger to utilize a portion of the assimilative capacity of the receiving water system and, thereby, eliminates the need to have the effluent meet the ambient WQOs prior to discharge. In this way, incorporation of IDZs into a water management framework greatly reduces water treatment costs for many project proponents, making many projects economically feasible that, otherwise, could not be implemented.

The IDZ concept has been applied, both explicitly and implicitly, in a number of WLs that have been issued by the NTWB and the MVLWB. However, an official policy relative to the establishment and application of IDZs that not been established by the federal government or the MVRMA boards. In addition, there has been considerable debate during water licensing about the need for incorporating the IDZs concept into the EQC-derivation process. This is a significant problem and one that needs to be resolved if project proponents are to better understand the requirements for wastewater discharges that need to be met by developmental projects. Therefore, it is recommended that the IDZ concept be explicitly incorporated into the water management policy that is developed for the north. In addition, it is recommended that IDZ guidelines be developed that clearly described the general characteristics that IDZs should and should not have.

A7.3.9 Establishment of Procedures for Deriving Effluent Quality Criteria

Our review of the WLs that have been issued by the NTWB and the MVRMA boards indicates that a variety of methods and procedures have been used to derive EQC. The results of this review also indicated that the procedures that were used to derive the EQC were only rarely described in sufficient detail to enable informed readers to fully understand and replicate the process. While the EQC that have been incorporated into the various WLs that were reviewed may well be reasonable, internally consistent, and scientifically defensible, the lack of appropriate documentation makes it difficult for prospective applicants to clearly understand the requirements for effluent discharges that are likely to be applicable to their project. This is a significant source of uncertainty in the water licensing process and one that must be addressed in a water management framework for the north.

Based on the results of our review of the procedures that have been used in other jurisdictions and our experience in this field, it is recommended that the federal government, in consultation with the MVRMA boards, establish a formal procedure for deriving EQC that can be applied consistently to development projects throughout the Mackenzie Valley. More specifically, a multi-stepped approach to the development of EQC is recommended (Figure

A7.6). The first step of this process involves the establishment of ambient WQOs that would protect the designated uses of the receiving water system under consideration. Again, ambient WQOs may be established using the non-degradation or use-protection approach, depending on the long-term ecosystem goals and objectives that have been established for the watershed.

The next step in the EQC derivation process involves estimation of MDFs for each wastewater source for the proposed facility under consideration. Determination of MDFs requires information on the location of proposed wastewater discharges, the dimensions of the IDZ, the rate of the wastewater discharge, and various physical and chemical data for the wastewater and the receiving water. Effluent dispersion modelling or mass balance modelling is used, to estimate MDFss for each wastewater source.

Subsequently, numerical EQC can be derived by back-calculating from the WQOs using the most appropriate dilution factor (DFs) and information on background concentrations of the variables of concern (BCs). The following equation is used to develop these effects-based EQC:

$$EQC = (WQO - BC) \times DF$$

The effects-based EQC provide a basis for defining the characteristics of the effluent that are required to protect the designated uses and/or relatively pristine nature of the receiving water system.

In addition to the effects-based EQC, it is also useful to determine treatment technology-based EQC for the project. For metal mining, the MMERs represent the most relevant source of treatment technology-based EQC. For pulp and paper mills, the pulp and paper effluent regulations should be consulted to establish treatment technology-based EQC. BAT for sewage treatment in the north (INAC 2003) represents a useful source of information for defining technology-based EQC. For industries for which specific effluent regulations have not established, the concentrations of COPCs that are considered to be achievable through the implementation of BATT can be determined by reviewing the information contained in the published literature or various reviews of the literature sources.

In the final step of the EQC derivation process, the water quality-based EQC are compared to the treatment technology-based EQC. The lower of the two values would be adopted as the EQC for each COPC. Adoption of such an approach to EQC derivation would provide project proponents with the certainty that they need regarding the requirements for wastewater discharge that they need to meet. At the same time, adoption of consistent procedures for deriving EQC will provide stakeholders with the certainty that they need relative to the protection of designated water uses and the pristine nature of northern ecosystems.

