Section 1C

Metal Mining Effluent Regulations Plan
v1 October 2005

CUMBERLAND
RESOURCES LTD.

MEADOWBANK GOLD PROJECT

METAL MINING EFFLUENT REGULATIONS (MMER) PLAN

OCTOBER 2005

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DESCRIPTION OF SUPPORTING DOCUMENTATION

Cumberland Resources Ltd. (Cumberland) is proposing to develop a mine on the Meadowbank property. The property is located in the Kivalliq region approximately 70 km north of the Hamlet of Baker Lake on Inuit-owned surface lands. Cumberland has been actively exploring the Meadowbank area since 1995. Engineering, environmental baseline studies, and community consultations have paralleled these exploration programs and have been integrated to form the basis of current project design.

The Meadowbank project is subject to the environmental review and related licensing and permitting processes established by Part 5 of the Nunavut Land Claims Agreement. To complete an environmental impact assessment (EIA) for the Meadowbank Gold project, Cumberland followed the steps listed below:

1. Determined the VECs (air quality, noise, water quality, surface water quantity and distribution, permafrost, fish populations, fish habitat, ungulates, predatory mammals, small mammals, raptors, waterbirds, and other breeding birds) and VSECs (employment, training and business opportunities; traditional ways of life; individual and community wellness; infrastructure and social services; and sites of heritage significance) based on discussions with stakeholders, public meetings, traditional knowledge, and the experience of other mines in the north.

2. Conducted baseline studies for each VEC and compared / contrasted the results with the information gained through traditional knowledge studies (see Columns 1 and 2 on the following page for a list of baseline reports).

3. Used the baseline and traditional knowledge studies to determine the key potential project interactions and impacts for each VEC (see Column 3 for a list of EIA reports).

4. Developed preliminary mitigation strategies for key potential interactions and proposed contingency plans to mitigate unforeseen impacts by applying the precautionary principle (see Columns 4 and 5 for a list of management plans).

5. Developed long-term monitoring programs to identify residual effects and areas in which mitigation measures are non-compliant and require further refinement. These mitigation and monitoring procedures will be integrated into all stages of project development and will assist in identifying how natural changes in the environment can be distinguished from project-related impacts (monitoring plans are also included in Columns 4 and 5).

6. Produce and submit an EIS report to NIRB.

As shown on the following page, this report is part of the documentation series that has been produced during this six-stage EIA process.

CUMBERLAND
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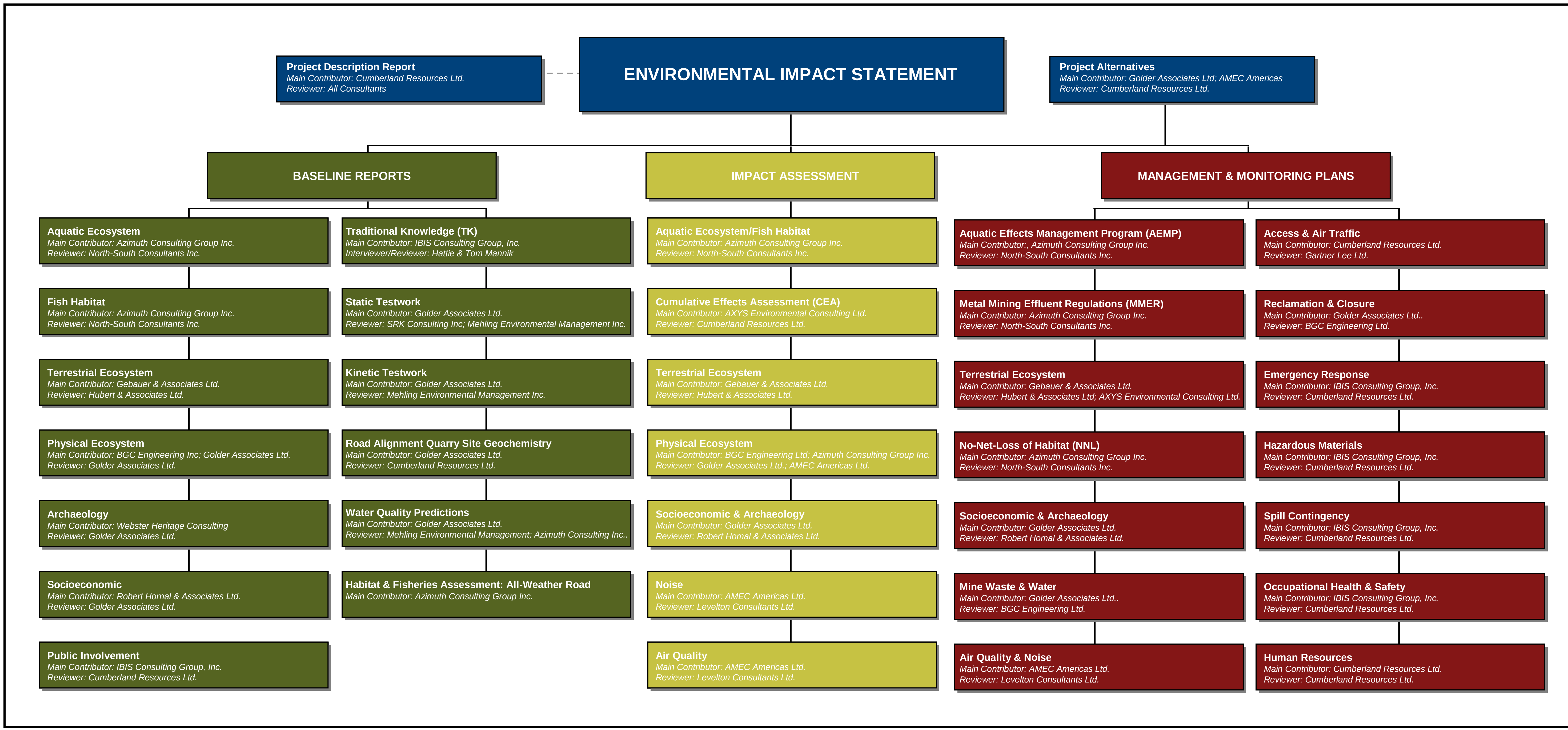
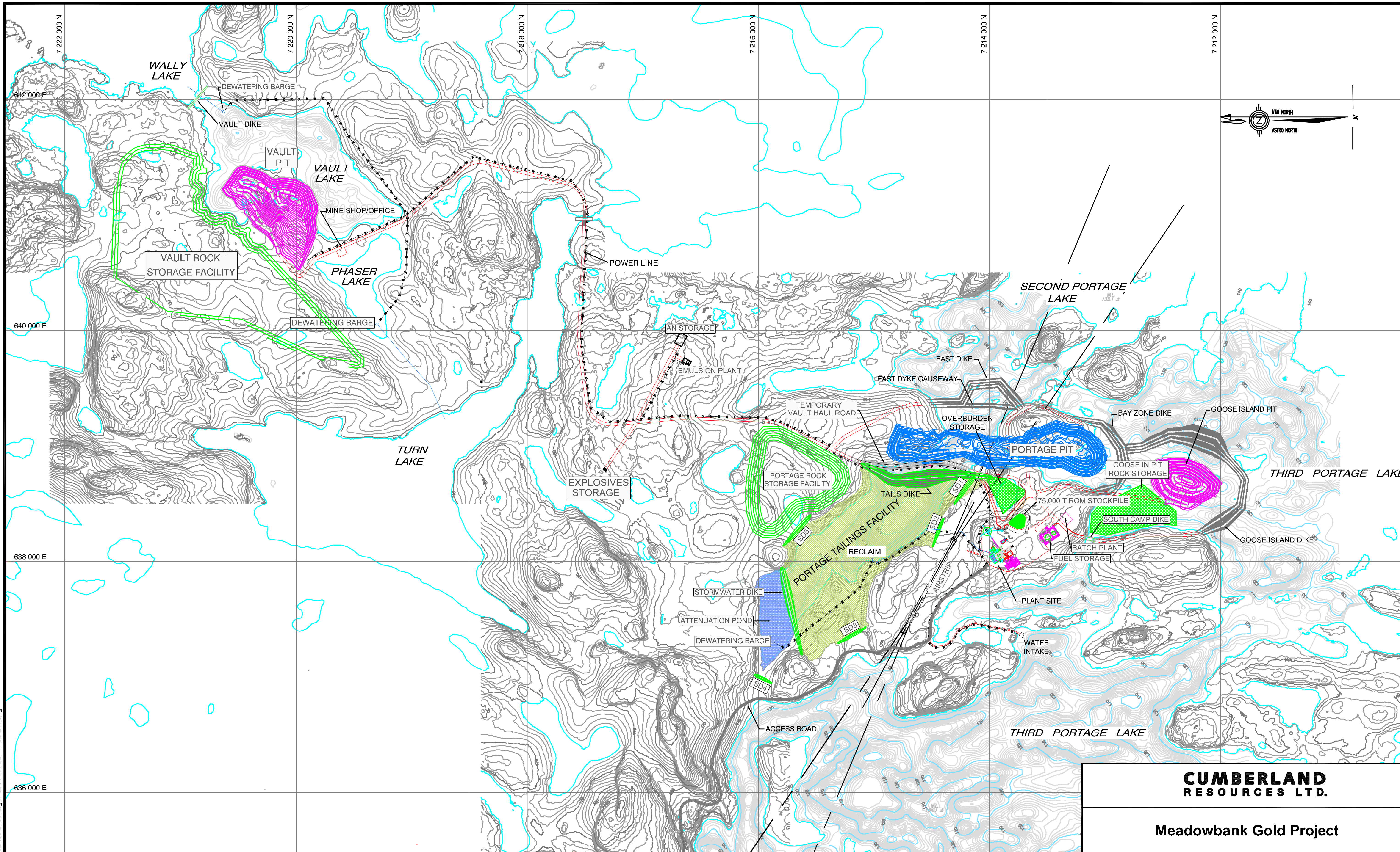
EIA DOCUMENTATION ORGANIZATION CHART



Date: October 2005

PROJECT LOCATION MAP



CUMBERLAND RESOURCES LTD.

Meadowbank Gold Project

General Site Plan

0 300 600 900 1200 1500
Scale in Meters

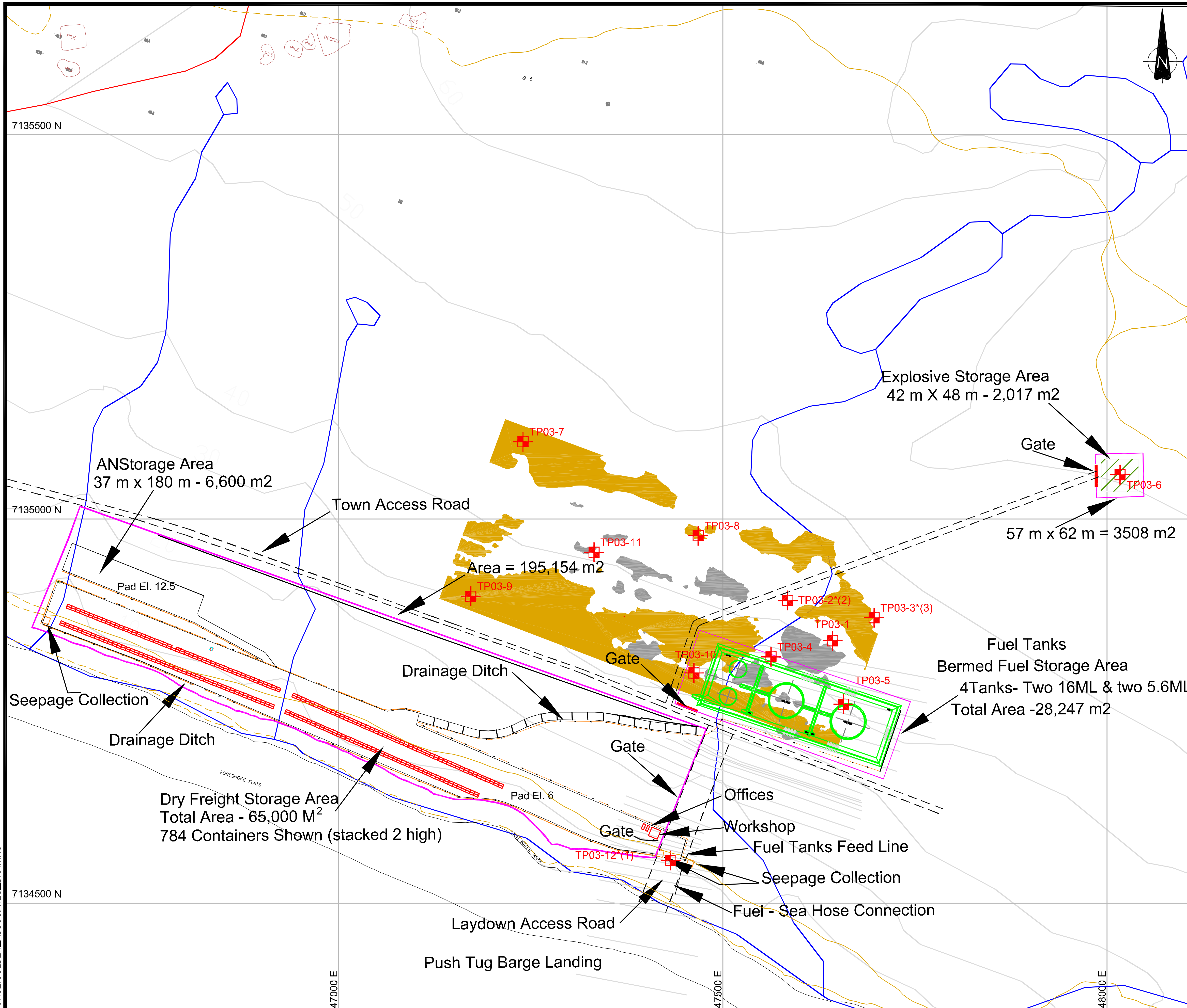
NOTES

1) Topographic contour interval 2m.
2) Bathymetric contour interval 1m.
3) Scale As shown.

LEGEND

SD: SADDLE DAM

Source:Golder Associates Drawing # 05141303&A-1400-2.1.dwg



LOCATION MAP

LEGEND

- Test Pit Location (Approximate)
- Property Limit
- Contour Interval
- Bedrock Outcrop (Approximate)
- Interpreted Frost-susceptible Ground

NOTES

1) Northing and eastings are in metres referenced to UTM Zone 14, NAD83.

2) Elevations are in metres referenced to geodetic datum.

3) Testpit, bedrock outcrop, seismic line and EM31 survey boundary locations were determined using GPS equipment and are considered approximate.

0 50 100 150 200 250
Scale in Meters

CUMBERLAND RESOURCES LTD.

Meadowbank Gold Project

Baker Lake Storage & Marshalling Area

SECTION 1 • INTRODUCTION

1.1 BACKGROUND

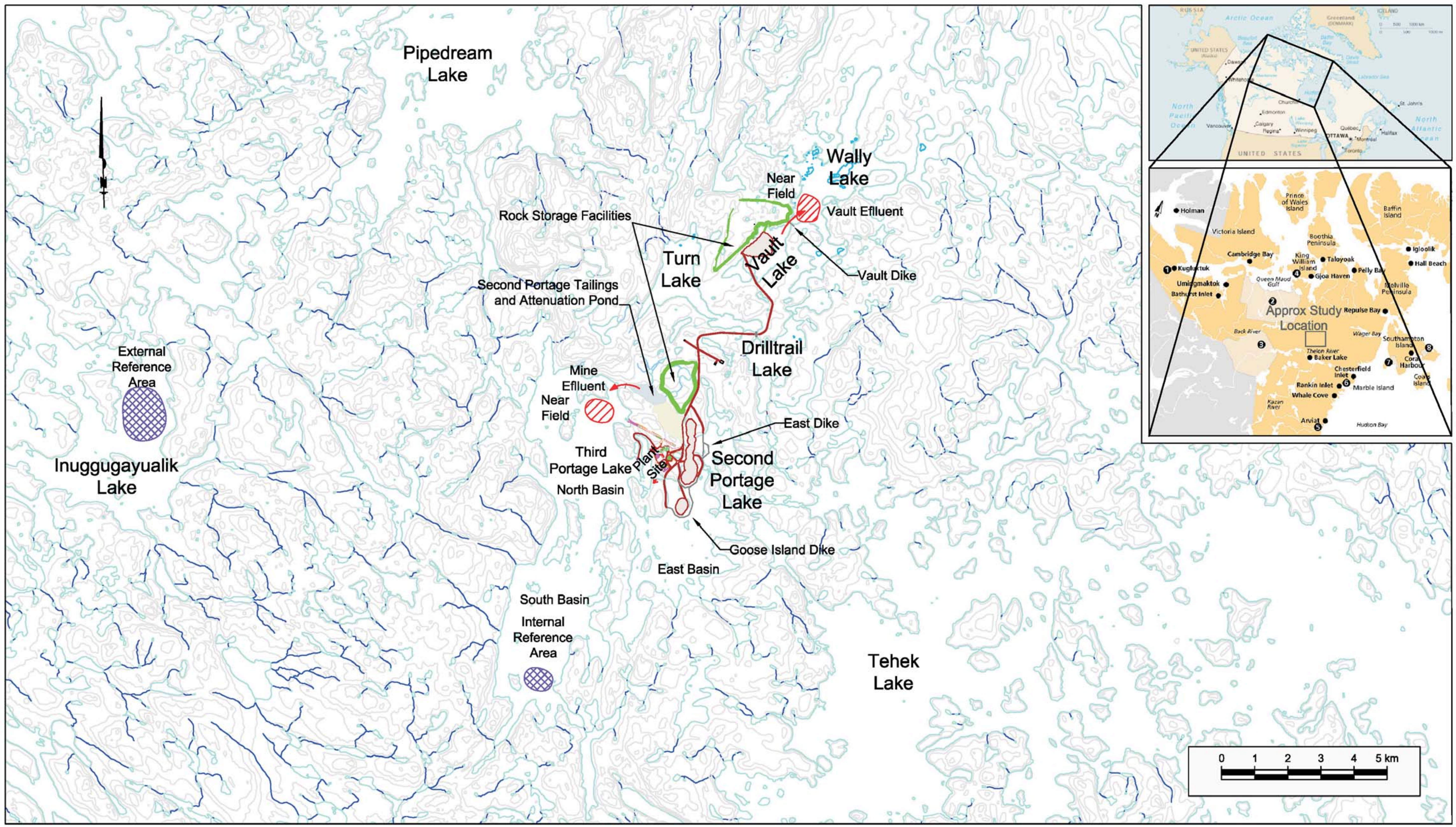
Cumberland proposes to construct and operate an open pit gold mine (Meadowbank Gold mine) approximately 75 km north of the Hamlet of Baker Lake on Chesterfield Inlet, Nunavut. Several lakes are located directly within the boundaries of the mineral zones being explored on the Meadowbank property (65° N, 96° W) and may be subject to direct or indirect environmental impacts related to mine development. Since 1996, baseline studies describing the physical, chemical, and biological characteristics of the aquatic environment in the vicinity of the project area have been conducted (baseline aquatic environment assessment report (BAEAR), 2005). In addition, a comprehensive environmental impact assessment (EIA) and an aquatic environmental management plan (AEMP, 2005) have been prepared to meet regulatory requirements pertaining to mine construction, operation, and closure. This report focuses on one aspect of mining operations—potential effects from effluent discharges to receiving waters. Specifically, it presents a framework for the application of the federal metal mining effluent regulations (MMER; Appendix A) to the Meadowbank Gold project, once discharges exceed 50 m^3/day.

Current information on how the mine will be designed, constructed, and operated, indicate that three areas will be impounded and drained to allow open pit mining (see Figures 1.1 and 1.2). The areas are:

- the northwestern half of Second Portage Lake (hereafter referred to as Portage pit)
- Third Portage Lake near the outlet to Second Portage Lake (hereafter referred to as Goose Island pit)
- Vault Lake (hereafter referred to as Vault pit).