A7.3.10 Establishing Guidelines for Aquatic Effects Monitoring

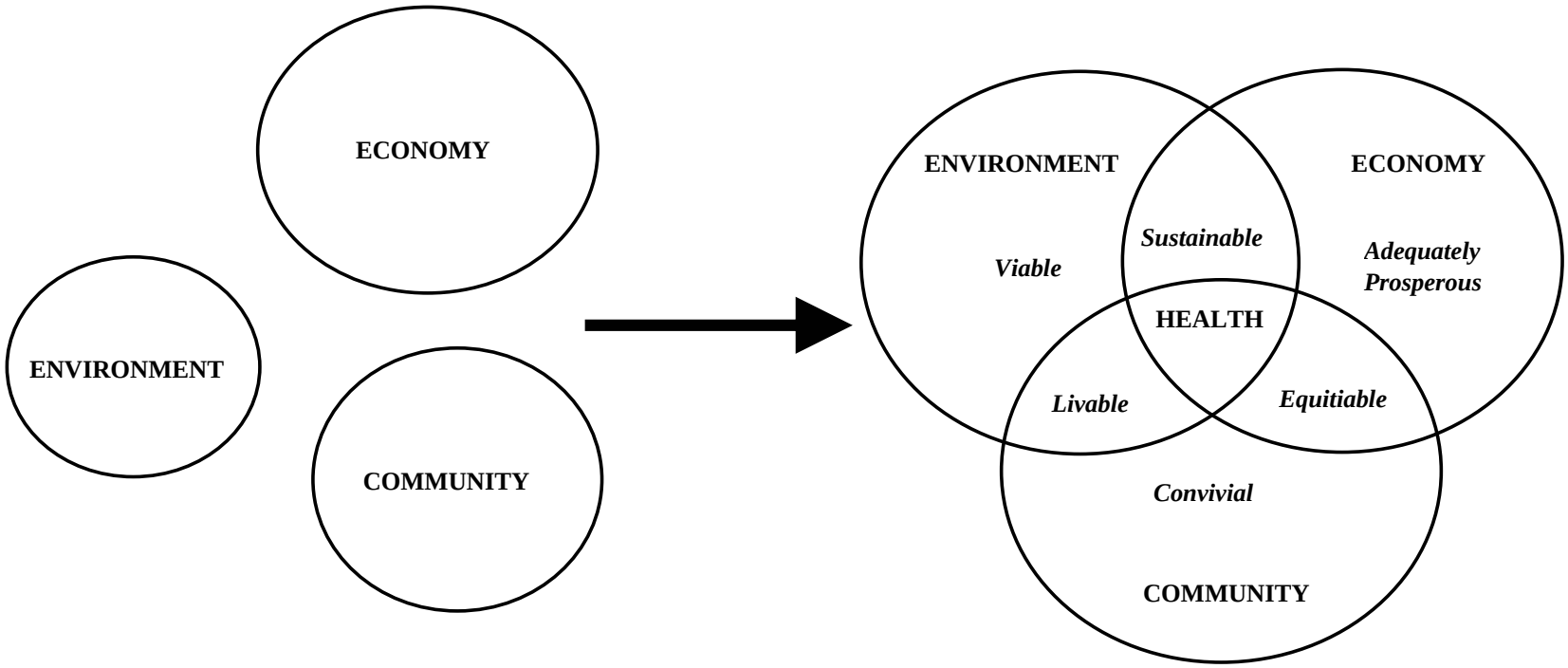
Aquatic effects monitoring is conducted in the vicinity of developmental projects to address issues and concerns raised by communities and regulatory agencies relative to the environmental effects of the project. More specifically, AEMPs attempt to measure changes, over time, in the water quality, sediment quality, and/or biological characteristics of the receiving waterbody in response to wastewater discharges and/or other activities associated with the project. Such AEMPs are usually designed to:

- Determine if there has been a change in the measured variable from baseline conditions;
- Determine if project-related activities are the source of the change in the measured variable;
- Determine if the measured results exceed predictions made in the environmental assessment; and/or,
- Determine if the measured change is likely to cause a significant adverse environmental impact.

While aquatic effects monitoring is commonly included as a condition for the WLs issued by the NTWB and MVRMA boards, neither the federal government not the boards have established guidelines for aquatic effects monitoring. Accordingly, each project proponent is responsible for designing and implementing an AEMP to evaluate the effects of the project on the aquatic ecosystem. In some cases, the boards have established technical committees to provide advice and oversight on the AEMP-development process. While this approach has been successful in some cases (i.e., when the project proponent is willing and capable of developing and implementing an appropriately-designed AEMP), it has resulted in serious problems in other cases (e.g., Diavik Diamond Mines Inc's AEMP). Accordingly, the project-by-project approach to development of AEMPs should be considered undesirable.

A better approach would involve the federal government, in consultation with the MVRMA boards, playing a leadership role in the development of guidelines for aquatic effects monitoring. Following review and approval by stakeholders, such guidelines would provide everyone involved in the water management process with a clear understanding of monitoring requirements and, hence, a basis for developing and evaluating AEMPs designed to assess project-related effects. The development of such guidelines should be identified as a high priority by the federal government and the MVRMA boards.

Figure A7.1. The shift from traditional to ecosystem-based decision making (from CCME 1996).



Relationships within ecosystems can best be visualized as three interlocking circles: environment, economy, and community. Traditionally most decision making separates these three components, with little understanding (or even heed), for example, of the effects of economic decisions on community needs or the environment. The challenge now is two-fold: to understand the links between these components and to redress the balance among them. The ecosystem approach requires an equal and integrated consideration of these elements.

Figure A7.2. A framework for ecosystem-based management (from CCME 1996).