All ore-bearing rock material will be transported to a single processing plant located near Second Portage Lake. All tailings will be contained nearby in a designated tailings impoundment area northwest of the Portage pit that will occupy the former northern arm of Second Portage Lake. All contact waters from the Portage/Goose Island waste rock storage area, roadside collection ditches, the airstrip, and other mine site facilities will be directed to the attenuation pond at the northern end of the Second Portage Lake. Water (effluent) from this pond will be discharged to Third Portage Lake. For the first five years of mine life, the attenuation pond will be separate from the tailings pond; however, after Year 5, both ponds will be merged and combined effluent will be directed towards Goose Island pit. After Year 5, the attenuation and tailings ponds will merge and effluent will no longer be discharged to Third Portage Lake. Instead, all water sources (except tailings water) will be directed to Goose Island pit. Goose Island pit will be used to manage all site water including all site contact water, pit water (from Portage pit), waste rock storage runoff and mill site runoff. Thus, Goose Island pit will gradually be filled between Years 5 and 8, inclusively. Pit water will be treated in situ if necessary and will not be discharged.

Only groundwater seepage, local precipitation, contact waters, and input from nearby tributaries will be discharged untreated into Wally Lake (hereafter referred to as the Wally Lake effluent discharge).



Legend

Road
Near Field Monitoring Area
Reference Area
Pit

PREPARED FOR:
CUMBERLAND RESOURCES LTD.

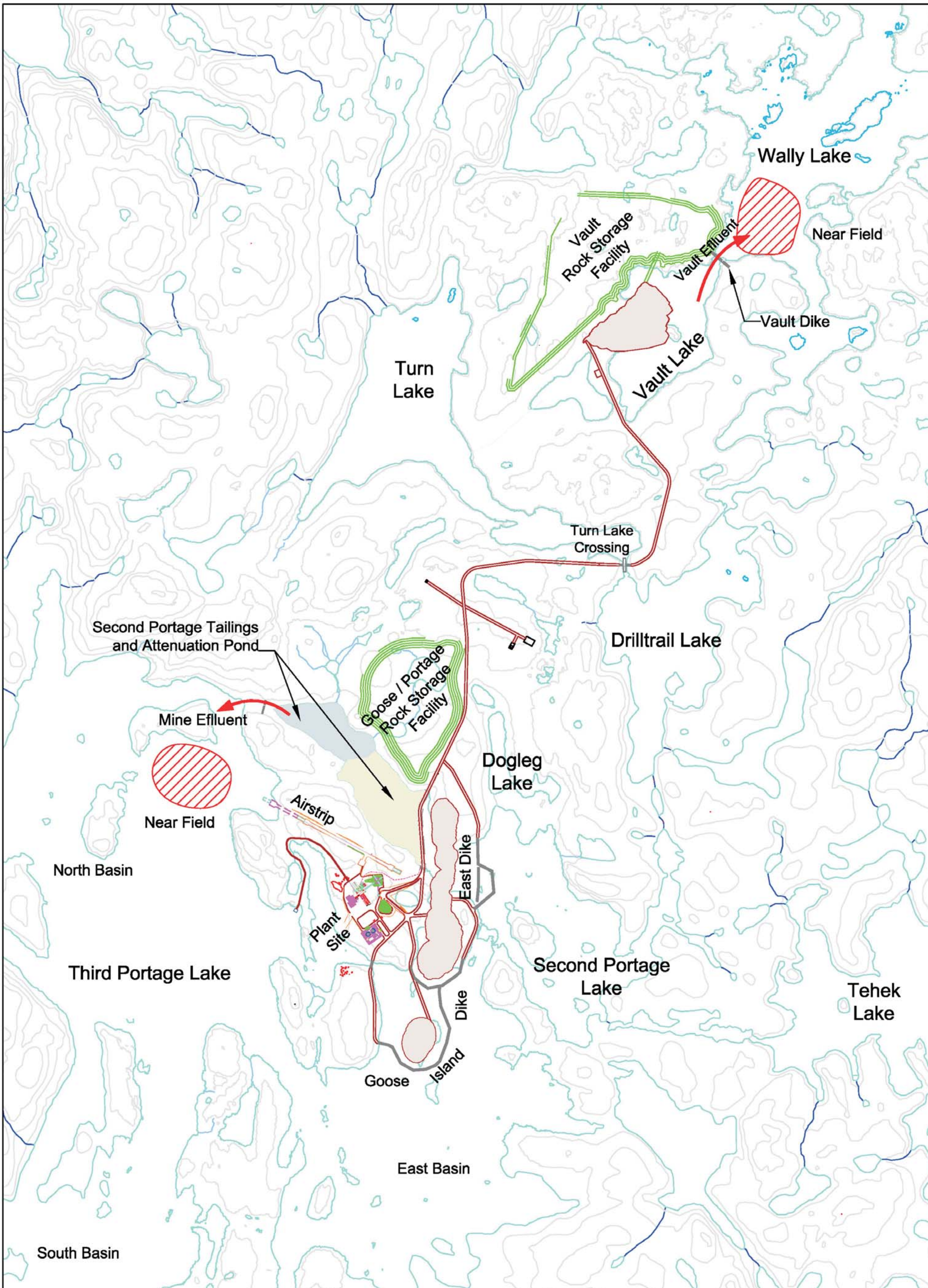
Azimuth Consulting Group Inc.
218-2902 West Broadway
Vancouver BC, V6K 2G8

PROJECT: Meadowbank MMER

TITLE: **Meadowbank Project Area Sampling Areas**

CLIENT: Cumberland Resources

Figure 1.1



Legend

- Near Field Monitoring Area
- Pit
- Road

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PREPARED FOR:

CUMBERLAND RESOURCES LTD.

DATE: 2/19/2004 10:51 AM

DRAWN BY: BT | CHECK BY: RB | PROJECT No: CBD-03-03

PROJECT: Meadowbank MMER

TITLE: **Meadowbank Project Area Near-Field Sampling Areas**

CLIENT: Cumberland Resources

Figure 1.2

Mine discharges into Third Portage Lake and Wally Lake will occur only during the open water period of summer/fall (i.e., approximately the last week of June to the last week of October). It is anticipated that both effluents will be released approximately 200 m offshore through diffusers suspended in the middle of the water column; discharge rates will be approximately 6,800 m^3/d for the Third Portage Lake effluent and 7,400 m^3/d for the Wally Lake effluent (Golder, 2005).

Pursuant to the MMER, Cumberland has developed a framework for conducting a series of environmental investigations addressing the Third Portage Lake and the Wally Lake discharges. These investigations will be aimed at characterizing and monitoring both effluents, as well as evaluating the spatial extent and magnitude of any effects to fish, fish habitat, and fisheries resources.

1.2 OBJECTIVES

The MMER were developed under the federal *Fisheries Act* and registered in the Canada Gazette Part II (Vol. 136, No. 13) on 6 June 2002. The regulations apply to all “mines,” “mines under development,” or “recognized closed mines” that:

- discharge an effluent containing deleterious substances with a flow rate that exceeds 50 m^3/day, based on effluent deposited from all the final discharge points of the mine
- deposit a deleterious substance in such a way that it enters or can enter any water that is frequented by fish.

Requirements of the MMER include three main components:

1. Routine effluent monitoring (hereafter referred to as the routine MMER program), which includes:
    - chemical analyses of effluent
    - acute lethal toxicity testing of effluent
    - effluent volume and flow rate measurements
    - calculation of mass loadings of deleterious substances to receiving waters.
2. Emergency response plan, which includes:
    - site risk analysis
    - organization scheme for emergency responses
    - altering and notification procedures
    - inventory of spill-response equipment, including the location of that equipment
    - training plan for mine personnel.
3. Environmental effects monitoring (hereafter referred to as the EEM program), which includes:
    - Part 1 – Effluent and water quality monitoring studies
    - Part 2 – Biological monitoring studies, including a site characterization, a fish survey, and a benthic invertebrate community survey.

The purpose of this report is to address the first and third components of the regulations by developing a scientifically defensible and cost-effective framework for the application of the routine MMER and EEM programs to the Meadowbank Gold project. At the same time, this framework is aimed at optimizing the value of any data shared with the AEMP (2005), which encompasses a broader scope of mining activities. A separate document addresses the second MMER component by providing details of a spill contingency plan for the mine.

A more formal and comprehensive study design for the EEM program will be submitted within 12 months of the mine being subject to the MMER (see details in Section 3), and it will be based on the framework in this document.

1.3 APPROACH

As indicated previously, baseline studies have been conducted since 1996 and considerable physical (e.g., water depth, temperature, and substrate type), chemical (e.g., metals concentrations in water, sediment, and fish tissue), and biological (e.g., phytoplankton, zooplankton, periphyton, benthic invertebrates, and fish) data have been collected for lakes in the project area (BAEAR, 2005). Along with available mine design information, these data will provide a basis for developing the monitoring framework for the routine MMER and EEM programs. While their scope differs substantially, the overall approach taken for applying these two programs to the Meadowbank Gold project shares common elements that will be presented in this report. These include:

- identification of site-specific considerations
- development of a preliminary study design (e.g., sampling locations and frequency)
- identification of study components
- summary of sampling methods
- outline of reporting requirements and schedule
- overview of quality assurance/quality control (QA/QC) procedures.

Note that, pending finalization of the plans for mine development, some details of the monitoring framework will be revised, particularly with regards to the EEM program. For instance, the number and location of EEM sampling areas will need to reflect results of effluent mixing investigations that can only be conducted once the Third Portage Lake and Wally Lake discharges are operational. On the other hand, the routine MMER program should not require major changes and needs to be initiated as soon as the mine becomes subject to the regulations.

For the purpose of organizing the report, three individual sections were prepared as follows:

- routine MMER program (Section 2)
- EEM program (Section 3)
- general QA/QC procedures (Section 4).

SECTION 2 • ROUTINE MMER PROGRAM

The routine MMER program requires the mine to undertake the following activities:

- weekly chemical analyses of effluent for pH and a suite of deleterious substances
- monthly testing of acute lethal toxicity of effluent to rainbow trout and the water flea, *Daphnia magna*. Note: Because effluent is only discharged during open water, the frequency of monthly testing will be maximized to acquire as many toxicity tests as allowed by the regulations (i.e., sampling to be conducted with an increased frequency).
- weekly or continuous measurements of effluent flow rates to derive an estimate of total monthly effluent volume deposited
- calculation of mass loadings of deleterious substances to receiving waters.

These activities will be applied to both discharges being planned for the Meadowbank Gold project: the Third Portage Lake effluent discharge and the Wally Lake effluent discharge (see Figure 1.2).

2.1 SITE-SPECIFIC CONSIDERATIONS

The primarily Arctic climate at the project area is harsh, with short cold summers and long dark winters. Effluents will be discharged over a very short period of time during open water, usually ranging from late June to late October. Consequently, implementation of the routine MMER program will be restricted to periods of discharge rather than throughout the year. The maximum number of samples will be collected within this period, while maintaining the required time interval between sampling dates (see Sections 2.3 to 2.5).

2.2 SAMPLING LOCATIONS

Two effluent samples will be collected: one from the final discharge point of the Third Portage Lake discharge, and one from the final discharge point of the Wally Lake discharge. The final discharge point is defined as an identifiable location beyond which the operator of the mine no longer has control over the quality of the effluent.

2.3 CHEMICAL ANALYSES

On a weekly basis (and not less than four days apart) during discharge periods, a grab sample[1] or a composite sample[2] will be collected from each of the two final discharge points and analyzed without delay for parameters listed in Table 2.1.

[1] Defined as an undiluted effluent sample collected at a time prescribed by the MMER.
[2] Defined as: a) a quantity of effluent consisting of not less than three equal volumes or three volumes proportionate to flow that have been collected at approximately equal time intervals over a sampling period of not less than 7 hours and not more than 24 hours; or b) a quantity of effluent collected continuously at a constant rate or at a rate proportional to flow rate of the effluent over a sampling period of not less than 7 hours and not more than 24 hours.

Table 2.1: Study Components & Sampling Frequency for the Routine MMER Program

Study Component	Parameters[1]	Sampling Frequency
Chemical analyses	pH[2], arsenic, copper, cyanide (if used in the mining process), lead, nickel, zinc, total suspended solids, radium 226	Weekly
Acute lethal toxicity testing	96 hr acute rainbow trout LC_{50} test	Monthly
	48 hr acute *D. magna* LC_{50} test	
Effluent volume[3], flow rate & loading[3]	Flow rate	Weekly (unless using continuous flow monitoring)

Notes: 1. All concentrations are total values. **2.** Measured in the field and laboratory. **3.** Calculated using flow rate measurements.

Effluent sample collection will be timed to coordinate with outgoing flights from the area to minimize shipping and holding times prior to analysis. Samples will be kept refrigerated at 4°C and shipped in coolers with ice packs via express courier service to the analytical laboratory.

Note that chemical analyses for any or all of arsenic, copper, lead, nickel, zinc, and cyanide may be reduced to once every three months, should 12 consecutive monthly mean concentrations of any of the above substances be less than 10% of the maximum authorized monthly mean concentrations (Table 2.2). Analysis for radium 226 may also be reduced to once every three months, should 10 consecutive tests yield concentrations be less than 0.037 Bq/L. Should any substance's monthly mean concentration be equal to or greater than 10% of the maximum authorized monthly mean concentration (Table 2.2), testing frequency for this substance must return to weekly status.

Table 2.2: MMER Schedule 4 – Authorized Limits of Deleterious Substances

Deleterious Substance	Maximum Authorized Monthly Mean Concentration[1]	Maximum Authorized Concentration in a Composite Sample[1]	Maximum Authorized Concentration in a Grab Sample[1]
Arsenic	0.50 mg/L	0.75 mg/L	1.00 mg/L
Copper	0.30 mg/L	0.45 mg/L	0.60 mg/L
Cyanide	1.00 mg/L	1.50 mg/L	2.00 mg/L
Lead	0.20 mg/L	0.30 mg/L	0.40 mg/L
Nickel	0.50 mg/L	0.75 mg/L	1.00 mg/L
Zinc	0.50 mg/L	0.75 mg/L	1.00 mg/L
Total suspended solids	15.00 mg/L	22.50 mg/L	30.00 mg/L
Radium 226	0.37 Bq/L	0.74 Bq/L	1.11 Bq/L

Note: 1. All concentrations are total values.

Should any grab or composite sample show concentrations of any of the deleterious substances or pH exceeding the authorized maximum values (Table 2.2), the mine owner will immediately notify the regional authority.

Chemical analyses will meet requirements set out in Schedule 3 of the MMER (Table 2.3). General QA/QC procedures that will be followed throughout the monitoring program are presented in Section 4 and follow guidance from Environment Canada (2002).

Table 2.3: MMER Schedule 3 – Analytical Requirements for Metal Mining Effluent

Deleterious Substance/pH	Precision	Accuracy	Method Detection Limit (MDL)
Arsenic	10%	100 ± 10%	0.010 mg/L
Copper	10%	100 ± 10%	0.010 mg/L
Cyanide	10%	100 ± 10%	0.010 mg/L
Lead	10%	100 ± 10%	0.030 mg/L
Nickel	10%	100 ± 10%	0.010 mg/L
Zinc	10%	100 ± 10%	0.020 mg/L
Total suspended solids	10%	100 ± 10%	3.000 mg/L
Radium 226	10%	100 ± 10%	0.01 Bq/L
PH	0.1 pH unit	0.1 pH unit	Not applicable

2.4 ACUTE LETHAL TOXICITY TESTING

On a monthly basis (and not less than 15 days apart) during discharge periods, a grab sample will be collected from each of the final discharge points (see Section 2.2) and tested, as per Table 2.1, without delay on the following:

- Rainbow trout (Oncorhynchus mykiss) according to Reference Method EPS 1/RM/13
- Water flea (*Daphnia magna*) according to Reference Method EPS 1/RM/14.

Note that *D. magna* testing will be conducted using an aliquot of effluent sample collected for rainbow trout. Furthermore, effluent sampling for toxicity tests will be conducted simultaneously with effluent sampling for chemical analyses.

Effluent sample collection will be timed to coordinate with outgoing flights from the area to minimize shipping and holding times prior to analysis. Samples will be kept refrigerated at 4°C and shipped in coolers with ice packs via express courier service to the toxicity testing laboratory.

In cases where an effluent is considered acutely lethal[3], toxicity testing will be done twice monthly (not less than seven days apart). In addition, effluent characterization described under the EEM program (see Section 3.2.1) will be conducted immediately on the aliquot of each grab sample collected for the routine MMER program.

Environment Canada has requested that sampling frequency be maximized, given the relatively short duration of effluent discharge (i.e., open water only). To accomplish this, monthly acute toxicity testing

[3] Defined as an effluent at 100% concentration that kills more than 50% of the rainbow trout subjected to it over a 96-hour period.

will be initiated within a week of initiation of effluent discharge and then be conducted at least once per month, with subsequent samples collected not less than two weeks apart.

General QA/QC procedures that will be followed throughout the monitoring program are presented in Section 4 and follow guidance from Environment Canada (2002).

2.5 EFFLUENT VOLUME & FLOW RATE

The total monthly volume (m^3) of effluent released from the Third Portage Lake and Wally Lake discharges will be recorded (Table 2.1). The total monthly volume will be based on the average of the flow rates measured concurrently with samples being collected for chemical analyses and toxicity testing (Sections 2.3 and 2.4) or with the use of a continuous measurement system that is accurate to within 15% of measured flow. Note that, if used, monitoring equipment will be calibrated not less than once in each year and results will be recorded.

2.6 MASS LOADINGS OF DELETERIOUS SUBSTANCES

Mass loadings (kg) of deleterious substances listed in Section 2.3 will be calculated for each final discharge point for each day on which a sample is collected for that deleterious substance. The mass loadings will be calculated by multiplying the concentration of the deleterious substance by the total volume of effluent discharged for each day sampled. The mass loading for each calendar month will be determined by multiplying the average of all mass loadings by the number of days in that calendar month during which effluent was discharged.

If the frequency of chemical analysis has been reduced to once every three months, the mass loading for this particular calendar quarter will be calculated by multiplying the concentration of the deleterious substance as measured in that calendar quarter by the total volume of effluent released from each final discharge point during the three months preceding the day of collection of the sample.

If the analytical results from any chemical analyses (see Section 2.3) are less than 10% of the method detection limit set out in Schedule 3 of the MMER, the results will be considered to be zero for the purposes of performing a mass loading calculation.

2.7 REPORTING REQUIREMENTS & SCHEDULE

An effluent monitoring report for all tests and monitoring conducted during each calendar quarter will be submitted to the authorization officer within 45 days following the end of the quarter. The following components will be included in each report:

- results of acute lethal toxicity tests for rainbow trout and *D. magna*
- results of chemical analyses for pH and deleterious substances, including monthly mean concentrations
- type of sample collected (i.e., composite or grab sample)
- monthly volumes of effluent deposited
- monthly loadings of deleterious substances.

Quarterly reports will also include any effluent characterization activities done in the event of observed acute lethality of an effluent.

In addition to quarterly reports, the mine will submit an annual report before the end of March each calendar year. The latter will summarize all effluent monitoring results of the previous year.

Any non-compliance issues (e.g., concentrations of any deleterious substances above limits shown in Table 2.2, effluent pH that is lower than 6.0 or greater than 9.5, or acutely lethal effluent) will be reported without delay.

SECTION 3 • ENVIRONMENTAL EFFECTS MONITORING (EEM) PROGRAM

The EEM program is composed of two parts:

- Part 1 – Effluent and water quality monitoring studies intended to provide background, supporting information for the assessment and interpretation of biological monitoring (see below). This component includes effluent characterization, sublethal toxicity testing, and water quality monitoring.
- Part 2 – Biological monitoring studies, including a site characterization, a fish survey (using indicators of fish population health and fish tissue analysis), and a benthic invertebrate community survey.

According to Environment Canada (2002), there are four key EEM activities:

1. effluent and water quality monitoring and reporting (Part 1)
2. submission of the study design of biological monitoring (Part 2)
3. conducting biological monitoring studies in the field (Part 2)
4. data assessment and interpretation, including submission of the interpretative report (Part 2).

The first objective of this section is to describe the framework for effluent and water quality monitoring activities that will be carried out at the Meadowbank Gold project. These will begin no later than six months after the mine is subject to the MMER (i.e., once discharges exceed 50 m^3/day) and results will be reported annually, by 31 March, to the authorization officer.