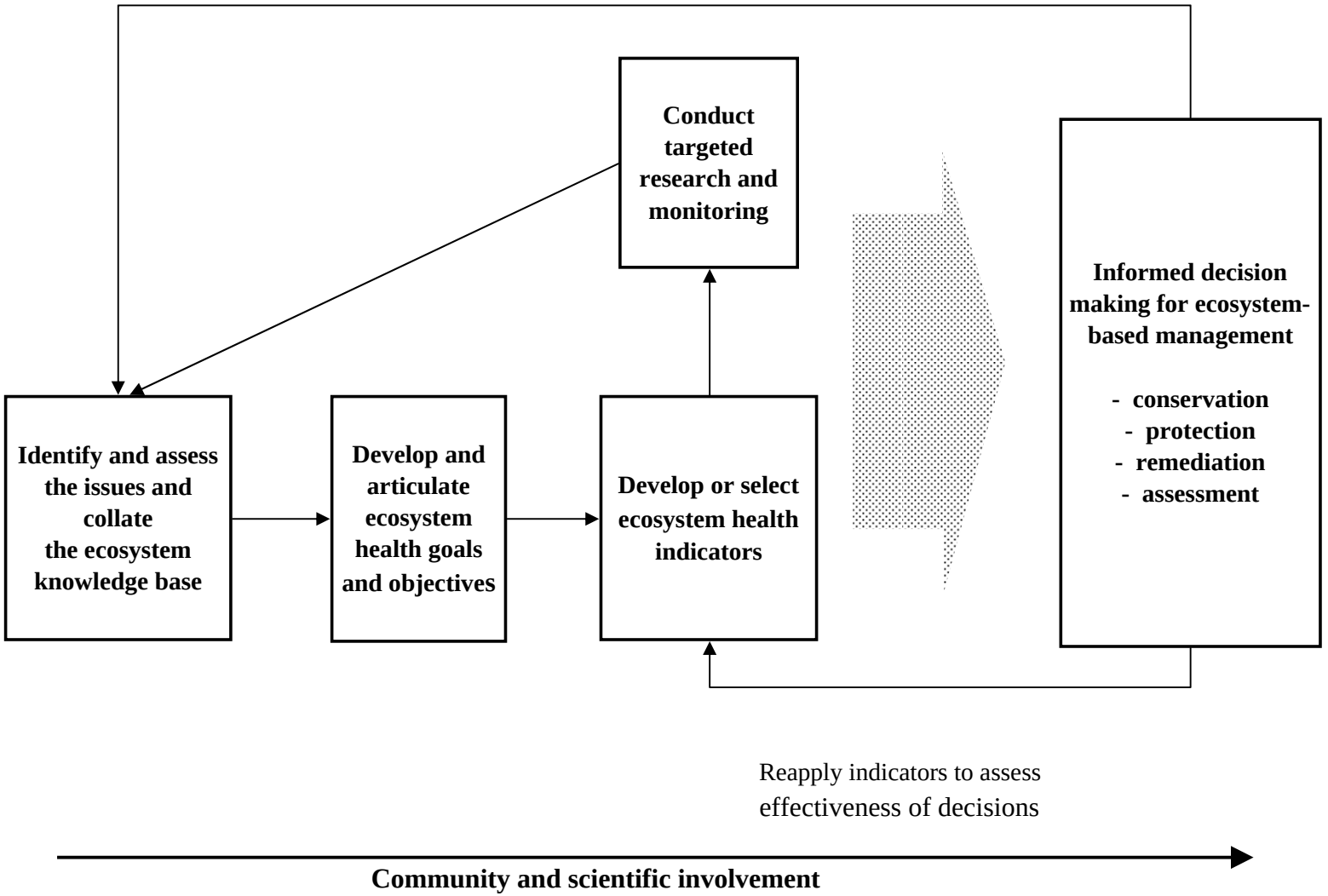


Figure A7.3. Overview of the recommended process for development of environmental quality objectives.

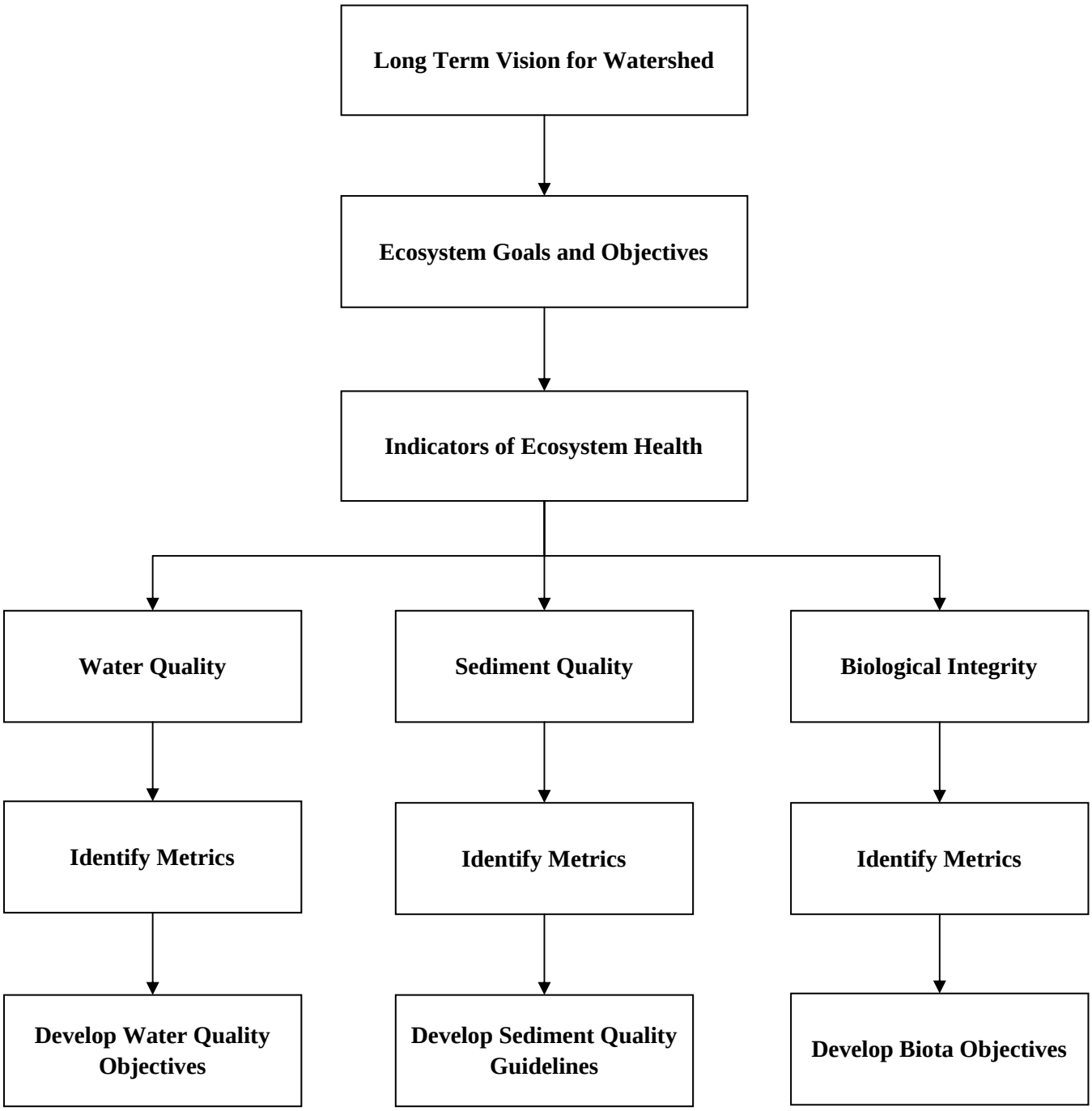


Figure A7.4. An overview of the implementation process for the ecosystem approach to environmental management.