The second objective of this section is to develop a preliminary study design for an initial monitoring study (i.e., the first biological monitoring study for a new mine). A formal study design report will be submitted within 12 months of the mine being subject to the MMER. The latter will be prepared once the plans for mine development have been finalized and once results of effluent mixing studies are available. An interpretative report will then be submitted within 30 months of the mine being subject to the MMER. Note that the EEM program is cyclical, with results from previous monitoring studies being evaluated to trigger subsequent monitoring studies, in accordance with a pre-defined monitoring frequency.

As was the case for the routine MMER program, the EEM program will also apply to both discharges being planned for the Meadowbank Gold project: the Third Portage Lake effluent discharge (at least up to Year 5) and the Wally Lake effluent discharge (Figure 1.2).

3.1 SITE-SPECIFIC CONSIDERATIONS

As mentioned in Section 2.1, the cold and harsh Arctic climate prevailing at the Meadowbank Gold project will limit discharge to a very short period, usually ranging from late June to late October, during ice-free conditions. Consequently, implementation of effluent and water quality monitoring under the EEM program will be restricted to periods of discharge rather than throughout the year.

The maximum number of samples will be collected within this period, while maintaining the required time interval between sampling dates (see Section 3.2).

3.2 EFFLUENT & WATER QUALITY MONITORING

3.2.1 Effluent Characterization

Both the Third Portage Lake and Wally Lake effluents will be characterized at their final discharge points four times per year (not less than one month apart) by analyzing parameters listed in Table 3.1. The samples will consist of aliquots of effluent collected to meet requirements of the routine MMER program (see Section 2.3).

Effluent sample collection will be timed to coordinate with outgoing flights from the area to minimize shipping and holding times prior to analysis. Samples will be kept refrigerated at 4°C and shipped in coolers with ice packs via express courier service to the analytical laboratory.

General QA/QC procedures that will be followed throughout the monitoring program are presented in Section 4 and follow guidance from Environment Canada (2002).

3.2.2 Sublethal Toxicity Testing

Sublethal toxicity testing will be performed using aliquots of effluent collected for the routine MMER program (see Sections 2.4 and 3.2.1). Both the Third Portage Lake and Wally Lake effluents will be tested as follows (Table 3.1):

- Rainbow trout (*O. mykiss*) embryo development test, according to Reference Method EPS 1/RM/28
- Invertebrate (*Ceriodaphnia dubia)* reproduction and survival test, Reference Method EPS 1/RM/21
- Common duckweed (*Lemna minor)* growth inhibition test, Reference Method EPS 1/RM/37
- Green algae *(Selenastrum capricornutum)* growth inhibition test, Reference Method EPS 1/RM/25.

The above tests will be conducted twice per year for the first three years and once per year after the third year.

Effluent sample collection will be timed to coordinate with outgoing flights from the area to minimize shipping and holding times prior to analysis. Samples will be kept refrigerated at 4°C and shipped in coolers with ice packs via express courier service to the toxicity testing laboratory.

General QA/QC procedures that will be followed throughout the monitoring program are presented in Section 4 and follow guidance from Environment Canada (2002).

Table 3.1: Study Components & Sampling Frequency for Part 1 – Effluent & Water Quality Monitoring under the EEM Program

Study Component	Parameters[1]	Sampling Frequency
Effluent characterization	pH, hardness, alkalinity, aluminum, cadmium, iron, mercury, molybdenum, ammonia, and nitrate	Four times per year
Sublethal toxicity testing	seven-day rainbow trout embryo development test	Twice per year for the first three years[2]
	seven-day invertebrate (*Ceriodaphnia dubia*) reproduction and survival test	
	seven-day macrophyte (*Lemna minor*) growth test	
	72 h or 96 h algae (*Selenastrum capricornutum*) growth test	
Water quality monitoring	Temperature, dissolved oxygen	Four times per year
	all routine MMER parameters: pH[3], arsenic, copper, cyanide (if used in the mining process), lead, nickel, zinc, total suspended solids, radium 226	
	all EEM effluent characterization parameters: hardness, alkalinity, aluminum, cadmium, iron, mercury, molybdenum, ammonia, and nitrate	

Notes: 1. All concentrations are total values. **2.** Frequency is reduced to once per year after the third year. **3.** Measured in the field and laboratory.

3.2.3 Water Quality Monitoring

Water quality monitoring will be conducted in three receiving environment locations:

- exposure area surrounding the point of entry of effluent into water from the Third Portage Lake discharge
- exposure area surrounding the point of entry of effluent into water from the Wally Lake discharge
- internal reference area located in the south basin of Third Portage Lake.

Sampling will be conducted four times per year (not less than one month apart) and timing will be coincident with effluent sampling activities being conducted for the routine MMER program (Section 2.3) and effluent characterization for the EEM program (Section 3.2.1). All water samples will be analyzed for parameters presented in Table 3.1.

Note that the exposure and references areas for water quality monitoring will not necessarily be the same as the sampling areas chosen for biological monitoring (Section 3.3). If they are different, samples for water quality will also be collected in sampling areas for biological monitoring, at the same time that biological monitoring is conducted.

Water sample collection will be timed to coordinate with outgoing flights from the area to minimize shipping and holding times prior to analysis. Samples will be kept refrigerated at 4°C and shipped in coolers with ice packs via express courier service to the analytical laboratory.

Sampling methods are described in Section 3.6; general QA/QC procedures (e.g., field duplicates, blanks, reference material) are presented in Section 4 and follow guidance from Environment Canada (2002).

3.2.4 Reporting Requirements & Schedule

An effluent and water quality monitoring report will be submitted no later than 31 March each year, reporting all of the previous calendar year's results. This report will include:

- collection dates and exact locations from which samples were collected for effluent characterization, sublethal toxicity testing, and water quality monitoring
- results of effluent characterization, sublethal toxicity testing, and water quality monitoring
- data related to the choice of effluent for sublethal toxicity testing
- methods and detection limits related to effluent characterization and water quality monitoring
- QA/QC procedures and results.

3.3 BIOLOGICAL MONITORING STUDIES

The purpose of this section is to summarize background information relevant to developing a preliminary study design; more details will be included, as appropriate, in the formal study design document. This information will include:

- regulatory requirements under various federal and territorial jurisdictions
- general site characteristics
- hydrology and effluent mixing
- anthropogenic influences
- aquatic resources characteristics (surveys and tissue analyses)
- mining operations and environmental protection practices
- results of baseline studies conducted in study area lakes (BAEAR, 2005) have been incorporated throughout Section 3.3 to provide supporting information and rationale to justify various approaches, methods, and alternatives proposed for the initial monitoring study.

3.3.1 Regulatory Context

The Meadowbank Gold project is currently undergoing an EIA (EIA, 2005) pursuant to the *Canadian Environmental Assessment Act* (CEAA). As part of this process, a comprehensive AEMP (AEMP, 2005) has been developed for a range of management and monitoring activities to be implemented during mine construction, operation, and post-closure. Monitoring activities associated with the AEMP will be harmonized with monitoring requirements of the MMER wherever possible. Note that the project will also be bound by the No-Net-Loss Policy of the *Fisheries Act* as well as conditions of a water license issued by the Nunavut Land and Water Board.

3.3.2 General Site Characteristics

This section briefly describes the mine site, summarizes the local climate and limnology, and outlines key features of the study area lakes (Figure 1.2): Second Portage Lake, Third Portage Lake, Vault Lake, Wally Lake, Drilltrail Lake, Tehek Lake, and Inuguggayualik Lake.

3.3.3 Mine Site Description

As indicated in Section 1.1, the Meadowbank Gold project will consist of an open pit gold mine with associated camp and supporting infrastructure. Current information on how the mine will be designed, constructed, and operated indicates that three areas will be impounded and drained to allow open pit mining. These are:

- the northwestern half of Second Portage Lake (i.e., Portage pit)
- Third Portage Lake near the outlet to Second Portage Lake (i.e., Goose Island pit)
- Vault Lake (i.e., Vault pit).

All ore-bearing rock material will be transported to a single processing plant located near Second Portage Lake. All tailings will be contained nearby in a designated tailings impoundment area northwest of the Portage pit that will occupy the former northern arm of Second Portage Lake. All contact waters from the Portage/Goose Island waste rock storage area, road runoff, process waters, and mine site drainage will be diverted to an attenuation pond in the north arm of Second Portage Lake. This attenuation pond is separate from the tailings pond, which receives processed mine tailings and treated sewage effluent.

Prior to Year 5, effluent discharge to Third Portage Lake will consist of:

- all site contact water from the Portage and Goose areas (e.g., from roads and disturbed lands such as the airstrip)
- water from interceptor ditches along the eastern and northern ends of the Portage/Goose waste rock storage facility
- seepage water from the waste rock disposal facility
- treated (if necessary) runoff from pit inflow water
- all water originating from the mill area.

Pit waters will be pumped to a water sump at the process plant and, if necessary, treated with lime and used to meet process water demand. This will also minimize the freshwater makeup requirement from Third Portage Lake during mine operation. All process water containing mine tailings will be contained within the reclaim pond within the actual tailings impoundment area south of the attenuation pond. A stormwater dike will be constructed between these two areas to prevent mixing. This design isolates metals-contaminated water associated with the tailings disposal facility from the general, site-wide water management plan.

As mining continues through Year 4, the reclaim pond containing mine tailings will advance north towards the attenuation pond. Coincident with filling of the main basin of Second Portage north arm with tailings, will be completion of mining within Goose Island pit. At this time, the attenuation pond will act as the reclaim pond for mine process water.

Beyond Year 5, after the reclaim and attenuation ponds have been merged, Goose Island pit will be used to manage all site water including site contact water, pit water (from Portage pit), waste rock storage runoff and mill site runoff. Goose Island pit will gradually be filled between Years 5 and 8 inclusively. No discharge of effluent to Third Portage Lake is forecast beyond Year 5. The available storage volume within the pit is estimated to be 4.2 Mm^3 of water, which is largely sufficient to contain all waters discharged to the pit to the end of mine life. Water quality within Goose Island pit will be monitored and treated in situ. A water treatment system will be located at the process plant for the operating life of the mine to treat pit water as required. At end of mine life, the process circuit will be transformed to a treatment plant to treat the remaining tailing water before what is left of the exposed tailings is drained, graded, and covered with alkaline ultramafic rock.

Only groundwater seepage, local precipitation, contact water from the Vault Waste Rock storage facility, and input from nearby tributaries will be discharged untreated into Wally Lake (i.e., Wally Lake effluent discharge) between Years 5 and 8, at end of mine life. Thus, effluent is only discharged from the Vault facility to Wally Lake for four years.

3.3.4 Local Climate & Limnology

The Meadowbank Gold project lakes are situated in the barren-ground central Arctic, within an area of continuous permafrost. With the exception of Inuguggayualik Lake, the study lakes are headwater lakes of the Quoich River system that flows south, through Tehek Lake into Chesterfield Inlet and eventually, Hudson Bay. Inuguggayualik Lake is located in a separate watershed, which is part of the Back River system that drains to the Arctic Ocean.

Lakes in this region of the Arctic are cold, soft-water, well-oxygenated, ultra-oligotrophic (i.e., very low in nutrients and having low productivity), and isothermal (i.e., uniform temperature from top to bottom) during summer and winter. These conditions of severe climate and low productivity result in very low diversity and abundance of aquatic fauna and flora.

Lake waters typically have very low turbidity and suspended solids concentrations, with circum-neutral pH (BAEAR, 2005). Dissolved anions, and nutrients (nitrogen, carbon, phosphorus) are also very low and near analytical detection limits. Concentrations of most metals measured during baseline studies (BAEAR, 2005) were near or below detection limits, and well below federal water quality guidelines for the protection of aquatic life (Canadian Council of Ministers of the Environment (CCME), 2001). Only lead marginally exceeded the guidelines at a few sampling locations in Second Portage, Vault, and Tehek lakes. Overall, there were no major spatial or seasonal differences in conventional water chemistry or metals concentrations among study area lakes.

The ice-free season on these lakes is very short. Ice break-up usually occurs during mid to late June; ice returns beginning in late September or early October, with complete ice cover by late October. By late winter, ice thickness can reach up to 2 m deep. Lakes are well mixed in this windy landscape during the open-water season; consequently, they are nearly always completely oxygen-saturated, and show no or only minor and temporary stratification.

The majority of study area lakes are shallow, averaging 6 to 12 m maximum depth, although depths in larger lakes such as Second and Third Portage Lakes can reach 40 m in certain areas. Lake shorelines are predominantly composed of a complex mixture of boulders and large cobble with some gravel to a depth of between 4 to 6 m below the surface. These substrates are very stable and not subject to erosion. Below a depth of about 6 m, there is a transition to fines with the bottom consisting predominantly of silt/clay. The material is several metres deep and the organic carbon content of the fine sediment provides a food source for burrowing invertebrate worms and chironomid larvae.

Sediment sampling in study area lakes (BAEAR, 2005) at depths greater than 6 m showed considerable similarity in grain size, with mostly fine clay (57% to 65%) and silt (30% to 38%), some sand (<10%), and no gravel.

Concentrations of metals in sediments were uniform throughout the lakes: arsenic, cadmium, chromium, copper, nickel, and zinc often exceeded federal sediment quality guidelines (i.e., interim sediment quality guideline [ISQG] and probable effects level [PEL]; CCME, 2001). Several EIAs conducted for northern projects have found similarly elevated metal concentrations throughout their regions (e.g., Diavik, Snap Lake, Ekati). This is a widespread phenomenon consistent with the highly mineralized nature of sediments in the Meadowbank Gold project lake system.

Second Portage Lake

As mentioned earlier, the northwestern half of this lake will be impounded and drained to create the Portage pit. The northern arm of Second Portage Lake will serve as a joint tailings impoundment area and attenuation pond (Figure 1.2). The extraction facilities, treatment plant, treatment ponds, and storage facilities will be located nearby. The remaining southern half of Second Portage Lake will remain intact, receiving waters from the east basin of Third Portage Lake, as well as flows from the north through Drilltrail Lake, Wally Lake, and Vault Lake. Waters from Second Portage Lake flow south-eastward into Tehek Lake.

Third Portage Lake

This large headwater lake flows from its east basin through two small channels into Second Portage Lake. A portion of this area will be impounded and drained to create the Goose Island pit. The north basin of Third Portage Lake will provide the source of water for mining operations at the Portage and Goose Island pits. It is anticipated that final effluent from the mine will be discharged along the eastern shore of the north basin (Figure 1.2).

According to Environment Canada (2002), an appropriate reference area for EEM biological monitoring studies should not be exposed to effluent and should have similar hydrology and habitat as the exposure area. Logistical considerations such as access are also important considerations. The south basin of Third Portage Lake, which meets these requirements, was selected as one of two reference areas for the EEM program (also see Inuggugayualik Lake). The south basin is located well upstream (i.e., approximately 8 km) from the planned Third Portage Lake effluent discharge and lies in the same fish-bearing water body. In addition, as described in subsequent sections, the physical, chemical, and biological characteristics of the south basin are very similar to receiving environments found in the north basin of Third Portage Lake and in Wally Lake. Although it is possible that fish could move between the North and South basins, this is not likely as lake trout are reasonably sessile and do not undertake concerted migrations. Furthermore, all other lakes in the project area are downstream of the mine, so the most upstream, isolated region of Third Portage Lake seems the best location as an internal reference area. Use of an external reference, in the Arctic drainage will also provide additional reference data.

Vault Lake

Vault Lake will be impounded and drained to create the Vault pit. Two small containment ponds will persist within the former lake, acting as an attenuation pond for contact waters from the Vault rock storage facility, pit seepage, and groundwater and precipitation. When full, surface waters from this attenuation pond will be slowly drained into Wally Lake (i.e., Wally Lake effluent discharge). No direct mine-related effluents will be directed to these ponds.

Wally Lake & Drilltrail Lake

Wally Lake, which will receive final effluent from the Vault pit attenuation pond, flows southward from its southwest end down into Drilltrail Lake, eventually reaching the southeast end of Second Portage Lake.

Phaser Lake

Phaser Lake is a small lake that drains into Vault Lake during spring freshet. To prevent inflow from Phaser to Vault Lake during mining (Years 5 to 8), Phaser Lake will be drawn down by 1 m and the flow will be directed south towards Turn Lake. This will enable Phaser Lake to receive snowmelt volume and ensure that Phaser Lake does not flow towards Vault Lake during mine operation.

Tehek Lake

This lake is the ultimate receiving environment for all mine-related effluent from the Meadowbank Gold project.

Inuggugayualik Lake

This lake was selected as the second of two reference areas for the EEM program. Although it is located in a separate watershed from other study area lakes (Figure 1.1), it was specifically targeted during baseline studies (BAEAR, 2005) to evaluate its appropriateness as an external reference area. Overall, the physical, chemical, and biological characteristics of Inuggugayualik Lake were found to be very similar to those of receiving waters adjacent to the Third Portage Lake and Wally Lake effluent discharges.

3.3.5 Hydrology & Effluent Mixing

3.3.5.1 Effluent Discharge

As mentioned previously, it is anticipated that both effluents will be released approximately 200 m offshore through diffusers suspended in the middle of the water column in low value fish habitat; maximum discharge rates will be approximately 6,800 m^3/d for the Third Portage Lake effluent and 7,400 m^3/d for the Wally Lake effluent. Discharges at both locations will only occur during the open-water season (i.e., late June to late October) as the pipes and lakes are frozen the remainder of the year. Furthermore, effluent will only be discharged to Third Portage Lake during Years 1 to 5 and to Wally Lake during Years 5 to 8. Thus, there is no cumulative effect of effluent discharge.

3.3.5.2 Receiving Environment Conditions

It is anticipated that effluents will be discharged into deeper waters (>10 m) to maximize mixing in Third Portage Lake and Wally Lake, both of which drain into Second Portage Lake and eventually into Tehek Lake. As described previously, receiving waters are oligotrophic, near oxygen saturation, cold, and clear, with low concentrations of nutrients and metals, although sediments contain naturally high concentrations of some metals. During the short open-water season, lake waters are well mixed in the windy Arctic environment. Flushing rates are generally low due to the headwater nature of this area, the low annual precipitations, and the minimal flow rates.

3.3.5.3 Plume Delineation Study

A plume delineation study is planned once the Third Portage Lake and Wally Lake discharges are operational. This study will be conducted using guidance from Environment Canada (2002) to provide a basis for developing a formal study design for the Meadowbank Gold project. A more complete assessment of hydrology and effluent characteristics will be conducted at that time.

3.3.6 Anthropogenic Influences

This project is located in a remote location far from other anthropogenic activities. With the exception of planned mining activities, there are no other anthropogenic influences in the Meadowbank Gold project area.

3.3.7 Aquatic Resource Characterization

The purpose of this section is to summarize available information from baseline studies (BAEAR, 2005) regarding key features of aquatic biological communities in the study area lakes.

Overall, all lakes show similar levels of abundance and biomass relating to primary (e.g., aquatic plants, phytoplankton) and secondary productivity (e.g., benthic invertebrates). Fish species composition, mean size, and condition factor were also similar among lakes. Overall, the project lakes support healthy communities of plankton, benthos, and fish that are characteristic of oligotrophic Arctic lakes (BAEAR, 2005).

Recent biological surveys are summarized below for each major component of the lake ecosystems.

Phytoplankton

The major phytoplankton species found in the project lakes are consistent with dominant and commonly occurring phytoplankton species usually found in oligotrophic lakes of circum-neutral pH with low nutrient concentrations. Chrysophytes composed 76% to 86% of total biomass over all stains in both July and August 2002, and were also the most abundant in 1998 samples. Diatoms (10% of biomass) and dinoflagellates (12% of biomass) were the next most abundant groups, followed by chlorophytes and cryptophytes, and low numbers of cyanophytes. Mean phytoplankton biomass was consistent among lakes in 2002, ranging from 101 to 174 mg/m^3 in July and from 145 to 177 mg/m^3 in August. The south basin of Third Portage Lake, being colder (larger and deeper), had slightly lower phytoplankton biomass than in the rest of Third Portage Lake and Wally Lake. Most importantly, the relative abundances of major phytoplankton taxa were similar among all lakes.

Zooplankton

Copepods and cladocerans are the major source of food for several fish species. Diversity was typically low for these Arctic, nutrient-poor lakes. Calanoid copepods dominate (55% of numbers caught), followed by cyclopoid copepods (40%), and cladocerans (5%). There were differences in relative abundance of different species among lakes and years. Depth and inter-annual changes in community composition can also have an effect on study results.