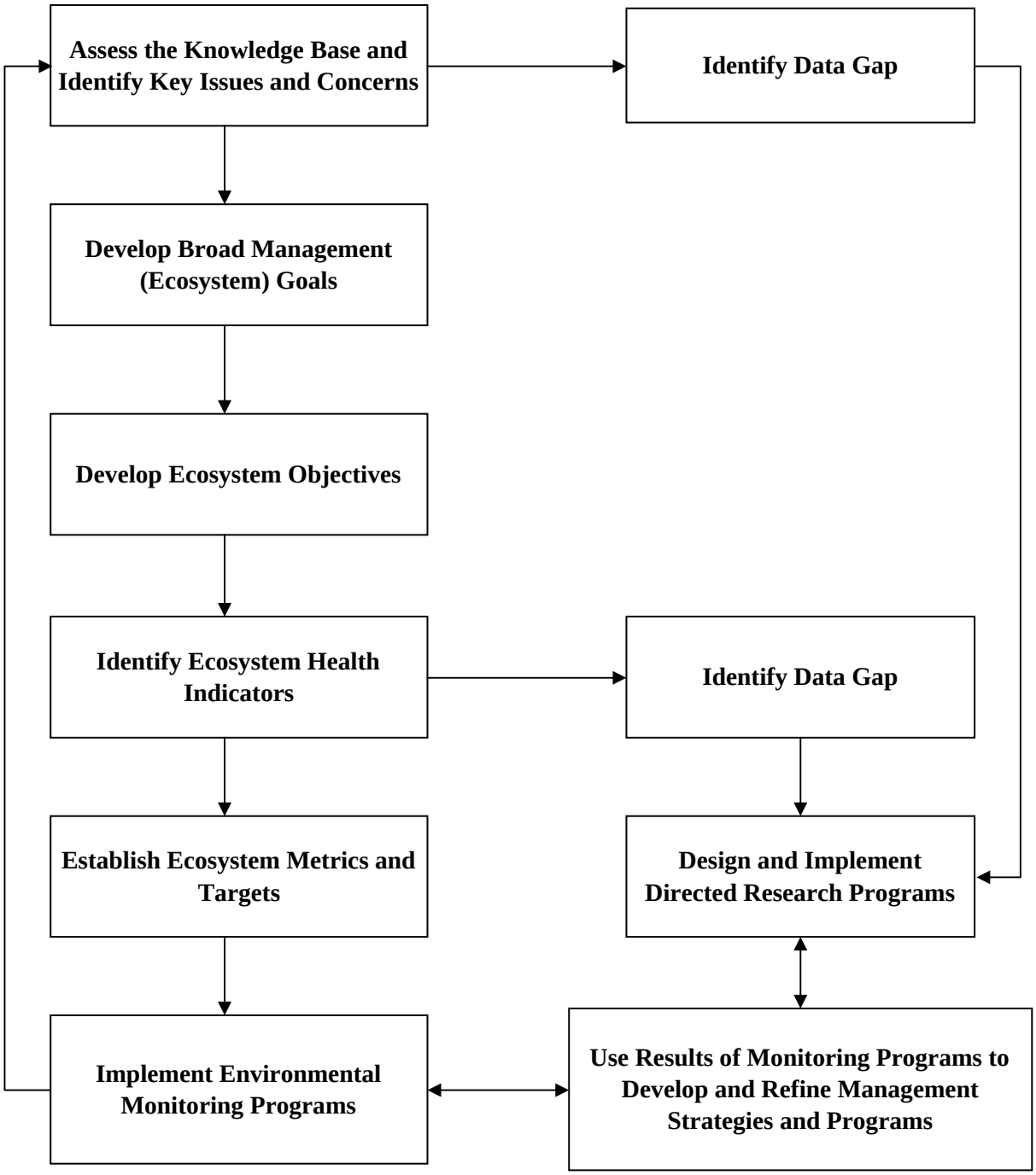


Figure A7.5. An overview of the process for deriving numerical water quality objectives (WQOs).