Taxa richness was consistent among lakes and years, with similar numbers of taxa in each lake. Generally, taxonomic composition was very similar between Third and Second Portage lakes, and both reference areas (i.e., the south basin of Third Portage Lake and Inuggugayualik Lake).

Benthic Invertebrates

Benthic invertebrates are an important food source for most fish species, especially young-of-the-year and juvenile lake trout, round whitefish, sculpin, and stickleback. As lake trout get larger, their diet shifts from benthos more towards fish.

For all baseline studies (1996 to 2003; Table 3.2; BAEAR, 2005), chironomids dominated the benthic community, both in terms of abundance (50% to 86%) and species diversity (70% to 80%), which is typical of most Arctic and temperate lakes. *Sphaeridae* (small bivalve clams) made up the second most abundant group (12% to 26%). Other groups identified include oligochaetes (1% to 9%), as well as contributions of less than 1% of total abundance for each of Hydracarina (mites), cladocerans, harpacticoid copepods, eubranchiopods (tadpole shrimp), amphipods, flatworms, and stoneflies. Nematodes and ostracods were found in all samples.

In terms of species diversity, similar numbers of benthic taxa were identified in July and August at each site (mean of 13 to 14). An average of 10 to 12 taxa were chironomid species, and a total of 20 genera of this insect family were identified. Overall, there were no large differences in species diversity among lakes as the total number of taxa identified in each lake was similar.

Table 3.2: Benthic Invertebrate Community Surveys from Baseline Studies

Year/Lake	Sample Stations	Oligochaetes	Bivalves	Chironomids	Other Taxa	Total	Richness (no. taxa)
August 1997							
Third Portage Lake	(n=2)	29	196	566	109	657	13
Second Portage Lake	(n=1)	15	44	218	0	276	5
Tehek Lake	(n=1)	0	73	203	58	334	10
Vault Lakes	(n=1)	44	73	73	44	232	9
Third Portage South Basin	(n=1)	0	102	58	15	174	4
August 1998							
Third Portage Lake	(n=1)	73	450	2,001	102	2,625	12
Second Portage Lake	(n=1)	145	928	1,218	160	2,451	15
Inuggugayualik Lake	(n=1)	334	638	7,671	308	8,950	19
July 2002							
Third Portage Lake	(n=5)	113	377	4,971	49	5,510	15
Second Portage Lake	(n=3)	73	319	5,355	82	5,829	11
Tehek Lake	(n=2)	0	358	2,837	135	3,330	15
Vault Lakes	(n=3)	68	947	4,986	331	6,332	14
Third Portage South Basin	(n=1)	15	116	783	15	928	11
Inuggugayualik Lake	(n=1)	138	1,327	8,642	196	10,302	15
August 2002							
Third Portage Lake	(n=5)	41	476	2,242	102	2,859	15
Second Portage Lake	(n=3)	34	276	2,692	300	3,301	14
Tehek Lake	(n=3)	15	218	972	155	1,358	12
Vault Lakes	(n=4)	151	586	7,273	374	8,384	15
Third Portage South Basin	(n=1)	44	218	421	0	682	11
Inuggugayualik Lake	(n=1)	29	44	841	29	943	11

Source: (BAEAR, 2005)

Fish

Fish species composition, mean size, and condition factor were similar for most lakes (Table 3.3). The low species diversity and large abundance of lake trout are typical of most Arctic lakes. Lake trout (*Salvelinus namaycush*) dominated all lakes (64% to 99% of abundances), and constituted large, old, climax populations that are typical of oligotrophic Arctic lakes. Round whitefish (*Prosopium cylindraceum*) and landlocked Arctic char (*Salvelinus alpinus*) were the next most abundant species, with small numbers of burbot (*Lota lota*), ninespine stickleback (*Pungitius pungitius*), and sculpins (*Cottus* sp.) present. There are no spring spawning species such as Arctic grayling (*Thymallus arcticus*) in the local drainage area. Evidence based on hydrology, life history, and strontium concentrations (fins and otoliths) confirms that Arctic char are landlocked.

Table 3.3: Fish Surveys from Baseline Studies

Species	Parameter Lake	Length (mm)			Weight (g)		Condition (K)		Age (yr)			Mercury (mg/kg)		
		n	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**n**	**Mean**	**Range**	**n**	**Mean**	**Range**
Lake Trout	Third Portage Lake	121	458	171 - 990	1,615	25 - 13,000	1.07	0.57 - 1.59	44	13.9	3 - 38	12	0.24	0.07 - 0.60
	Second Portage Lake	105	449	165 - 1100	1,526	50 - 20,000	1.11	0.69 - 1.57	26	16.0	4 - 26	7	0.49	0.10 - 1.17
	Tehek Lake	80	390	178 - 820	840	50 - 6,250	1.08	0.66 - 1.44	18	12.6	6 - 35	3	0.31	0.20 - 0.52
	Vault Lakes	6	340	191 - 556	488	50 - 1,525	0.78	0.41 - 1.24						
	Inuggugayualik Lake	237	496	180 - 945	1,700	50 - 9,500	1.11	0.63 - 1.49	48	14.9	4 - 32	12	0.38	0.15 - 1.03
Arctic Char	Third Portage Lake	8	288	176 - 520	577	50 - 1,575	1.03	0.42 - 1.62	5	3.6	3 - 5			
	Second Portage Lake	30	478	186 - 580	1,133	75 - 2,100	1.09	0.71 - 1.49	14	9.7	2 - 13	6	0.10	0.07 - 0.18
	Tehek Lake	8	459	325 - 510	968	350 - 1,350	0.99	0.75 - 1.23	5	11.2	7 - 15	4	0.06	0.03 - 0.09
	Inuggugayualik Lake	6	679	485 - 860	3,915	1,400 - 6,500	1.18	1.00 - 1.28						
Round Whitefish	Third Portage Lake	22	267	182 - 370	233	75 - 540	1.11	0.52 - 1.90	3	4.3	4 - 5	5	0.02	0.02 - 0.02
	Second Portage Lake	15	329	193 - 426	495	75 - 975	1.17	0.95 - 1.44	5	14.0	7 - 23	3	0.08	0.05 - 0.10
	Tehek Lake	30	323	196 - 400	425	50 - 700	1.19	0.47 - 1.67	5	11.6	7 - 17	2	0.03	0.03 - 0.04
	Vault Lakes	6	299	216 - 364	271	100 - 500	0.93	0.72 - 1.23						
	Inuggugayualik Lake	65	317	190 - 397	412	59 - 775	1.19	0.71 - 1.70						

Source: (BAEAR, 2005).

Metals concentrations in tissues from lake trout, round whitefish, and Arctic char were low in all lakes, and similar to fish from other remote Arctic lakes. Tissue concentrations of mercury were very low in round whitefish (0.02 to 0.10 mg/kg wet weight [ww], n=10) and lake trout (0.07 to 1.03 mg/kg ww, n=49).

Migratory fish are denied access to this region by St. Clair Falls, about 50 km upstream of Chesterfield Inlet on the Quoich River. These falls are believed to be impassable to fish and are thus a natural barrier to upstream movement to anadromous Arctic char. Anadromous Arctic char and lake whitefish (*Coregonus clupeaformis*) are not known to occur in the Quoich River system above St. Clair Falls (Lawrence and Davies, 1977; MacDonald and Stewart, 1980).

Fish movement between lakes is minimal, being severely restricted by the small, ephemeral channels that connect these headwater lakes, particularly between Third and Second Portage Lakes. Hoopnets set in connecting channels between major lakes (e.g., Second and Third Portage; Second Portage and Tehek) have captured very few fish. There are no defined migrations by any fish species between lakes in the project area.

Fish provide a food source to some fish-eating birds such as loons, and infrequently, local residents of Baker Lake. According to traditional knowledge, the lakes are fished very infrequently.

3.3.8 Mining Operations & Environmental Protection Practices

Details of mining operations and environmental protection practices are provided in the EIA. The AEMP (2005) presents management and monitoring activities that will be implemented during mine construction, operation, and post-closure.

3.4 FISH SURVEY & FISH TISSUE ANALYSES

This section outlines a preliminary study design for conducting a fish survey and fish tissue analyses at the Meadowbank Gold project. According to Environment Canada (2002), these investigations consist of (1) monitoring fish to determine if there are differences in the growth, reproduction, survival or condition of fish populations, and (2) monitoring concentrations of mercury in fish tissue (as an indicator of fish usability), in order to determine whether or not the mine effluent(s) is having an effect on fish.

A fish survey at the Meadowbank Gold project will only be required if the concentration of effluent in either Third Portage Lake or Wally Lake exceeds 1% within 250 m of the discharge locations. In addition, fish tissue analyses are only required if concentrations of total mercury in the Third Portage Lake effluent or the Wally Lake effluent exceed 0.10 µg/L.

At this stage of the project development, we have conservatively assumed that a fish survey and fish tissue analyses will be required for both effluent discharges. Note that metals concentrations in fish (i.e., not restricted to mercury) will be a routine monitoring component of the AEMP (2005) for the project. Data from this program will be incorporated into EEM results, as appropriate.

3.4.1 Fish Species Selection

According to Environment Canada (2002), selection of fish species for monitoring purposes must be based on a number of criteria including exposure to effluent, relevance to the study area, and sensitivity to effluent, with the objective of determining population level effects and usability of fish. Selected fish should be resident, easy to age, of high fecundity, include mature individuals, be relevant to the food chain, relatively sedentary, and be exposed to effluent over a long period.

Round whitefish and lake trout were selected as the candidate fish species for population monitoring, for the reasons outlined in Table 3.4.

Table 3.4: Candidate Fish Species for Population Monitoring

Lake Trout	**Round Whitefish**
Top predator in food chain, feeds on younger lake trout and other fish	Prey of lake trout, feeds on zooplankton and benthos (key link in food chain)
Most abundant species in all lakes sampled during baseline studies (BAEAR, 2005), including Third Portage Lake, Wally Lake, and Inuggugayualik Lake	Second most abundant species in all lakes sampled during baseline studies (BAEAR, 2005), including Third Portage Lake, Wally Lake, and Inuggugayualik Lake
Limited movements, resident (important for comparing between exposure and reference areas)	Limited movements, resident (important for comparing between exposure and reference areas)
Piscivorous (may indicate if biomagnification is present)	Benthivorous (possibly good indicator of sediment contamination)
Wide range of ages available, including older mature individuals (reproductive assessment)	Good range of ages available, including mature individuals (reproductive assessment) Smaller, faster growing (easier to detect changes)

There are no other species present that we are aware of that would make better candidate species for evaluation, based on observed distributions and abundances. No other fish species were considered suitable for monitoring for the following reasons:

- sculpin abundance is too low for sampling in all study area lakes
- landlocked Arctic char were found in fewer sites and at lower abundances than the other two species
- no other fish species were present in sufficient numbers in all study area lakes (e.g., ninespine stickleback was not found at Third Portage Lake)
- as fish movement is minimal, fish communities are not expected to change.

Sampling of fish is targeted for early to mid-August, to correspond with the greatest likelihood of encountering favourable field conditions for Arctic lake sampling.

3.4.2 Sampling Areas & Sample Size

The fish survey will follow a multiple reference/exposure study design as follows (Figures 1.1 and 1.2):

- Third Portage Lake internal reference area – located in the south basin of Third Portage Lake, well upstream of mine activities. As indicated earlier, Third Portage South Basin is farther upstream than all other project area water bodies, because of the headwater nature of these lakes. Given that fish movements within and between lakes are local and opportunistic, there is a very low likelihood that reference and exposure area fish will mingle.

- Inuggugayualik Lake external reference area – located in the eastern portion of the lake, which is approximately 15 km west of the study area. This second reference lake will provide further discriminatory power to resolving exposure and reference data.

- Third Portage Lake exposure area – located in proximity to the effluent discharge along the eastern shore of the north basin.

- Wally Lake exposure area – located in proximity to the effluent discharge.

Note that the exact location of sampling areas will depend on results of the planned plume delineation study (see Section 3.3.1.3). The need to include far-field sampling areas will also be determined once patterns of effluent mixing are better understood.

Notwithstanding the above, the use of multiple reference areas for the fish and benthic invertebrate communities surveys (Section 3.5) was considered important to capture natural variation in biological communities inherent to the study area lakes. For example, a single reference area may differ from the exposure area(s) with respect to several natural variables in addition to effluent exposure. This may lead to making erroneous conclusions that differences among areas are mine-related. The use of multiple references offers a greater ability to discern meaningful differences.

Non-lethal catch and release of a minimum of 100 round whitefish and lake trout will be conducted in each sampling areas, per Environment Canada (2002); therefore, a total of 800 fish (i.e., 100 fish x 4 sampling areas x 2 species) will be sampled. In the event of mortality, tissues will be sampled for all standard parameters (e.g., internal and external condition, gonadosomatic and liversomatic indices) as well as tissue metals analysis from a subset of individuals. These data will be compared to pre-mine data.

Note that the benthic invertebrate community survey (Section 3.5) will be conducted concurrently with the fish survey. Supporting water and sediment chemistry sampling will also be conducted to assist in the interpretation of fish survey and fish tissue data (Section 3.6).

3.4.3 Proposed Methods

The study area lakes support a large biomass of fish that includes significant numbers of large, old lake trout. Given this situation and some concern expressed by Baker Lake residents over mortality of fish, the fish survey will be conducted using non-destructive sampling.

All sampling and analysis procedures will follow, as much as possible, guidance outlined in Environment Canada (2002). General QA/QC procedures that will be followed throughout the EEM monitoring program are presented in Section 4. Power analysis will be used where appropriate to determine collection sample size based on recent data and presented in the final study design.

3.4.3.1 Sample Collection

Index sized gill nets (2.5 to 28 cm) will be used to capture round whitefish and lake trout. Mesh sizes will be varied in order to encompass the full range of size classes expected. Sample collection will be done at the same time of year and the same locations as previous baseline studies whenever possible.

Prior to release, all fish will be measured for the following parameters:

- fork length (L) in millimetres
- total weight (W) in grams
- age (pelvic fin ray)
- external condition, appearance, behaviour, parasites, external marks, and tumours.

The use of pelvic fin rays is not ideal for these slow-growing species, but otolith collection would require destructive sampling.

Mortality of fish will be minimized as much as possible by checking nets regularly to remove captured fish; however, inadvertent mortalities will be autopsied to determine internal condition and parasite load, sex and gender ratio, diet from examination of stomach contents, and verification of ageing by sampling the appropriate structures of larger fish (scales, fins, otoliths).

Although the EEM program does not require that tissue samples be analyzed for metals other than mercury, we propose to analyze eight samples from both species (to achieve 95% power with $\alpha = 0.05$ for detecting differences of approximately 2SD; Environment Canada, 2002) at each site for % moisture content, % lipid content, and total metals including mercury. This collection program will be harmonized with requirements of the AEMP (2005) for metals in fish tissue. A sample may be a composite of one or more fish, but no fish will be used for more than one sample. Non-lethal sampling for mercury is possible by using a newly developed method requiring less than a gram of tissue (Baker et al, 2004); however, the other tests would require that fish be sacrificed. Normally a minimum of 5 g is required per sample for mercury testing, but more would be needed to complete additional metals analyses.

Details of field sampling activities will be recorded in a field logbook containing the following information:

- area identification and location (universal transverse mercator [UTM] coordinates)
- species sample
- gillnet dimensions, duration, catch-per-unit-effort
- individual and composite identification
- date and time of sampling
- level of effort
- life history parameters (see above)

- details of paired water quality measurements
- photographs
- general observations (depth, biota, other relevant information).

All tissue samples requiring chemical analyses will be shipped on ice to the analytical laboratory.

3.4.3.2 Laboratory Analysis

Methods for tissue analysis will follow guidance provided in Environment Canada (2002). Fish tissue delivered to ALS will be analyzed using standard analytical procedures and detection limits for metals analyses and lipid content. All data will be reported in terms of mg per wet weight kilogram (mg/kg ww or ppm). Lipid and moisture content will also be determined to estimate dry weight concentrations if necessary. Note that nearly all metals (except mercury) are not positively correlated with increasing fish size.

3.4.4 Possible Alternatives

There should be no difficulty in catching sufficient numbers of both round whitefish and lake trout, using gill nets to obtain the full size distribution present.

Should non-destructive fish surveying of 100 round whitefish and non-destructive tissue sampling from these fish not be feasible or sufficient for analytical or other reasons, destructive methods will be used. This would involve collecting a total of 320 fish (i.e., 20 fish x 2 sexes x 4 sampling areas x 2 species) to be assessed for a suite of parameters as well as chemical analyses (preferably to be done on 20 mature fish of one sex and similar size), based on guidance from Environment Canada (2002).

3.5 BENTHIC INVERTEBRATE COMMUNITY SURVEY

This section outlines a preliminary study design for conducting a benthic invertebrate community survey at the Meadowbank Gold project. The purpose of this component of the EEM program is to determine whether the Third Portage Lake and Wally Lake effluents are affecting fish habitat.

3.5.1 Sampling Areas & Sample Size

The benthic invertebrate community survey will follow a multiple reference/exposure study design consistent with the one proposed for the fish survey (Section 3.4). Specific sampling areas and sample allocations are shown in Figures 1.1 and 1.2 and can be summarized as follows:

- Third Portage Lake internal reference area – five replicate stations located in the south basin of Third Portage Lake
- Inuggugayualik Lake external reference area – five replicate stations located in the eastern portion of the lake
- Third Portage Lake near-field (exposure) area – five replicate stations located in proximity to the effluent discharge

- Wally Lake near-field (exposure) area – five replicate stations located in proximity to the effluent discharge.

The exact location of near-field sampling areas will depend on results of the planned plume delineation study (see Section 3.3.1.3). The need to include far-field sampling areas will be determined once patterns of effluent mixing are better understood. Note that baseline studies (BAEAR, 2005) have focused on depositional areas and relied on a petite Ponar grab for benthos sampling. Most stations were located at depths of around 9 to 10 m on a gentle slope of fine grain sediments (mostly clay, some silt). While sampling methods will differ slightly (e.g., baseline studies used a 250 µm sieve size), baseline stations will be re-sampled in this study, as appropriate, to allow for qualitative inter-annual comparisons.

The selected sample size (i.e., five replicate stations per sampling area) follows Environment Canada (2002) guidance, which recommends setting α and β equal at 0.1, and assumes that variance will be reasonably similar between exposure and reference areas. If necessary, power analysis will be used in the formal study design, based on results of the 2004 monitoring program. Each of the replicate stations will be separated by a distance of at least 30 m and will be approximately 10 m x 10 m in size. A total of three field subsamples will be collected semi-randomly within each replicate station and pooled in the field to provide one data point per station.

To improve our ability to detect changes related to effluent exposure and/or physical substrate characteristics, sediment will be collected at each replicate station and analyzed for grain size, total organic carbon (TOC), and metals. Details of this study component are provided in Section 3.6.

Benthos sampling is targeted for the end of August, which coincides with the open-water season. This also represents a period when benthic invertebrates are generally abundant and sufficiently large for taxonomic identification to genus.

3.5.2 Proposed Methods

All sampling and analysis procedures will follow, as much as possible, guidance outlined in Environment Canada (2002). General QA/QC procedures that will be followed throughout the EEM monitoring program are presented in Section 4.

3.5.2.1 Sample Collection

To assist in station positioning, a global positioning system (GPS) will be used to acquire UTM coordinates (NAD 83) at each replicate station.

Benthos field subsamples will be collected within the 10 x 10 m footprint of each of the five replicate stations using a 0.023 m^2 petite Ponar grab (pending verification with Environment Canada). After examination of grab quality to ensure that it meets collection criteria (e.g., no large foreign objects; adequate penetration; not overfilled; not leaking water; no obvious disturbance or winnowing), it will be carefully opened in a plastic basin. Grab contents will be gently rinsed through a 250 µm screen using site water strained for zooplankton. In the laboratory, the 500 µm fraction will be separated from the 250 µm fraction, which will be archived and processed only if appropriate. Sieved biota will be transferred into a 1 L plastic container and preserved in a 10% solution of buffered formalin. Grab failures may occur due to hard bottom conditions or large debris. In these situations, the grab will be re-deployed until an adequate grab sample is obtained.

This procedure will be repeated until three field subsamples are collected and pooled for each replicate station. Prior to starting a new station, the grab and other stainless steel equipment will be cleaned by scrubbing and rinsing with lake water.