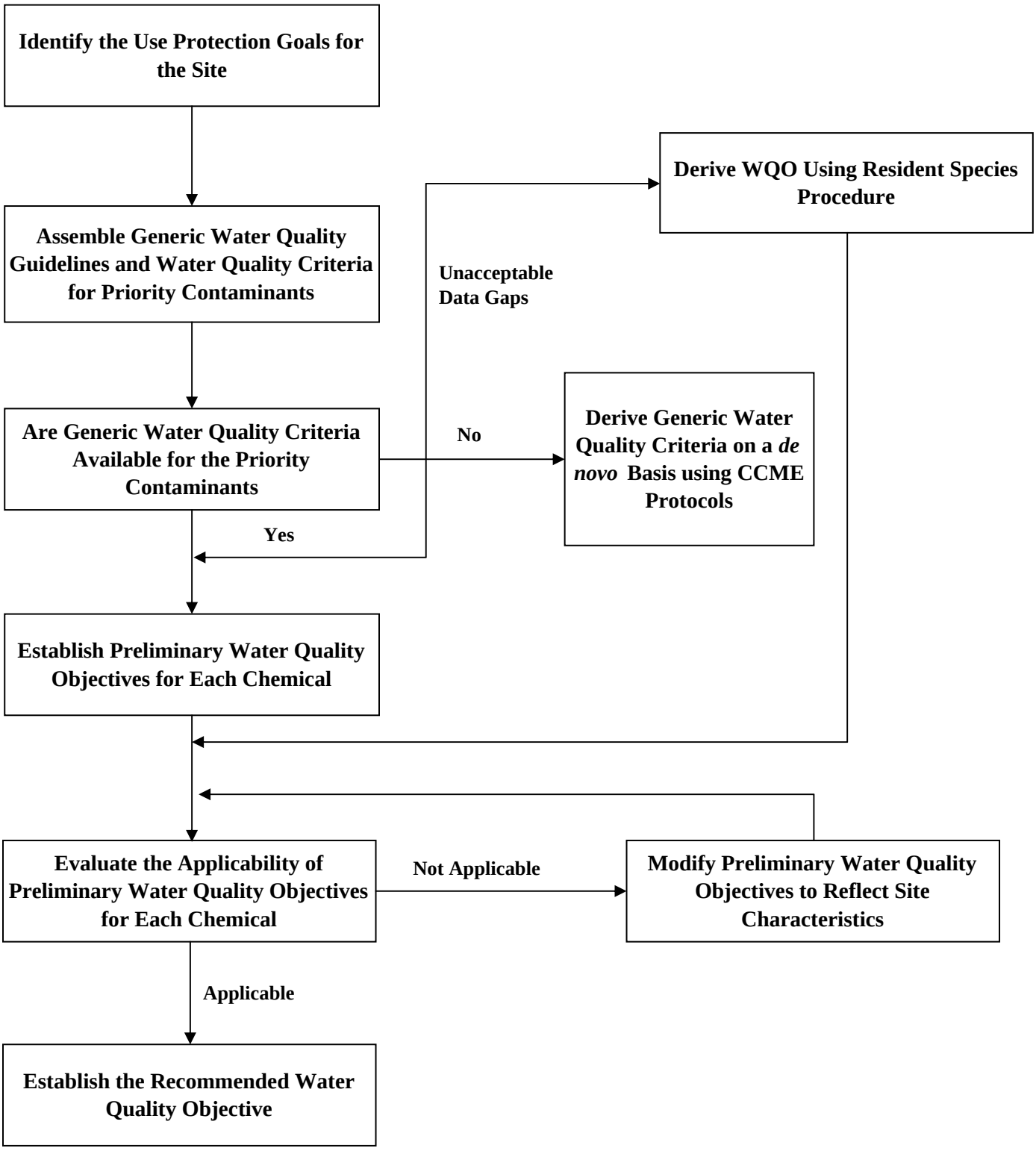
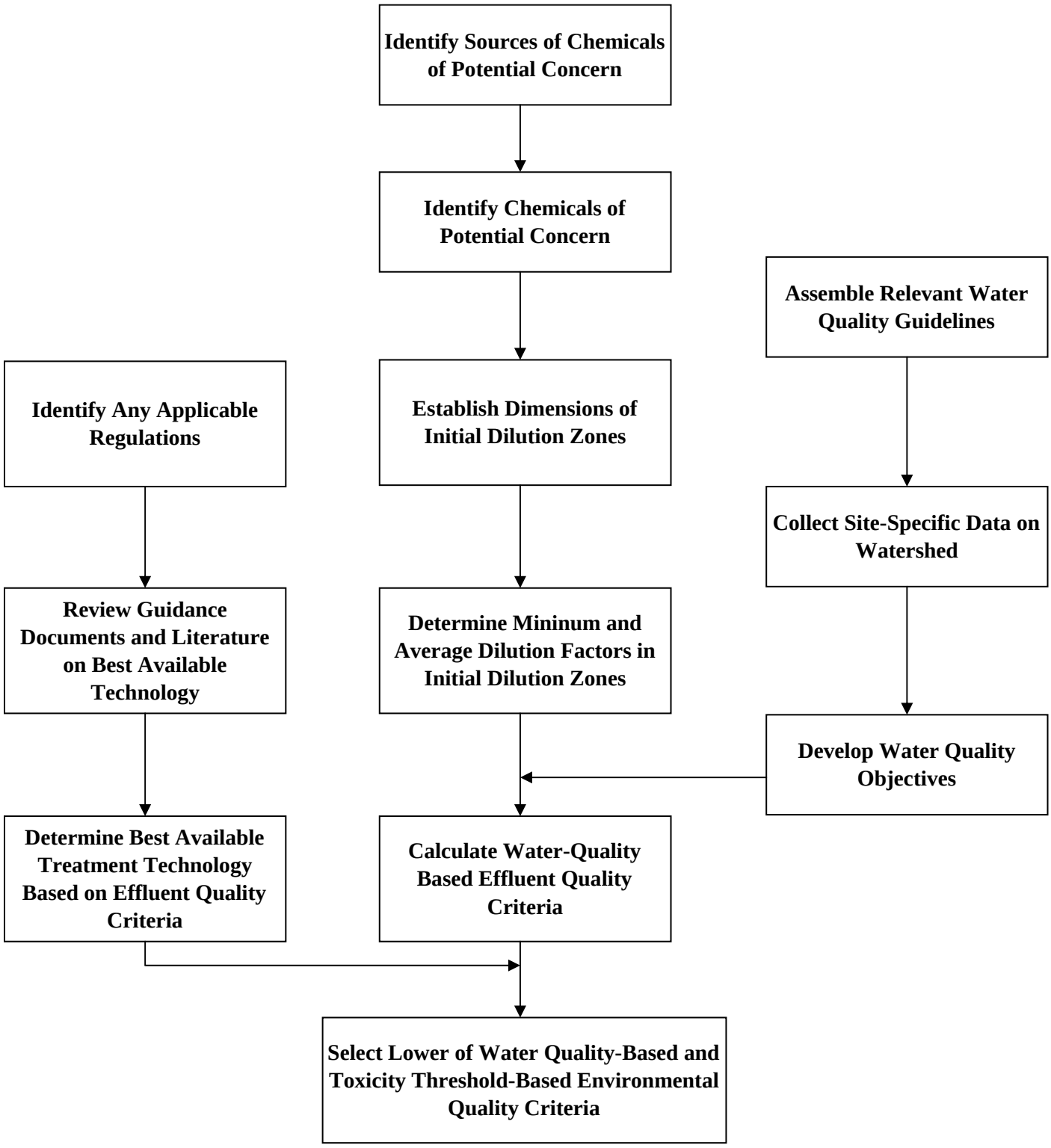