Sample jars will be appropriately labelled and recorded in a field logbook that will include, but not be limited to, the following information:

- station identification
- station location (UTM coordinates)
- date and time of sampling
- field crew members
- level of effort
- substrate characteristics and details of paired water quality measurements and/or sediment quality samples
- photographs
- general observations.

Samples will be shipped to a benthic taxonomist for analysis.

3.5.2.2 Sample Analysis

Methods for sample sorting and taxonomy will follow detailed guidance provided in Environment Canada (2002). Note that benthos identification will be performed at the lowest practicable taxonomic level.

At a minimum, the following endpoints will be used for assessing benthic invertebrate community structure:

- total invertebrate density
- taxon richness, abundance and density for all major taxa
- simpson’s diversity index (D)
- Bray-Curtis (B-C) index
- indicator species abundance.

Appropriate statistical analyses (e.g., analysis of variance and analysis of contrasts for this design; multidimensional scaling) will be used in conjunction with tabular and graphical presentations of the data.

3.6 SUPPORTING ENVIRONMENTAL VARIABLES

The following section summarizes our approach for conducting water and sediment quality monitoring that will specifically support biological monitoring studies. In the case of water quality monitoring, sampling stations described in Section 3.2 (i.e., Part 1 of the EEM program) primarily focus on locations adjacent to the point of entry of effluent from each final discharge (i.e., the Third Portage Lake and Wally Lake effluent discharges) as well as one reference area, the south basin of Third Portage Lake. Since these locations will likely differ from those targeted for the fish survey (Section 3.4.2) and the benthic invertebrate community survey (Section 3.5.1), additional water samples will be required at the same locations and time that biological monitoring is conducted.

Note that extensive monitoring will be conducted as part of the AEMP (2005) (e.g., sediment chemistry; water chemistry; in-situ TSS and turbidity monitoring; periphyton, phytoplankton, benthos, and fish) to detect impacts other than from effluent discharges (e.g., dikes, blasting). This information will be available to assist in interpretation of results from the EEM program.

3.6.1 Water Quality Survey

3.6.1.1 Sampling Areas & Frequency

To ensure consistency with the fish and benthic invertebrate community surveys, water quality monitoring will be based on a multiple reference/exposure design as follows (Figure 1.2):

- Third Portage Lake internal reference area – one water quality station at the centre of this sampling area, located in the south basin of Third Portage Lake

- Inuggugayualik Lake external reference area – one water quality station at the centre of this sampling area, located in the eastern portion of the lake

- Third Portage Lake near-field (exposure) area – one water quality station at the centre of this sampling area, located in proximity of the effluent discharge

- Wally Lake near-field (exposure) area – one water quality station at the centre of this sampling area, located in proximity of the effluent discharge.

Sampling of the above water quality stations is only required once, at the same time that biological monitoring studies are carried out. Note that, as recommended by Environment Canada (2002), water samples will also be conducted concurrently with the routine MMER program and effluent characterization and routine water quality monitoring described in Section 3.2 for the EEM program.

3.6.1.2 Water Chemistry Parameters & Proposed Methods

Station positioning will be conducted in the same manner as described for the benthic survey (Section 3.5.2). Once located, each water quality monitoring station will be sampled for the following parameters:

- Field parameters (water column at 1 m intervals): dissolved oxygen (DO), pH, conductivity, and water temperature. Total water depth and transparency will also be recorded.

- Laboratory parameters (two depths: subsurface and near the bottom); all parameters are listed in Table 3.1.

Sampling and analysis methods, as well as sample containers, preservatives required, and holding times, will follow Environment Canada (2002) guidance. In brief, this will involve using a conductivity/ temperature/oxygen meter and a portable pH meter. To collect water samples we will employ a direct pumping system whereby water is pumped from depth with a diaphragm pump and ultra-clean Teflon tubing. Water is discharged directly into sample collection bottles and held on ice. All instruments will be calibrated prior to use according the manufacturer's specifications. For water collection, the following general procedures will be followed:

- sampling will proceed from the least contaminated to the more contaminated stations
- sample bottles and caps will be rinsed three times prior to water collection
- no preservatives will be placed in the sample bottles prior to sample collection
- sample collectors will wear nitryl gloves to avoid contamination of the sample
- caps of water containers will be held lid-down during sample collection.

Detailed notes for field measurements and water samples will be recorded in a field logbook that will include, but not be limited to, the following information:

- station identification and location (UTM coordinates)
- date and time of sampling
- field crew members
- sampling methods
- field measurements, number and volume of water samples collected
- handling techniques, preservation methods, and sampling containers used
- documentation of paired biological monitoring studies
- photographs
- general observations.

Water sample collection will be timed to coordinate with outgoing flights from the area to minimize shipping and holding times prior to analysis. Water samples will be kept refrigerated at 4°C and shipped in coolers with ice packs via express courier service to the analytical laboratory. Note that all efforts will be made to ensure that water samples are analyzed within appropriate holding times.

3.6.2 Sediment Quality Survey

3.6.2.1 Sampling Areas & Frequency

To ensure consistency with the fish and benthic invertebrate community surveys, sediment quality monitoring will be based on a multiple reference/exposure design as follows (Figures 1.2 and 3.1):

- *Third Portage Lake internal reference area* – A total of five composite sediment samples will be collected within this sampling area, located in the south basin of Third Portage Lake; the five composite sediment samples will match benthos replicate stations (see Section 3.5.1).

- *Inuggugayualik Lake external reference area* – A total of five composite sediment samples will be collected within this sampling area, located in the eastern portion of the lake; the five composite sediment samples will match benthos replicate stations (see Section 3.5.1).

- *Third Portage Lake near-field (exposure) area* – A total of five composite sediment samples will be collected within this sampling area, located in proximity of the effluent discharge; the five composite sediment samples will match benthos replicate stations (see Section 3.5.1).

- *Wally Lake near-field (exposure) area* – a total of five composite sediment samples will be collected within this sampling area, located in proximity of the effluent discharge; the five composite sediment samples will match benthos replicate stations (see Section 3.5.1).

Sediment sample collection will coincide with the timing of biological monitoring studies.

3.6.2.2 Sediment Chemistry Parameters & Proposed Methods

As is the case for all EEM study components, sampling and analysis methods will follow Environment Canada (2002) guidance.

Station positioning will be conducted in the same manner as described for the benthic survey (Section 3.5.2). At each of the benthos replicate station, a composite sediment sample will be prepared from sediments collected from a minimum of three individual grabs. Sediments will be collected using a 0.023 m^2 petite Ponar grab. Each retrieved grab sample will be examined to ensure acceptable sample quality (i.e., no large foreign objects; adequate penetration; not overfilled; no leaking water; no disturbance or winnowing). Once the grab sample quality is determined to be acceptable, overlying water will be siphoned off. The top 2 to 3 cm will be removed using a pre-cleaned stainless steel spoon and placed in a pre-cleaned stainless steel mixing bowl. Sediment will be mixed using the spoon until it is homogenous in texture and colour. The process will be repeated for each of the three individual grabs that compose a composite sample. Care will be taken to ensure that sediment at each benthos replicate station is collected and processed in the same manner to minimize inconsistencies.

To avoid cross-contamination between replicate stations, the Ponar grab, stainless steel compositing bowls and spoons will be decontaminated. This will entail rinsing the grab with site water to remove sediment and organic material, scrubbing with phosphate-free (Liquinox™) critical cleaning detergent, and again rinsing with site water. Field cross-contamination swipes will be taken and analyzed for metals to assess the degree to which contaminants may be exchanged from one sample to the next during sample collection and processing. Filter blanks (i.e., filters that are not swiped on equipment) will be archived pending results of the cross-contamination swipes. To evaluate variability within sediment composites, homogenization duplicate samples will also be collected and analyzed.

Detailed notes for sediment samples will be recorded in a field log book that will include, but not be limited to, the following information:

- station identification and location (UTM coordinates)
- date and time of sampling
- field crew members
- sampling methods
- volume of sediment samples collected and analyses required
- sediment characteristics; documentation of paired biological monitoring studies
- photographs
- general observations.

Sediment samples will be placed in their appropriate containers and shipped by courier to the analytical laboratory. Samples will be stored in a covered ice chest with frozen gel packs or ice and transferred to 4°C storage until analysis by the laboratory. Analyses will include grain size, TOC, and metals.

SECTION 4 • GENERAL QA/QC PROGRAM

Quality assurance (QA) encompasses a wide range of management and technical practices designed to ensure an end product of known quality commensurate with the intended use of the product. Quality control (QC) is an internal aspect of QA. It includes techniques used to measure and assess data quality and remedial actions to be taken when data quality objectives are not realized.

Reliable sample tracking, logging, and data recording will be practiced and documented to establish continuity between the sample collected and the results reported. Standard operating procedures and laboratory activities will be made available, as required. Environment Canada (2002) provides detailed guidance regarding QA/QC procedures for most aspects of the routine MMER and EEM programs. It is our intent to follow this guidance as much as possible and, where deviations are required, document the changes and evaluate potential implications for data quality and interpretative value.

The purpose of this section is to briefly outline field and laboratory approaches proposed for the Meadowbank Gold project routine MMER and EEM programs.

4.1.1 Field Data Collection

The primary QA method in the field involves the completion of data sheets to provide a record and hard copy of relevant observations. Descriptions of key information that will be recorded on the data sheets are provided in Sections 3.4 to 3.6.

The main concerns for sample collection in the field centre on the proper use of equipment and prevention of cross-contamination. Consistency in sample collection/storage, proper calibration methods, proper instruction/training and experience of qualified technicians, and collection of appropriate QA samples will be an integral part of the field investigations.

4.1.2 Shipping & Transport

Along with proper sample packing and shipping methods, we will use comprehensive chain-of-custody procedures to ensure that sample integrity is maintained until arrival at the laboratories. Arrangement for sample shipment will be confirmed with the laboratories prior to field work and these laboratories will be advised of the shipping information (e.g., carrier, date sent and waybill number) so they can track the samples during shipment in case there are any delays.

Chain-of-custody documentation will be used for all samples shipped from or received by the laboratories.

4.1.3 Laboratory Procedures

Analytical procedures (i.e., chemistry, toxicity, benthos taxonomy) will follow guidance from Environment Canada (2002).

SECTION 5 • REFERENCES

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APPENDIX A

Metal Mining Effluent Regulations –

Canada Gazette Part II, Vol. 136, No. 13

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Notice

Registration
SOR/2002-222 6 June, 2002
FISHERIES ACT
Metal Mining Effluent Regulations
P.C. 2002-987 6 June, 2002
Her Excellency the Governor General in Council, on the recommendation of the Minister of Fisheries and Oceans, pursuant to subsections 34(2), 36(5)

and 38(9) of the Fisheries Act, hereby makes the annexed Metal Mining Effluent Regulations.

METAL MINING EFFLUENT REGULATIONS

PART 1

GENERAL

Interpretation

1. (1) The following definitions apply in these Regulations.

"Act" means the Fisheries Act. (Loi)

"acute lethality test" means the test to determine the acute lethality of effluent to rainbow trout as set out in Reference Method EPS 1/RM/13. (essai de détermination de la létalité aiguë)

"acutely lethal effluent" means an effluent at 100% concentration that kills more than 50% of the rainbow trout subjected to it over a 96-hour period when tested in accordance with the acute lethality test. (effluent à létalité aiguë)

"authorization officer" means the holder of the title that is set out in column 2 of Schedule 1 for a province that is set out in column 1 where a mine or recognized closed mine is located. (agent d'autorisation)

"commercial operation", in respect of a mine, means an average rate of production equal to or greater than 25% of the design rated capacity of the mine over a period of 90 consecutive days. (exploitation commerciale)

"composite sample" means

(a) a quantity of effluent consisting of not less than three equal volumes or three volumes proportionate to flow that have been collected at approximately equal time intervals over a sampling period of not less than seven hours and not more than 24 hours; or

(b) a quantity of effluent collected continuously at a constant rate or at a rate proportionate to the rate of flow of the effluent over a sampling period of not less than seven hours and not more than 24 hours. (échantillon composite)

"Daphnia magna monitoring test" means the test to determine the acute lethality of effluent to Daphnia magna as set out in Reference Method EPS 1/RM/14. (essai de suivi avec bioessais sur la Daphnia magna)

"deleterious substance" means a substance prescribed under section 3 except as otherwise prescribed by these Regulations. (substance nocive)

"effluent" means mine water effluent, milling facility effluent, tailings impoundment area effluent, treatment pond effluent, treatment facility effluent — other than effluent from a sewage treatment facility —, seepage

and surface drainage that contains a deleterious substance. (effluent)
"final discharge point", in respect of an effluent, means an identifiable discharge point of a mine beyond which the operator of the mine no longer exercises control over the quality of the effluent. (point de rejet final)
"grab sample" means a quantity of undiluted effluent collected at a time prescribed by these Regulations. (échantillon instantané)
"milling" means crushing or grinding ore for the purpose of producing a metal or a metal concentrate. (préparation du minerai)
"milling facility effluent" means tailing slurries, heap leaching effluent, solution mining effluent and all other effluent deposited from a milling facility. (effluent d'installations de préparation du minerai)
"mine" means mining or milling facilities that are designed or used to produce a metal, a metal concentrate or an ore from which a metal or metal concentrate may be produced or any facilities, including smelters, pelletizing plants, sintering plants, refineries and acid plants, where any effluent from the facility is combined with the effluent from mining or milling. (mine)
"mine under development" means a mine where the construction of an open pit or underground mine has started. (mine en développement)
"mine water effluent" means, in respect of mining activities, water that is pumped from or flows out of any underground works, solution chambers or open pits. (effluent d'eau de mine)
"monthly mean concentration" means the average value of the concentrations measured in all composite or grab samples collected from each final discharge point during each month when a deleterious substance is deposited. (concentration moyenne mensuelle)
"new mine" means a mine that begins commercial operation on or after the date of registration of these Regulations. (nouvelle mine)
"operations area" means all the land and works that are used or have been used in conjunction with mining or milling activity, including
(a) open pits, underground mines, heap leaching areas, solution mines, buildings, ore storage areas and waste rock dumps;
(b) tailings impoundment areas, lagoons and treatment ponds; and
(c) cleared or disturbed areas that are adjacent to the land and works. (chantier)
"operator" means the person who operates, has control or custody of or is in charge of a mine or recognized closed mine. (exploitant)
"placer mining" means a mining operation that extracts minerals or metals

from stream sediments by gravity or magnetic separation. (exploitation des placers)

"recognized closed mine" means a mine referred to in section 32 for which the owner or operator has satisfied the requirements of subsection 32(1). (mine fermée reconnue)

"Reference Method EPS 1/RM/13" means Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout (Reference Method EPS 1/RM/13), July 1990, published by the Department of the Environment, as amended in December 2000, and as may be further amended from time to time. (méthode de référence SPE 1/RM/13)

"Reference Method EPS 1/RM/14" means Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Daphnia magna (Reference Method EPS 1/RM/14), July 1990, published by the Department of the Environment, as amended in December 2000, and as may be further amended from time to time. (méthode de référence SPE 1/RM/14)

"reopened mine" means a mine that resumes commercial operation on or after the date of registration of these Regulations. (mine remise en exploitation)

"surface drainage" means all surface run-off contaminated by a deleterious substance as a result of flowing over, through or out of an operations area. (eau de drainage superficiel)

"tailings impoundment area" means

(a) a water or place set out in Schedule 2; or

(b) a disposal area that is confined by anthropogenic or natural structures or by both, but does not include a disposal area that is, or is part of, a natural water body that is frequented by fish. (dépôt de résidus miniers)

"total suspended solids" means any solid matter that is retained on a 1.5 micron pore filter paper when the effluent is tested in compliance with the analytical requirements set out in Schedule 3. (total des solides en suspension)

"transitional authorization" means a temporary authorization issued by an authorization officer in accordance with section 35. (autorisation transitoire)

(2) Where the word "mine" is used in sections 2 to 39, it includes a mine, a mine under development, a new mine and a reopened mine but does not refer to a recognized closed mine.

Application

2. (1) These Regulations apply in respect of mines and recognized closed mines that
(a) at any time after these Regulations are registered, exceed an effluent flow rate of 50 m3 per day, based on effluent deposited from all the final discharge points of the mine; and
(b) deposit a deleterious substance in any water or place referred to in subsection 36(3) of the Act.
(2) Despite subsection (1), these Regulations do not apply in respect of mines that stopped commercial operation before the registration of these Regulations, unless they are reopened after the registration of these Regulations, or in respect of placer mining operations.
Deleterious Substances
3. For the purpose of these Regulations, the substances set out in column 1 of Schedule 4 and any acutely lethal effluent are prescribed as deleterious substances.
Authority to Deposit
4. (1) Subject to subsection (2), the owner or operator of a mine may deposit, or permit the deposit of, an effluent that contains a deleterious substance in any water or place referred to in subsection 36(3) of the Act if a transitional authorization permits the deposit or if
(a) the concentration of the deleterious substance in the effluent does not exceed the authorized limits set out in Schedule 4;
(b) the pH of the effluent is equal to or greater than 6.0 but is not greater than 9.5; and
(c) the deleterious substance is not an acutely lethal effluent.
(2) The authority in subsection (1) is conditional
(a) in the case of a transitional authorization that permits the deposit, on the owner or operator complying with section 36; and
(b) in the other case, on the owner or operator complying with sections 6 to 27.
Authority to Deposit in Tailings Impoundment Areas
5. (1) Despite section 4, the owner or operator of a mine may deposit or permit the deposit of waste rock or an effluent that contains any concentration of a deleterious substance and that is of any pH into a tailings impoundment area.
(2) The authority in subsection (1) is conditional on the owner or operator complying with sections 7 to 28.
PART 2

CONDITIONS GOVERNING AUTHORITY TO DEPOSIT

DIVISION 1

GENERAL

Prohibition on Diluting Effluent

6. The owner or operator of a mine shall not combine effluent with water or any other effluent for the purpose of diluting effluent before it is deposited.

Environmental Effects Monitoring

7. (1) The owner or operator of a mine shall conduct environmental effects monitoring studies of the potential effects of effluent on the fish population, on fish tissue and on the benthic invertebrate community in accordance with the requirements and within the periods set out in Schedule 5.

(2) The owner or operator shall record the results of the studies and submit the reports and required information to the authorization officer as set out in Schedule 5.

(3) The studies shall be performed and their results interpreted and reported on in accordance with generally accepted standards of good scientific practice at the time that the studies are performed.

Identifying Information

8. (1) The owner or operator of a mine shall submit in writing to the authorization officer the information referred to in subsection (2) not later than 60 days after the day on which one or both of the following occur:

(a) the mine becomes subject to these Regulations; and

(b) ownership of the mine is transferred.

(2) The information that shall be submitted is the name and address of

(a) both the owner and the operator of the mine; and

(b) any parent company of the owner and the operator.

(3) The owner or operator shall submit in writing to the authorization officer any change in the information not later than 60 days after the change occurs.

Final Discharge Points

9. The owner or operator of a mine shall identify each final discharge point and submit in writing to the authorization officer, not later than 60 days after the day on which the mine becomes subject to these Regulations, the following information:

(a) plans, specifications and a general description of each final discharge point together with its specific geo-referenced location; and
(b) a description of how each final discharge point is designed and maintained in respect of the deposit of deleterious substances.
10. (1) The owner or operator of a mine shall submit in writing to the authorization officer the information required by section 9, for
(a) any final discharge point that is identified by an inspector, and that was not identified as required by section 9, within 30 days after the discharge point is identified; and
(b) each new final discharge point, at least 60 days before depositing effluent from that new final discharge point.
(2) The owner or operator shall submit in writing to the authorization officer the information on any proposed change to a final discharge point at least 60 days before the change is to be made.
Monitoring Equipment Information
11. The owner or operator of a mine shall keep records relating to effluent monitoring equipment that contain
(a) a description of the equipment and, if applicable, the manufacturer's specifications and the year and model number of the equipment; and
(b) the results of the calibration tests of the equipment.
DIVISION 2
EFFLUENT MONITORING CONDITIONS
Deleterious Substance and pH Testing
12. (1) Subject to subsection (3), the owner or operator of a mine shall, not less than once per week and not less than four days apart, collect from each final discharge point a grab sample or composite sample of effluent and, without delay, record the pH and concentrations of the deleterious substances set out in column 1 of Schedule 4.
(2) Testing conducted under subsection (1) shall comply with the analytical requirements set out in Schedule 3.
(3) The owner or operator is not required to collect samples for the purpose of recording the concentrations of cyanide set out as item 3 of Schedule 4 if that substance is not used as a process reagent within the operations area.
13. (1) Despite section 12 and subject to subsection (3), the owner or operator of a mine may reduce the frequency of testing for a deleterious substance that is set out in any of items 1 to 6 of Schedule 4 to not less than once in each calendar quarter if that substance's monthly mean

concentration in the effluent is less than 10% of the value set out in column 2 of that Schedule for the 12 months immediately preceding the most recent test.

(2) Despite section 12 and subject to subsection (3), the owner or operator of a mine, other than an uranium mine, may reduce the frequency of testing for Radium 226 set out as item 8 of Schedule 4 to not less than once in each calendar quarter if that substance's concentration in the effluent is less than 0.037 Bq/L in 10 consecutive tests conducted under section 12.

(3) The owner or operator shall increase the frequency of testing to that prescribed in section 12 for a deleterious substance that is set out in any of items 1 to 6 or 8 of Schedule 4 if the substance's monthly mean concentration is equal to or greater than 10% of the value set out in column 2 of these items.

Acute Lethality Testing

14. (1) Subject to section 15, the owner or operator of a mine shall collect from each final discharge point a grab sample and conduct an acute lethality test, in accordance with the requirements and procedures specified in Reference Method EPS 1/RM/13,

(a) once a month, in accordance with the procedure set out in section 5 or 6 of that document; and

(b) without delay, in accordance with the procedure set out in section 6 of that document, if a deposit occurs that is out of the normal course of events.

(2) For the purpose of paragraph (1)(a), the owner or operator shall

(a) select and record the sampling date not less than 30 days in advance of collecting the grab sample; and

(b) collect the grab samples not less than 15 days apart.

(3) When collecting a grab sample of effluent for the purpose of subsection (1), the owner or operator shall collect a sufficient volume of effluent to enable the owner or operator to comply with paragraph 15(1)(a).

Increased Frequency of Acute Lethality Testing

15. (1) If a sample of effluent is determined to be acutely lethal when tested under paragraph 14(1)(a), the owner or operator of a mine shall

(a) without delay, conduct the effluent characterization set out in subsection 4(1) of Schedule 5 on the aliquot of each grab sample collected under paragraph 14(1)(a);

(b) collect from each final discharge point a grab sample twice a month and conduct an acute lethality test on each grab sample without delay in accordance with the procedure set out in section 6 of Reference Method EPS 1/RM/13; and

(c) collect the grab samples not less than seven days apart.

(2) The owner or operator may resume sampling and testing at the frequency prescribed in section 14 if the effluent is determined not to be acutely lethal in three consecutive tests conducted under paragraph (1)(b).

Reduced Frequency of Acute Lethality Testing

16. (1) The owner or operator of a mine may reduce the frequency of conducting acute lethality tests prescribed in paragraph 14(1)(a) to once in each calendar quarter if the effluent is determined not to be acutely lethal over a period of 12 consecutive months.

(2) For the purpose of determining whether effluent is acutely lethal in the 12-month period referred to in subsection (1), the owner or operator shall use the results of the acute lethality tests conducted under paragraph 14(1)(a).

(3) Despite subsection (2), for the purpose of determining whether effluent is acutely lethal in the 12-month period referred to in subsection (1), the owner or operator may also use acute lethality data collected during twelve consecutive months prior to the date of registration of these Regulations, if the owner or operator submits a report to the authorization officer that indicates that the data

(a) meets the quality assurance requirements of Reference Method EPS 1/RM/13;

(b) relates to effluent generated after the start of commercial operation by the mine; and

(c) was collected not more than 36 months before the registration of these Regulations.

(4) The owner or operator who reduces the frequency of conducting acute lethality testing under subsection (1) shall

(a) select and record the sampling date not less than 30 days in advance of collecting the grab samples; and

(b) collect the grab samples not less than 45 days apart.

(5) If a grab sample is determined to be acutely lethal while the testing is proceeding in accordance with subsection (1), the owner or operator shall increase the frequency and conduct the testing as prescribed in section 15.

Daphnia magna Monitoring Tests

17. (1) The owner or operator of a mine shall conduct Daphnia magna monitoring tests in accordance with the procedure set out in section 5 or 6 of Reference Method EPS 1/RM/14 at the same time that the acute lethality tests are conducted under section 14, 15 or 16 of these Regulations.

(2) The owner or operator shall conduct Daphnia magna monitoring tests on the aliquots of each effluent sample collected for the acute lethality tests.

Obligation to Record All Test Results

18. The owner or operator of a mine shall record without delay the information specified by section 8.1 of Reference Method EPS 1/RM/13 and by section 8.1 of Reference Method EPS 1/RM/14 for all acute lethality and Daphnia magna monitoring tests that are conducted to monitor deposits from final discharge points.

Volume of Effluent and Flow Rate

19. (1) The owner or operator of a mine shall record without delay in cubic metres the total monthly volume of effluent deposited from each final discharge point.

(2) The total monthly effluent volume deposited from each final discharge point shall be based on the average of the flow rates that are measured in accordance with subsection (3).

(3) The owner or operator shall

(a) measure flow rates at the same time as samples are collected under section 12, unless the owner or operator uses a system that takes continuous measurements;

(b) use monitoring equipment that is accurate to within 15% of measured flow; and

(c) calibrate the monitoring equipment not less than once in each year and record the results.

Calculation of Loading

20. (1) Subject to subsection (4), the owner or operator of a mine shall record in kilograms the mass loading of the deleterious substances set out in column 1 of Schedule 4 contained in the effluent deposited from each final discharge point for each day on which the sample is collected for that deleterious substance under section 12 or 13.

(2) Subject to subsection (4), the owner or operator shall determine the mass loading by multiplying the concentration of the deleterious substance

recorded under section 12 or 13 by the total volume of effluent deposited from each final discharge point on the day on which the sample is collected.

(3) The owner or operator shall determine the mass loading for each calendar month by multiplying the average of all mass loadings determined for that month under subsection (2) by the number of days in that calendar month during which there was a deposit.

(4) If the owner or operator of a mine has reduced the frequency of testing to not less than once in each calendar quarter under subsection 13(1) or (2), the owner or operator shall determine the mass loading for the calendar quarter by multiplying the concentration of the deleterious substance as measured in that calendar quarter by the total volume of effluent deposited from each final discharge point during the three months preceding the day of collection of the sample.

(5) If the analytical result from any test conducted under section 12 is less than one-tenth of the method detection limit set out in column 4 of Schedule 3, the test result shall be considered to be zero for the purpose of performing a calculation under subsection (2).

Reporting Monitoring Results

21. (1) The owner or operator of a mine shall submit to the authorization officer an effluent monitoring report for all tests and monitoring conducted during each calendar quarter not later than 45 days after the end of the quarter.

(2) The effluent monitoring report shall include

(a) the information specified by section 8.1 of Reference Method EPS 1/RM/13 and by section 8.1 of Reference Method EPS 1/RM/14 as required by section 18;

(b) the concentration and monthly mean concentration of each deleterious substance set out in column 1 of Schedule 4 that is contained in effluent samples collected under subsection 12(1) and the concentrations of such deleterious substances contained in effluent samples collected under subsection 13(1) or (2);

(c) the pH of the effluent samples as required by subsection 12(1);

(d) whether a composite or grab sample collection method was used for each effluent sample as required by subsection 12(1);

(e) the total volume of effluent deposited during each month of the reporting quarter as recorded under section 19;

(f) the mass loading of the deleterious substances set out in column 1 of

Schedule 4 as recorded under section 20; and
(g) the results of the effluent characterization conducted under paragraph 15(1)(a).
22. The owner or operator of a mine shall submit to the authorization officer, not later than March 31 in each year, a report summarizing the effluent monitoring results for the previous calendar year in the form set out in Schedule 6.
23. A report referred to in sections 7, 21 and 22 shall be submitted in writing and in the electronic format, if any, provided by the federal Department of the Environment.
24. (1) The owner or operator of a mine shall notify an inspector without delay if the results of the effluent monitoring tests conducted under sections 12 to 16 indicate that
(a) the limits set out in Schedule 4 are being or have been exceeded;
(b) the pH of the effluent is less than 6.0 or greater than 9.5; or
(c) an effluent is acutely lethal.
(2) The owner or operator shall provide a written report of the test results to the inspector within 30 days after the tests have been completed.
(3) Subsections (1) and (2) do not apply to the owner or operator of a mine with a valid transitional authorization.
Relief
25. (1) Any time period specified for collecting samples of effluent referred to in this Division may be extended if
(a) unforeseen circumstances cause safety concerns or access problems and render the collection of samples of effluent impracticable; and
(b) the owner or operator notifies an inspector of the circumstances.
(2) The owner or operator shall collect the samples of effluent without delay when the circumstances permit.
DIVISION 3
NOTICE, RECORDS AND OTHER DOCUMENTS
End of Commercial Operation Notice
26. (1) The owner or operator of a mine shall notify the authorization officer in writing of the day on which the mine has stopped commercial operation not later than 90 days after the end of commercial operation.
(2) The owner or operator shall notify the authorization officer in writing without delay if the mine returns to commercial operation.
Records, Books of Account or Other Documents

27. Subject to subsection 32(4), the owner or operator of a mine shall keep all records, books of account or other documents required by these Regulations at the mine's location for a period of not less than five years, beginning on the day they are made.

DIVISION 4

TAILINGS IMPOUNDMENT AREAS

Deposits from Tailings Impoundment Areas

28. (1) The owner or operator of a mine shall deposit effluent from a tailings impoundment area only through a final discharge point that is monitored and reported on in accordance with the requirements of these Regulations.

(2) The owner or operator of a mine shall comply with section 6 and the conditions prescribed in paragraphs 4(1)(a) to (c) for all effluent that exits a tailing impoundment area.

PART 3

DEPOSITS OUT OF THE NORMAL COURSE OF EVENTS

Prescribed Authorities

29. For the purpose of subsection 38(4) of the Act, the following authorities are prescribed:

(a) the local environmental protection office of the federal Department of the Environment in the province where the mine is located; and

(b) the department or ministry that is responsible for environmental matters in the province where the deposit occurred or would occur, if the Minister of the federal Department of the Environment has an arrangement with that department or ministry to receive the report and that Minister notifies the owner or operator of the mine of the arrangement.

Emergency Response Plan

30. (1) The owner or operator of a mine shall establish, and update annually, an emergency response plan that describes the measures to be taken to prevent the deposit of a deleterious substance out of the normal course of events or to mitigate the effects of that deposit.

(2) The plan shall include

(a) a site risk analysis;

(b) an organizational scheme for emergency responses, including the roles and responsibilities of the mine's personnel;

(c) alerting and notification procedures;

(d) an inventory of spill-response equipment, including the location of that equipment; and

(e) a training plan for the mine's personnel.
(3) The owner or operator shall complete the emergency response plan and have it available for inspection not later than eight months after the day on which these Regulations are registered or not more than 60 days after the mine becomes subject to these Regulations, whichever is later.

Reporting

31. (1) Any person required by subsection 38(4) of the Act to report the occurrence of a deposit out of the normal course of events of a deleterious substance within the meaning of subsection 34(1) of the Act, or to report if there is a serious and imminent danger of such a deposit, shall without delay report the occurrence or danger to an inspector or to an authority prescribed in section 29 and shall, if a deposit has occurred, submit a written report to the inspector or the authority as soon as possible in the circumstances and in any event not later than 30 days after the deposit occurred.
(2) The written report shall contain
(a) the name, description and concentration of the deleterious substance deposited;
(b) the estimated quantity of the deposit and how the estimate was achieved;
(c) the quantity of any deleterious substance that was deposited at a place other than through a final discharge point;
(d) the quantity of any deleterious substance that was deposited through a final discharge point; and
(e) the circumstances of the deposit, the measures that were taken to mitigate the effects of the deposit and, if the emergency response plan was implemented, details concerning its implementation.

PART 4

RECOGNIZED CLOSED MINES

Requirements

32. (1) An owner or operator who intends to close a mine shall
(a) provide written notice of that intention to the authorization officer;
(b) maintain the mine's rate of production at less than 25% of its design rated capacity for a continuous period of three years starting on the day that the written notice is received by the authorization officer; and
(c) conduct a biological monitoring study during the three-year period referred to in paragraph (b) in accordance with Division 3 of Part 2 of

Schedule 5.
(2) A mine becomes a recognized closed mine after the expiry of the three-year period referred to in subsection (1), and any deposit from that recognized closed mine is subject to the prohibitions in subsection 36(3) of the Act.
(3) The owner or operator shall notify the authorization officer in writing without delay if the recognized closed mine reopens.
(4) The owner or operator referred to in this section shall keep at any place in Canada all records, books of account or other documents required by these Regulations for a period of not less than five years beginning on the day they are made, and shall notify the authorization officer in writing of their location.
Identifying Information
33. (1) The owner or operator of a recognized closed mine shall submit in writing to the authorization officer the information referred to in subsection (2) not later than 60 days after the day on which
(a) the recognized closed mine becomes subject to these Regulations; or
(b) ownership of the recognized closed mine is transferred.
(2) The information that shall be submitted is the name and address of
(a) both the owner and the operator of the recognized closed mine; and
(b) any parent company of the owner or the operator.
(3) The owner or operator shall notify the authorization officer of any change in the information not later than 60 days after the change occurs.
PART 5
TRANSITIONAL AUTHORIZATIONS
Application for Transitional Authorization
34. (1) The owner or operator of a mine may apply to an authorization officer for a transitional authorization that permits the deposit of

(a) an acutely lethal effluent, unless another law of the jurisdiction where the mine is located requires that the mine produce a non-acutely lethal effluent;
(b) an effluent containing any concentration of a deleterious substance that is set out in any of items 1 to 8 of Schedule 4, unless another law of the jurisdiction where the mine is located requires that the mine produce an effluent containing the deleterious substance in a concentration that is equal to or less than the limits set out in Schedule 4; and

(c) an effluent of any pH, unless another law of the jurisdiction where the mine is located requires that the mine produce an effluent with a pH equal to or greater than 6.0 but not greater than 9.5.

(2) Despite paragraph (1)(a), the owner or operator may apply for a transitional authorization to deposit acutely lethal effluent only if the mine produced such an effluent at any time during the 12-month period preceding the application.

(3) The owner or operator of a mine may apply to an authorization officer for a transitional authorization that permits only the deposit of an effluent containing any concentration of total suspended solids, but may not apply if another law of the jurisdiction where the mine is located requires that the mine produce an effluent containing total suspended solids in a concentration equal to or less than the limits set out in Schedule 4 or if, during the 12-month period preceding the application, the results of two consecutive effluent monitoring tests conducted under sections 12 to 16 indicate that

(a) the concentration in the effluent of any of the deleterious substances referred to in any of items 1 to 6 or 8 of Schedule 4 exceeded the applicable authorized limits set out in that Schedule;

(b) the pH of the effluent was less than 6.0 or greater than 9.5; or

(c) the effluent was acutely lethal.

(4) The owner or operator referred to in subsection (1) shall submit an application for a transitional authorization not later than three months after these Regulations are registered and shall submit with the application,

(a) the information required by Part 1 of Schedule 7 including, for the 12-month period preceding the application

(i) the monthly mean concentrations of the deleterious substances set out in column 1 of Schedule 4 that are contained in the effluent,

(ii) whether the effluent is acutely lethal, and

(iii) the pH of the effluent;

(b) a description of the facilities and procedures that are necessary to deposit an effluent that complies with paragraphs 4(1)(a) to (c);

(c) a proposed schedule for the construction of the facilities and implementation of the procedures; and

(d) a signed statement of certification as set out in Part 2 of Schedule 7.

(5) The owner or operator referred to in subsection (3) shall submit an application for a transitional authorization not earlier than 24 months and not later than 27 months after these Regulations are registered and shall submit with the application

(a) the information required by Part 1 of Schedule 7 including, for the 12-month period preceding the application,

(i) the monthly mean concentrations of the deleterious substances set out in column 1 of Schedule 4 that are contained in the effluent,

(ii) whether the effluent is acutely lethal, and

(iii) the pH of the effluent;

(b) a description of the facilities and procedures that are necessary to deposit an effluent that complies with the concentrations referred to in item 7 of Schedule 4;

(c) a proposed schedule for the construction of the facilities and implementation of the procedures;

(d) a signed statement of certification as set out in Part 2 of Schedule 7; and

(e) a statement of certification signed by the owner, the operator or their duly authorized representative indicating that there is no feasible alternative to the transitional authorization, based on documented engineering evidence.

Issuance of Transitional Authorization

35. (1) An authorization officer shall issue to the owner or operator of a mine a transitional authorization, if

(a) the owner or operator is entitled to make the application under subsections 34(1) to (3) and has complied with subsection 34(4) or (5), as applicable; and

(b) any construction of facilities and the implementation of the procedures described by the owner or operator under paragraph 34(4)(b) or (5)(b), as applicable will result in the deposit of an effluent that complies with the requirements prescribed in paragraphs 4(1)(a) to (c).

(2) The authorization officer shall issue a transitional authorization in the form set out in Schedule 8 and provide in the authorization

(a) for the deposit of acutely lethal effluent, the information required by Part 1 of Schedule 8; and

(b) for the deposit of effluent that contains a deleterious substance set out in column 1 of Schedule 4, the information required by Part 2 of Schedule 8, including the maximum concentration of the deleterious substances and the pH range of the effluent the determination of which are specified in that Schedule.

(3) Authorization officers shall maintain a public record of all transitional authorizations issued for mines located in the province where they perform their functions.

Transitional Authorization Obligations

36. An owner or operator of a mine who has been issued a transitional authorization

(a) shall comply with sections 6 to 27 and, if the mine is depositing effluent into a tailings impoundment area, subsection 28(1);

(b) shall start the construction of the facilities and implement the procedures referred to in paragraph 34(4)(b) or (5)(b), as applicable, in a timely manner;

(c) shall report to the authorization officer, without delay, any change in the information provided under subsection 34(4) or (5);

(d) shall not deposit effluent that contains a deleterious substance set out in column 1 of Schedule 4 that exceeds the maximum concentration that is specified in the transitional authorization or has a pH that is outside the pH range specified in the transitional authorization; and

(e) shall not deposit effluent that is acutely lethal unless authorized to do so in the transitional authorization.

Transitional Authorization Reporting

37. (1) The owner or operator of a mine with a valid transitional authorization shall notify an inspector without delay if

(a) an effluent that contains a deleterious substance set out in column 1 of Schedule 4 exceeds the concentration or is outside the pH range that is specified in the transitional authorization; or

(b) an acutely lethal effluent is being or has been deposited, unless the deposit of acutely lethal effluent is authorized in the transitional authorization.

(2) The owner or operator shall provide to the inspector a written report of any test results which identified that the effluent contains a deleterious substance or is acutely lethal under subsection (1) within 30 days after the tests have been completed.

Revocation of Transitional Authorizations

38. An authorization officer may revoke a transitional authorization if

(a) the information provided by the owner or operator of a mine to support the application for the transitional authorization is false or incomplete;

or
(b) the owner or operator has failed to comply with any requirement prescribed in sections 36 and 37.

Expiry of Transitional Authorizations

39. (1) Subject to subsection (2), transitional authorizations expire 30 months after the day on which these Regulations are registered.

(2) Transitional authorizations referred to in subsection 34(3) expire 60 months after the day on which these Regulations are registered.

PART 6

REPEALS AND COMING INTO FORCE

Repeals

40. The Alice Arm Tailings Deposit Regulations (see footnote 1) are repealed.

41. The Metal Mining Liquid Effluent Regulations (see footnote 2) are repealed.

Coming into Force

42. (1) Subject to subsection (2), these Regulations come into force on the day on which they are registered.

(2) Sections 3 to 33 and 36 to 39 and 41 come into force six months after the day on which these Regulations are registered.