Figure A7.6. Overview of the recommended process for developing effluent quality criteria.



Appendix 8 Interests and Needs Relative to Water Management in the North

A8.0 Introduction

Consultation is the cornerstone of the Mackenzie Valley Resource Management Act (MVRMA; INAC 2001). Accordingly, the water management process established under the MVRMA has been characterized by extensive public consultation, as evidenced by the numerous opportunities to request further information on WL applications, participate in technical sessions to identify issues and concerns regarding applications, prepare and deliver interventions at public hearings convened by the boards, serve on technical committees struck to provide the boards with input on WL terms and conditions, and comment on draft WLs. The information provided by participants in these processes could be used to define, more broadly, interests and needs relative to water management in the north.

A8.1 Observations on Water Management Interests and Needs

Input provided during various consultative processes established by the MVRMA boards indicates that participants often have similar interests and needs. For example, testimony provided at the public hearings that were convened to support licensing of the three diamond mines in the NWT indicated that virtually all participants recognized that northern ecosystems represent unique aquatic resources that must be protected and conserved for future generations. In addition, such testimony confirmed that maintenance of the existing uses of water resources is a high priority that cannot be compromised by renewable and non-renewable resource development schemes. Furthermore, input provided at these hearings indicates that northerners recognize the benefits that resource development projects bring to the region and support the concept of sustainable resource development. Finally, project proponents have expressed an interest in securing access to renewable and non-renewable resources within a management framework that clearly articulates roles, responsibilities, and expectations. Effectively addressing the diverse interests and needs of participants within an effective water management framework represents one of the key challenges facing the land and water boards established under the MVRMA.