SCHEDULE 1

(Subsection 1(1)

AUTHORIZATION OFFICERS

ItemColumn 1

ProvinceColumn 2

Title

1.OntarioDirector, Environmental Protection
Ontario Region
Department of the Environment

2.QuebecDirector, Environmental Protection
Quebec Region
Department of the Environment

3.Nova ScotiaDirector, Environmental Protection
Atlantic Region
Department of the Environment

4.New BrunswickDirector, Environmental Protection

Atlantic Region
Department of the Environment
5.ManitobaDirector, Environmental Protection
Prairie and Northern Region
Department of the Environment
6.British ColumbiaDirector, Environmental Protection
Pacific and Yukon Region
Department of the Environment
7.Prince Edward IslandDirector, Environmental Protection
Atlantic Region
Department of the Environment
8.SaskatchewanDirector, Environmental Protection
Prairie and Northern Region
Department of the Environment
9.AlbertaDirector, Environmental Protection
Prairie and Northern Region
Department of the Environment
10.Newfoundland and LabradorDirector, Environmental Protection
Atlantic Region
Department of the Environment
11.Yukon TerritoryDirector, Environmental Protection
Pacific and Yukon Region
Department of the Environment
12.Northwest TerritoriesDirector, Environmental Protection
Prairie and Northern Region
Department of the Environment

13.NunavutDirector, Environmental Protection
Prairie and Northern Region
Department of the Environment

SCHEDULE 2
(Subsection 1(1))
(TAILINGS IMPOUNDMENT AREAS)
ItemColumn 1

Water or PlaceColumn 2

Description

1.Anderson Lake, ManitobaAnderson Lake located at 54o 51' north latitude and 100o 0' west longitude near the town of Snow Lake, Manitoba. More precisely, the area bounded by

(a) the contour of elevation around Anderson Lake at the 285-m level, and

(b) the control dam built at the east end of Anderson Lake.

2.Garrow Lake, Northwest TerritoriesGarrow Lake located at 75o 23' north latitude and 97o 48' west longitude near the south end of Little Cornwallis Island, Northwest Territories.

3.South Kemess Creek, British ColumbiaThat part of South Kemess Creek being within the watershed of that tributary of South Kemess Creek

(a) extending eastwards and upstream from the centre of a tailings dam constructed at 57° 1' north latitude and 126° 41' west longitude, and

(b) below the crest of the dam at an elevation of 1515 m.

4.Albino Lake, British ColumbiaAlbino Lake located at 56o 39.4' north latitude and 130o 29.4' west longitude near the Eskay Creek Mine in British Columbia. More precisely, the area bounded by

(a) the contour of elevation around Albino Lake at the 1040-m level, and

(b) the outlet of Albino Lake.

5.Tom MacKay Lake, British ColumbiaTom MacKay Lake located at 56o 39' north latitude and 130o 34' west longitude near the Eskay Creek Mine in British Columbia. More precisely, the area bounded by

(a) the contour of elevation around Tom MacKay Lake at the 1078-m level, and

(b) the outlet of Tom MacKay Lake.

SCHEDULE 3
(Subsections 1(1), 12(2) and 20(5))

ANALYTICAL REQUIREMENTS FOR
METAL MINING EFFLUENT

Item	Column 1 Deleterious Substance/pH	Column 2 Precision[1]	Column 3 Accuracy[2]	Column 4 Method Detection Limit (MDL)
1.	Arsenic	10%	100 ± 10%	0.010 mg/L
2.	Copper	10%	100 ± 10%	0.010 mg/L
3.	Cyanide	10%	100 ± 10%	0.010 mg/L
4.	Lead	10%	100 ± 10%	0.030 mg/L
5.	Nickel	10%	100 ± 10%	0.010 mg/L
6.	Zinc	10%	100 ± 10%	0.020 mg/L
7.	Total Suspended Solids	15%	100 ± 15%	3.000 mg/L
8.	Radium 226	10%	100 ± 10%	0.01 Bq/L
9.	pH	0.1 pH unit	0.1 pH unit	Not Applicable

1 Relative standard deviation at concentrations 10 times above the MDL.
2 Analyte recovery at concentrations above 10 times the MDL.

SCHEDULE 4
(Section 3, paragraph 4(1)(a), subsections 12(1) and (3), section 13, subsection 20(1), paragraphs 21(2)(b) and (f), 24(1)(a) and 34(1)(b), subsection 34(3), paragraphs 34(4)(a) and (5)(a) and (b), 35(2)(b), 36(d) and 37(1)(a) and Schedules 5 and 7)

AUTHORIZED LIMITS OF DELETERIOUS SUBSTANCES

ItemColumn 1

Deleterious SubstanceColumn 2

Maximum Authorized Monthly Mean ConcentrationColumn 3

Maximum Authorized Concentration in a Composite SampleColumn 4

Maximum Authorized Concentration in a Grab Sample
1.Arsenic0.50 mg/L0.75 mg/L1.00 mg/L
2.Copper0.30 mg/L0.45 mg/L0.60 mg/L
3.Cyanide1.00 mg/L1.50 mg/L2.00 mg/L
4.Lead0.20 mg/L0.30 mg/L0.40 mg/L
5.Nickel0.50 mg/L0.75 mg/L1.00 mg/L
6.Zinc0.50 mg/L0.75 mg/L1.00 mg/L
7.Total Suspended Solids15.00 mg/L22.50 mg/L30.00 mg/L
8.Radium 2260.37 Bq/L0.74 Bq/L1.11 Bq/L

NOTE: All concentrations are total values.
SCHEDULE 5
(Section 7 and paragraphs 15(1)(a) and 32(1)(c))
ENVIRONMENTAL EFFECTS MONITORING STUDIES
INTERPRETATION
1. The following definitions apply in this Schedule.
"effect on fish tissue" means measurements of total mercury that exceed 0.45 µg/g wet weight in fish tissue taken in an exposure area and that are statistically different from the measurements of total mercury in fish tissue taken in a reference area. (effet sur les tissus de poissons)
"effect on the benthic invertebrate community" means a statistical difference between benthic invertebrate community measurements taken in an exposure area and a reference area or a statistical difference between measurements taken at sampling areas in the exposure area that indicate gradually decreasing effluent concentrations. (effet sur la communauté d'invertébrés benthiques)
"effect on the fish population" means a statistical difference between fish population measurements taken in an exposure area and a reference area. (effet sur la population de poissons)
"exposure area" means all fish habitat and waters frequented by fish that are exposed to effluent. (zone exposée)

"fish" means fish as defined in section 2 of the Fisheries Act but does not include parts of fish, parts of shellfish, parts of crustaceans or parts of marine animals. (poisson)
"reference area" means water frequented by fish that is not exposed to effluent and that has fish habitat that, as far as practicable, is most similar to that of the exposure area. (zone de référence)
"sampling area" means the area within a reference or exposure area where representative samples are collected. (zone d'échantillonnage)
2. Environmental effects monitoring studies consist of the effluent and water quality monitoring studies set out in Part 1, and the biological monitoring studies set out in Part 2, of this Schedule.

PART 1

EFFLUENT AND WATER QUALITY MONITORING STUDIES

Required Studies

3. Effluent and water quality monitoring studies consist of effluent characterization, sublethal toxicity testing and water quality monitoring.

Effluent Characterization

4. (1) Effluent characterization is conducted by analysing a sample of effluent and recording the hardness and alkalinity of the sample and the concentrations, in total values, of the following:
(a) aluminum;
(b) cadmium;
(c) iron;
(d) subject to subsection (3), mercury;
(e) molybdenum;
(f) ammonia; and
(g) nitrate.
(2) The effluent characterization shall be conducted four times per calendar year and not less than one month apart, on aliquots of effluent sample collected under sections 12 and 13 of these Regulations, with the first characterization to be conducted on an aliquot of effluent sample collected not later than six months after the day on which the mine becomes subject to section 7 of these Regulations.
(3) The recording of the concentration of total mercury in effluent referred to in paragraph (1)(d) may be discontinued if that concentration is less than 0.10 μg/L in 12 consecutive samples collected under subsection (2).

(4) Quality assurance and quality control measures shall be implemented that will ensure the accuracy of the effluent characterization data.

Sublethal Toxicity Testing

5. (1) Sublethal toxicity testing shall be conducted by following the applicable methods referred to in subsections (3) and (4) and recording the results for

(a) a fish species, an invertebrate species, a plant species and an algal species, in the case of effluent deposited into fresh waters; and

(b) a fish species, an invertebrate species and an algal species, in the case of effluent deposited into marine or estuarine waters.

(2) The sublethal toxicity tests shall be conducted on the aliquots of effluent sample collected in accordance with subsection 4(2) from the mine's final discharge point that has potentially the most adverse environmental impact on the environment, taking into account the mass loadings of the deleterious substances set out in column 1 of Schedule 4 as determined under subsection 20(2) of these Regulations and the manner in which the effluent mixes within the exposure area.

(3) The sublethal toxicity tests under paragraph (1)(a) shall be conducted using the following test methodologies, as amended from time to time, as applicable to each species:

(a) in the case of a fish species,

(i) Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows (Report EPS 1/RM/22), February 1992, published by the Department of the Environment, or

(ii) Biological Test Method: Toxicity Tests Using Early Life Stages of Salmonid Fish (Rainbow Trout) (Reference Method EPS 1/RM/28), July 1998, published by the Department of the Environment;

(b) in the case of an invertebrate species, Biological Test Method: Test of Reproduction and Survival Using the Cladoceran Ceriodaphnia dubia (Report EPS 1/RM/21), February 1992, published by the Department of the Environment;

(c) in the case of a plant species, Biological Test Method: Test for Measuring the Inhibition of Growth Using the Freshwater Macrophyte, Lemna minor (Reference Method EPS 1/RM/37), March 1999, published by the Department of the Environment; and

(d) in the case of an algal species,

(i) Biological Test Method: Growth Inhibition Test Using Freshwater Alga Selenastrum capricornutum (Report EPS 1/RM/25), November 1992, published

by the Department of the Environment, or
(ii) Détermination de l'inhibition de la croissance chez l'algue Selenastrum capricornutum (Reference Method MA 500-S.cap.2.0), September 1997, published by the Centre d'expertise en analyse environnementale du Québec.

(4) The sublethal toxicity tests under paragraph (1)(b) shall be conducted using the following test methodologies, as amended from time to time, as applicable to each species:

(a) Biological Test Method: Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars) (Report EPS 1/RM/27), December 1992, published by the Department of the Environment;

(b) Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms (Third Edition) (Reference Method EPA/600/4-91/003), August 1994, published by the U.S. Environmental Protection Agency; and

(c) Short-term Methods for Estimating the Chronic Toxicity of Effluent and Receiving Waters to West Coast Marine and Estuarine Organisms (First Edition) (Reference Method EPA/600/R-95-136), August 1995, published by the U.S. Environmental Protection Agency.

6. (1) Subject to subsection (2), the sublethal toxicity tests under section 5 shall be conducted two times each calendar year for three years and once each year after the third year, with the first testing to occur on an effluent sample collected not later than six months after the mine becomes subject to section 7 of these Regulations.

(2) Sublethal toxicity testing may be conducted once each calendar year, if the results of six sublethal toxicity tests conducted after December 31, 1997, on a fish species, an invertebrate species and either an aquatic plant species or an algal species are submitted to the authorization officer not later than six months after the mine becomes subject to section 7 of these Regulations.

Water Quality Monitoring

7. (1) Water quality monitoring is conducted by

(a) collecting samples of water from

(i) the exposure area surrounding the point of entry of effluent into water from each final discharge point and from the related reference areas, and

(ii) the sampling areas that are selected under paragraphs 12(b) and 13(a);

(b) recording the temperature of the water and the dissolved oxygen concentration in the water in the exposure and reference areas where the samples are collected;
(c) recording the pH, hardness and alkalinity of the water samples and the concentration of the substances set out in paragraphs 4(1)(a) to (g);
(d) recording the concentration of the deleterious substances set out in column 1 of Schedule 4; and
(e) implementing quality assurance and quality control measures that will ensure the accuracy of water quality monitoring data.
(2) The water quality monitoring shall be conducted, starting not later than six months after the day on which the mine becomes subject to section 7 of these Regulations,
(a) four times per calendar year and not less than one month apart on the samples of water collected from the areas referred to in subparagraph (1)(a)(i); and
(b) at the same time that the biological monitoring studies are conducted on samples of water collected in the areas referred to in subparagraph (1)(a)(ii).
Effluent and Water Quality Monitoring Report
8. A report on the effluent and water quality monitoring studies conducted during a calendar year under sections 4 to 7 shall be submitted to the authorization officer not later than March 31 of the following year, and shall include
(a) the dates on which each sample was collected for effluent characterization, sublethal toxicity testing and water quality monitoring;
(b) the locations of the final discharge points from which samples were collected for effluent characterization;
(c) the location of the final discharge point from which samples were collected for sublethal toxicity testing and the data on which the selection of the final discharge point was made in compliance with subsection 5(2);
(d) the latitude and longitude of sampling areas for water quality monitoring, in degrees, minutes and seconds, and a description that is sufficient to identify the location of the sampling areas;
(e) the results of effluent characterization, sublethal toxicity testing and water quality monitoring;
(f) the methodologies used to conduct effluent characterization and water quality monitoring, and the related method detection limits; and

(g) a description of quality assurance and quality control measures that were implemented and the data related to the implementation of those measures.

PART 2

BIOLOGICAL MONITORING STUDIES

Required Studies

9. Biological monitoring studies consist of

(a) a site characterization;

(b) a study respecting the fish population, if the concentration of effluent in the exposure area is greater than 1% in the area located within 250 m of a final discharge point;

(c) a study respecting fish tissue, if during effluent characterization conducted under paragraph 4(1)(d) a concentration of total mercury in the effluent is identified that is equal to or greater than 0.10 μg/L; and

(d) a study respecting benthic invertebrate community.

DIVISION 1

THE FIRST BIOLOGICAL MONITORING STUDIES

First Study Design

10. Prior to the conduct of the biological monitoring studies, a study design shall be submitted in accordance with section 14 that contains

(a) a site characterization that includes the information required by section 11;

(b) a description of how the study respecting the fish population will be conducted, if such a study is required under paragraph 9(b), that includes

(i) the information referred to in paragraphs 12(a) to (d), and

(ii) how the study will provide the information necessary to determine if the effluent has an effect on the fish population;

(c) a description of how the study respecting fish tissue will be conducted, if that study is required under paragraph 9(c), that includes

(i) the information referred to in paragraphs 12(a) to (d), and

(ii) how the study will provide the information necessary to determine if the effluent has an effect on fish tissue;

(d) a description of how the study respecting the benthic invertebrate community will be conducted that includes

(i) the information referred to in paragraphs 13(a) to (d), and

(ii) how the study will provide the information necessary to determine if the effluent has an effect on the benthic invertebrate community;

(e) the dates and times that the samples will be collected for the

biological monitoring;
(f) a description of the quality assurance and quality control measures that will be implemented to ensure the validity of the data that is collected; and
(g) a summary of the results of any biological monitoring studies that were submitted under subparagraph 14(b)(iii).
11. A site characterization shall include the following information:
(a) a description of the manner in which the effluent mixes within the exposure area, including an estimate of the concentration of effluent in water at 250 m from each final discharge point;
(b) a description of the reference and exposure areas where the biological monitoring studies will be conducted that includes information on the geological, hydrological, oceanographical, limnological, chemical and biological features of those areas;
(c) the type of production process used by the mine, and the environmental protection practices in place at the mine;
(d) a summary of any federal, provincial or other laws applicable to the mine in respect of effluent and environmental monitoring;
(e) a description of any anthropogenic, natural or other factors that are not related to the effluent under study and that may reasonably be expected to contribute to any observed effect; and
(f) any additional information relevant to the site characterization.
12. The information respecting the fish population and fish tissue studies shall include a description of and the scientific rationale for
(a) the fish species selected, taking into account the abundance of the species most exposed to effluent;
(b) the sampling areas selected;
(c) the sample size selected; and
(d) the field and laboratory methodologies selected.
13. The information respecting the benthic invertebrate community studies shall include a description of and the scientific rationale for
(a) the sampling areas selected, taking into account the benthic invertebrate diversity and the area most exposed to effluent;
(b) the sample size selected;
(c) the sampling season selected; and
(d) the field and laboratory methodologies selected.
Submission of the First Study Design
14. The first study design shall be submitted to the authorization officer

not later than

(a) 12 months after the day on which the mine becomes subject to section 7 of these Regulations; or

(b) 24 months after the day on which the mine becomes subject to section 7 of these Regulations if

(i) biological monitoring studies are completed before the mine becomes subject to section 7 of these Regulations,

(ii) the biological monitoring studies referred to in subparagraph (i) determine whether the effluent was causing an effect on fish population, fish tissue or the benthic invertebrate community, and

(iii) the results of the biological monitoring studies are submitted to the authorization officer along with a report that contains scientific data to support the results not later than 12 months after the day on which the mine becomes subject to section 7 of these Regulations.

Conducting the First Biological Monitoring Studies

15. (1) Subject to subsection (2), the first biological monitoring studies shall start not sooner than six months after the day on which a study design is submitted under section 14, and shall be conducted in accordance with that study design.

(2) If unusual circumstances make it impossible to follow the study design, the owner or operator must inform the authorization officer without delay.

Assessment of Data Collected from Studies

16. The data collected during the biological monitoring studies shall be used

(a) to calculate the arithmetic mean, the median, the standard deviation, the standard error and the minimum and maximum values in the sampling areas for

(i) in the case of a fish population survey, indicators of growth, reproduction, condition and survival that include, where practicable, the length, total body weight and age of the fish, the weight of its liver or hepatopancreas and, if the fish are sexually mature, the egg size, fecundity and gonad weight of the fish,

(ii) in the case of the fish tissue analyses, the concentration of total mercury wet weight in the fish tissue, and

(iii) in the case of a benthic invertebrate community survey, the total benthic invertebrate density, the Simpson's diversity index, the taxa richness, the Bray-Curtis index, the total organic carbon content of sediment and the particle size distribution of sediment;

(b) to identify the sex of the fish sampled and the presence of any lesions, tumours, parasites or other abnormalities;

(c) to conduct an analysis of the results of the calculations under paragraph (a) and information identified under paragraph (b) to determine if there is a statistical difference between the sampling areas; and

(d) to conduct a statistical analysis of the results of the calculations under paragraph (a) to estimate the probability of correctly detecting an effect of a pre-defined size and the degree of confidence that can be placed in the calculations.

First Interpretative Report

17. The first biological monitoring studies conducted under section 15 shall be followed by an interpretative report that contains the following information:

(a) a description of any deviation from the study design that occurred while the biological monitoring studies were being conducted and any impact that the deviation had on the studies;

(b) the latitude and longitude of sampling areas in degrees, minutes and seconds and a description of the sampling areas sufficient to identify the location of the sampling areas;

(c) the dates and times when samples were collected;

(d) the sample sizes;

(e) the results of the data assessment made under section 16 and any supporting raw data;

(f) based on the results referred to in paragraph (e), the identification of any effect on

(i) the fish population,

(ii) fish tissue, and

(iii) the benthic invertebrate community;

(g) a comparison of the results referred to in paragraph (f) and the results of the sublethal toxicity testing reported under paragraph 8(e) to determine if there is a correlation;

(h) the conclusions of the biological monitoring studies, taking into account

(i) the results of any previous biological monitoring studies submitted under paragraph 14(b),

(ii) the presence of anthropogenic, natural or other factors that are not related to the effluent under study and that may reasonably be expected to contribute to any observed effect,

(iii) the results of the statistical analysis conducted under paragraph 16(c), and

(iv) a description of quality assurance or quality control measures that were implemented and the data related to the implementation of those measures;

(i) a description of how the results will impact the study design for subsequent biological monitoring studies; and

(j) the date when the next biological monitoring study will be conducted.

18. The first interpretative report shall be submitted

(a) not later than 30 months after the date the mine becomes subject to section 7 of these Regulations, if the study design was submitted under paragraph 14(a); or

(b) not later than 42 months after the date the mine becomes subject to section 7 of these Regulations, if the study design was submitted under paragraph 14(b).

DIVISION 2

SUBSEQUENT BIOLOGICAL

MONITORING STUDIES

Subsequent Study Designs

19. (1) Subject to subsection (2), the study design for a second and any subsequent biological monitoring study shall be submitted to the authorization officer at least six months before a second or subsequent biological monitoring study is conducted, and shall include

(a) a summary of the information referred to in paragraph 10(a) and, where applicable, a detailed description of any changes to that information since the submission of the most recent study design;

(b) the information referred to in paragraphs 10(b) to (f);

(c) a summary of the results of any previous biological monitoring studies that were conducted after the coming into force of section 7 of these Regulations respecting the fish population, fish tissue analyses and the benthic invertebrate community; and

(d) if the results of the two previous biological monitoring studies indicate that there is an effect on the fish population, on fish tissue or on the benthic invertebrate community, a description of one or more additional sampling areas within the exposure area that shall be used to assess the magnitude and geographic extent of the effect.

(2) If the results of the previous biological monitoring study indicate

the magnitude and geographic extent of an effect on the fish population, on fish tissue or on the benthic invertebrate community, the study design shall include the information required by paragraph (1)(c) and a detailed description of what field and laboratory studies will be used to determine the cause of the effect.

Conduct of Subsequent Biological Monitoring Studies

20. (1) Subject to subsection (2), the second and any subsequent monitoring studies shall be conducted in accordance with the study design submitted under section 19.

(2) If unusual circumstances make it impossible to follow the study design, the owner or operator must inform the authorization officer without delay.

Content of Subsequent Interpretative Reports

21. (1) Subject to subsection (2), the second and subsequent biological monitoring studies conducted under section 20 shall be followed by an interpretative report that contains

(a) the information referred to in paragraphs 17(a) to (j); and

(b) if the study design that was submitted under subsection 19(1) contains information referred to in paragraph 19(1)(d), the magnitude and geographic extent of the effect referred to in that paragraph.

(2) If the study design was submitted under subsection 19(2), the interpretative report shall contain only the cause of the effect referred to in that subsection and, if the cause was not determined, an explanation of why and a description of any steps that must be taken in the next study to determine that cause.

Submission of the Subsequent Interpretative Reports

22. (1) Subject to subsection (2), the interpretative report of the second and any subsequent biological monitoring studies shall be submitted to an authorization officer not later than 36 months after the day on which the interpretative report of the previous biological monitoring study was required to be submitted.

(2) The interpretative report of the second and subsequently conducted biological monitoring studies shall be submitted

(a) not later than 24 months after the day on which the interpretative report of the previous study was required to be submitted, if the results of the previous study indicate an effect on fish populations, on fish tissue and on the benthic invertebrate community;

(b) not later than 72 months after the day on which the interpretative report of the previous study was required to be submitted, if the results of the previous two consecutive biological monitoring studies indicate no effect on fish populations, on fish tissue and on the benthic invertebrate community; or
(c) not later than 24 months after the day on which the interpretative report of the previous study was required to be submitted, if the results of the previous two consecutive biological monitoring studies indicate an effect on fish populations, on fish tissue or on the benthic invertebrate community, and if the magnitude or geographic extent of the effect or cause of the effect is not known.
(3) For the purposes of subsection (2), if an owner or operator of a mine is not required to conduct a study on the fish population or on fish tissue under paragraph 9(b) or (c), the effluent is considered to have no effect on the fish population or on fish tissue respectively.

DIVISION 3

FINAL BIOLOGICAL MONITORING STUDY PRIOR TO CLOSING MINE

Final Study Design

23. (1) If an owner or operator of a mine has provided to the authorization officer a notice to close a mine under subsection 32(1) of these Regulations, a study design shall be submitted to the authorization officer, not later than six months after providing the notice, and shall include
(a) if study design is submitted for the first time, the information referred to in paragraph 10(a) and, in all other cases, a summary of the information referred to in paragraph 10(a) and, where applicable, a detailed description of any changes to that information since the submission of the most recent study design;
(b) the information referred to in paragraphs 10(b) to (f);
(c) a summary of the results of any previous biological monitoring studies that were conducted after the date of registration of these Regulations respecting the fish population, fish tissue and the benthic invertebrate community; and
(d) if the results of the two previous biological monitoring studies indicate that there is an effect on the fish population, on fish tissue or on the benthic invertebrate community, a description of one or more additional sampling areas within the exposure area, which additional sampling areas shall be used to assess the magnitude and geographic extent

of the effect.

(2) If the results of the previous biological monitoring studies indicate the magnitude and geographic extent of an effect on fish population, on fish tissue or on the benthic invertebrate community, the study design shall include the information required by paragraph (1)(c) and a detailed description of what field and laboratory studies will be used to determine the cause of the effect.

Conduct of Final Biological Monitoring Studies

24. (1) Subject to subsection (2), the final monitoring studies shall be conducted in accordance with the study design submitted under section 23 not sooner than six months after the day on which the final study design has been submitted.

(2) If unusual circumstances make it impossible to follow the study design, the owner or operator must inform the authorization officer without delay.

Content of Final Interpretative Report

25. The final biological monitoring studies conducted under section 24 shall be followed by an interpretative report that contains

(a) the information referred to in paragraphs 17(a) to (h);

(b) if the study design that was submitted under subsection 23(1) contains the information referred to in paragraph 23(1)(d), the magnitude and geographic extent of the effect referred to in that paragraph; and

(c) if the study design was submitted under subsection 23(2), the cause of the effect referred to in that subsection.

Submission of the Final Interpretative Report

26. The final interpretative report shall be submitted to the authorization officer not later than 36 months after the day on which the notice to close the mine was provided under subsection 32(1) of these Regulations.

SCHEDULE 6

(Section 22)

INFORMATION TO BE INCLUDED IN

ANNUAL SUMMARY REPORT

The following information is to be submitted for each final discharge point.

Mine Name:

Mine Operator:

Address:

Telephone:

E-mail:

Location of Final Discharge Point:

Reporting Period:

Date of Report:

TABLE 1
MONTHLY MEAN CONCENTRATIONS, pH RANGE AND VOLUME OF EFFLUENT (1)(2)

MonthAs
(mg/L)Cu
(mg/L)CN
(mg/L)Pb
(mg/L)Ni
(mg/L)

Jan
Feb
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

MonthZn
(mg/L)TSS
(mg/L)Ra
(Bq/L)pHEffluent Volume
(m3)
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

(1) Any measurement not taken because there was no deposit from the final discharge point shall be identified by the letters "ND" - (No Deposit).
(2) Any measurement not taken because no measurement was required in accordance with the conditions set out in section 13 of the Regulations shall be identified by the letters "NMR" - (No Measurement Required).
TABLE 2
RESULTS OF ACUTE LETHALITY TESTS AND DAPHNIA MAGNA MONITORING TESTS

Date Sample CollectedEffluent Acutely Lethal to Rainbow Trout
(yes or no)Effluent Acutely Lethal to Daphnia Magna
(yes or no)

Non-compliance Information
If effluent was non-compliant with the authorized limits set out in Schedule 4, indicate the cause(s) of non-compliance and remedial measures planned or implemented. Also indicate remedial measures planned or implemented in response to the failure of acute lethality tests.

SCHEDULE 7
(Paragraphs 34(4)(a) and (d) and (5)(a) and (d))
PART 1
INFORMATION TO BE INCLUDED IN AN APPLICATION
FOR A TRANSITIONAL AUTHORIZATION

1. The name, address and telephone number of the applicant.
2. The name, position title, telephone number, facsimile number and E-mail address of a contact person.
3. The name, mailing address and geographic location of the mine.
4. A general description of the mining operation with details of the parts of the operation for which the application is made.
5. A site plan showing the location of the main mining and milling facilities, the effluent treatment facilities and all the final discharge points.
6. All available pH data and data related to the monthly mean concentrations of the deleterious substances set out in column 1 of Schedule 4 in the effluent for which the application is made for the one-year period immediately preceding the date of application.
7. The effluent flow rate at each final discharge point.
8. The available results of all acute lethality tests related to the effluent for which the application is made for the one-year period immediately preceding the date of application.
9. Plans, specifications and other information on the design and capability of the effluent treatment process in place at the mine on the date of application.
10. Based on the best available information at the time of application, a description of the facilities and procedures that are necessary to produce a non-acutely lethal effluent that complies with the authorized limits of the substances set out in column 1 of Schedule 4.
11. A proposed schedule for the construction of the facilities and implementation of the procedures.
12. The details of any effluent monitoring results related to fish, fish habitat or the human use of fish that are known to the operator.

13. A signed statement indicating whether there is a law in the jurisdiction where the mine is located, and the identification of that law, that requires the mine to produce
(a) a non-acutely lethal effluent;
(b) an effluent containing a deleterious substance in a concentration that is equal to or less than the limits set out in Schedule 4; or
(c) an effluent with a pH equal to or greater than 6.0 but not greater than 9.5.
14. Any further information that is required to support the application.

PART 2

STATEMENT OF CERTIFICATION

I certify that the information provided under Part 1 of Schedule 7 to the Metal Mining Effluent Regulations was prepared by persons with sufficient knowledge to evaluate the information. I further certify, based on my reasonable inquiry of the persons responsible for making the determination, that the information submitted is true, accurate and complete.

Date:

Signature:

(operator, owner or their authorized representative)

(Position title)

SCHEDULE 8
(Subsection 35(2))
(PART 1)
TRANSITIONAL AUTHORIZATION FOR
ACUTELY LETHAL EFFLUENT

(Name and address of the owner and operator of the mine)

Owner:

Operator:

(Name and address of the mine)

is (are) hereby authorized as of (date)

to deposit acutely lethal effluent until (date)

for effluent from (identify final discharge point)

IMPORTANT: Please refer to sections 6 to 27 and subsection 28(1) of the Metal Mining Effluent Regulations (MMER) for conditions governing the authority to deposit. In addition, please note that this authorization may be revoked under section 38 of those Regulations.

Authorization Officer: (Signature):

(Name):

(Position):

(Date):

PART 2

TRANSITIONAL AUTHORIZATION FOR DELETERIOUS SUBSTANCES
(Name and address of the owner and operator of the mine)
Owner:

Operator:

(Name and address of the mine)

is (are) hereby authorized as of (date)

to deposit acutely lethal effluent until (date)

for effluent from (identify final discharge point)

Deleterious SubstanceMaximum Authorized

Monthly Mean Concentration1Maximum Authorized Concentration in a Composite Sample2Maximum Authorized Concentration in a Grab Sample3
Arsenic
Copper
Cyanide
Lead
Nickel
Zinc
Radium 226
Total
Suspended
Solids
Authorized Effluent pH Range4:

IMPORTANT: Please refer to sections 6 to 27 and subsection 28(1) of the Metal Mining Effluent Regulations for conditions governing the authority to deposit. In addition, please note that this authorization may be revoked under section 38 of those Regulations.
Authorization Officer: (Signature):

(Name):

(Position):

(Date):

1 The maximum monthly mean concentration of the deleterious substance in effluent is the greater of the maximum monthly mean concentration of the substance recorded during the 12-month period preceding the date of the application for the transitional authorization and the authorized monthly mean concentration set out in column 2 of Schedule 4. The maximum monthly mean concentration for a substance may not exceed the concentration required by the jurisdiction where the mine is located, if applicable.
2 The maximum authorized concentration of the deleterious substance in each composite sample collected is equal to 1.5 times the maximum authorized monthly mean concentration.
3 The maximum authorized concentration of the deleterious substance in each grab sample collected is equal to 2.0 times the maximum authorized monthly mean concentration.
4 The lower limit of the authorized pH range is equal to the lowest pH recorded during the 12-month period preceding the date of the application

for the transitional authorization or 6.0, whichever is less. The upper limit of the authorized pH range is equal to the highest pH recorded during the 12-month period preceding the date of the application or 9.5, whichever is greater.

REGULATORY IMPACT
ANALYSIS STATEMENT

(This statement is not part of the Regulations.)

Description

The objective of the new Metal Mining Effluent Regulations (MMER) is to update and strengthen the current Metal Mining Liquid Effluent Regulations (MMLER). The new MMER will also repeal the Alice Arm Tailings Deposit Regulations (AATDR).

The current MMLER were made on February 24, 1977 under sections 33 and 34 of the Fisheries Act as it stood at that time. These Regulations were designed to limit the deposit of deleterious substances into waters frequented by fish from new, expanded and reopened metal mines. The MMLER do not apply to mines that commenced operation prior to 1977 or to mines that use cyanide in the milling process. Authorized effluent concentration limits were set for arsenic, copper, lead, nickel, radium-226, total suspended solids (TSS) and zinc, and minimum levels were set for pH.

The new MMER will apply to all metal mines, including pre-1977 mines. They further augment the requirements of the MMLER by: adding limits for cyanide to the original MMLER limits for arsenic, copper, lead, zinc, nickel and radium-226; including an upper limit on pH; lowering the limit for TSS; requiring Environmental Effects Monitoring (EEM); and requiring the production of non-acutely lethal effluent.

Background

The new MMER are the result of an extensive consultation process spanning approximately six years.

In June 1993, the Assessment of the Aquatic Effects of Mining in Canada (AQUAMIN) process was initiated in response to Environment Canada's commitment to update and strengthen the MMLER. This multi-stakeholder process involved representatives from federal departments, provincial ministries, industry, environmental non-governmental organizations, and First Nations groups. The final AQUAMIN report of April 1996 advanced more than 50 recommendations in three key areas, those being: specific amendments to the MMLER; the design of a national EEM program; and information gaps and research needs.

In response to the recommendations of the AQUAMIN report, a multi-stakeholder adviSORy group and several expert working groups were established to provide ongoing advice on the development of the new MMER and the associated EEM program. This phase of the consultation process took place from mid-1997 to mid-1999 and, similar to AQUAMIN, involved representatives from federal departments, provincial ministries, industry, environmental non-governmental organizations, and First Nations groups.

The AATDR were made in April 1979 allowing the Kitsault Mine to deposit mine tailings into Alice Arm, a deep fjord in northwestern British Columbia. The AATDR are in effect a site-specific exemption to the MMLER, and the Kitsault Mine is the only mine in Canada that is so exempted. This mine has not operated since 1982.

In November 1992, Environment Canada commenced a review of its regulations, including the AATDR, as part of an overall federal government regulatory review process. The Environmental Protection Program Regulatory Review Discussion Document, issued in November 1993, recommended that the AATDR be repealed. In the November 1994 final report, it was again recommended that these Regulations be repealed.

Industry Profile

The Canadian metal mining industry produces over $11 billion of metal production revenue (based on figures for 1997). Over 90 metal mines operate in Canada. The geographic distribution of these mines, and the number of mine types, value of production and number of employees are shown in Tables 1 and 2.

Table 1: Value of Metal Mine Production and Number of Employees(see footnote 3)

Value fo Production and Number of Employees 1997
Type of MineValue of Production
($ Billions)Number of Employees
Gold2.59,621
Silver-Lead-Zinc1.23,058
Uranium0.61,024
Iron1.64,839
Nickel-Copper-Zinc5.113,478
Other metal mines0.2992
*Total11.233,012
*due to rounding, total might not add up

Table 2: Distribution of Canadian Metal Mines(see footnote 4)
Province and TerritoryDistribution of Operating Mines 1999
Base MetalsPrecious MetalsUraniumIronTotal
Yukon 1 1
B.C.46 10
N.W.T.,NV22 4
Saskatchewan123 6
Manitoba62 8
Ontario1719 36
Quebec813 223
New Brunswick2   2
Newfoundland 1 23
Total40463493

The Kitsault Mine
The Kitsault Mine was an open-pit molybdenum mine that operated from January 1968 to late 1972 and from April 1981 to November 1982. Mining ceased in 1982 due to poor market conditions and has not resumed.
In February 1997, the owner of the mine, Climax Canada Limited, filed a reclamation work plan with the Government of British Columbia. In this plan, the company proposed to proceed with demolition and salvaging of the mine site infrastructure including the tailings line, tailings tunnel and tailings drop boxes, the freshwater supply line, the pit shop building, and the mill/ concentrator complex. This reclamation work has been completed and, as of September 1, 1999, all surface installations had been removed including the tailings pipeline.
Regulatory Requirements
The new MMER result in the following changes to current regulatory requirements under the MMLER:
the new regulations apply to all new and existing metal mines in Canada including gold mines that use cyanide in the milling process and mines that were in operation prior to the 1977 MMLER (the MMER apply to about 100 operating mines, while the MMLER applied to about 30 mines in 1998);
effluent limits are prescribed for cyanide;
the prescribed limit for total suspended solids (TSS) has been lowered from 25 mg/L to 15 mg/L for monthly mean concentrations;
effluent pH must be maintained in the range of 6.0 to 9.5 as opposed to only meeting currently prescribed minimum values;

mines are required to produce an effluent that is non-acutely lethal to rainbow trout;
mines are required to monitor the acute lethality of effluent to rainbow trout and Daphnia magna in accordance with prescribed reference methods; and
mines are required to conduct an Environmental Effects Monitoring (EEM) program in accordance with prescribed requirements.
Current MMLER and MMER effluent requirements are compared in Table 3.
Table 3: Comparison of MMLER and MMER Requirements

ParameterCurrent MMLER Requirements(1)MMER Requirements(2)
Monthly(3)Composite(4)Grab(5)Monthy(3)Composite(4)Grab(5)
Arsenic
(mg/L) 0.50.751.00.50.751.0
Copper
(mg/L) 0.30.450.60.30.450.6
Cyanide
(mg/L) nonenonenone1.01.52.0
Lead
(mg/L) 0.20.30.40.20.30.4
Nickel
(mg/L) 0.50.751.00.50.751.0
Zinc
(mg/L) 0.50.751.00.50.751.0
PH>6.0>5.5>5.0In range of 6.0 to 9.5
Radium-226(Bq/L)0.370.741.110.370.741.11
TSS (mg/L)2537.5501522.530
(% Non-acutely
lethal effluent)(6)No requirements100%

(1) All MMLER concentrations are total values with the exception of radium-226 which is a dissolved value.
(2) All MMER concentrations are total values.
(3) Maximum authorized monthly arithmetic mean concentration.
(4) Maximum authorized concentration in a composite sample.
(5) Maximum authorized concentration in a grab sample.
(6) For the purposes of the MMER, non-acutely lethal means survival of at least 50% of rainbow trout subjected to 100% concentration effluent for a period of 96 hours.

The new MMER limits are based on a comprehensive review and assessment of national and international mining effluent standards, pollution prevention practices and control technologies of relevance to the mining sector, and the current performance of the Canadian mining sector in terms of effluent quality. The new limits reflect the effluent quality that is being achieved by the best performing (upper 50th percentile) of Canadian metal mines and thus are based on the availability of demonstrated technology.

The proposed MMER requirements take into account current provincial and territorial regulatory requirements and essentially mirror those in place under the Province of Ontario's Municipal Industrial Strategy for Abatement (MISA) program.

Environmental Effects Monitoring (EEM)

The metal mining EEM program builds on the experience of the EEM program developed and implemented under the 1992 Pulp and Paper Effluent Regulations.

The objective of the metal mining EEM program will be to evaluate the effects of mining effluent on the aquatic environment, specifically fish, fish habitat, and the use of fisheries resources. The program will help evaluate the effectiveness of current and future pollution prevention and control technologies, practices and programs within the mining sector and will evaluate the need for more enhanced protection of fish, fish habitat and fisheries on a site-specific basis. Each mine owner or operator will be required to develop, conduct and report the findings of a site-specific EEM program which monitors key components of the aquatic ecosystem. All mines will be required to:

submit study designs detailing each field monitoring study;

conduct a field monitoring program as described by the study design;

submit interpretive reports after completion of each field study; and

conduct ongoing effluent characterization, sub-lethal toxicity testing and water quality monitoring.

The frequency and nature of EEM monitoring will vary at each site depending upon the results of previous monitoring studies. Where an effect on fish or benthic invertebrates is found, mines will be required to conduct focused monitoring of the effect. Where EEM studies indicate there are no effects, the mine will be required to conduct periodic monitoring, with a reduced frequency in comparison to focused monitoring.

The recommendations of the AQUAMIN report stressed the need for an effective EEM program for the Canadian mining industry. An effective EEM program will allow for continuous improvement in mining effluent treatment and will provide a scientifically defensible basis for establishing, where necessary, site-specific remediation requirements or more stringent site-specific measures to protect fish, fish habitat and fisheries.

Alternatives

Metal Mining Effluent Regulations

Status Quo

The status quo alternative was rejected since it has been recognized by governments, industry and other stakeholders that the current MMLER require updating and strengthening; the AQUAMIN recommendation that a revised regulation should apply to all Canadian metal mines is of particular relevance in this regard. The MMER represent the outcome of comprehensive consultation processes spanning a period of approximately

six years and reflect the environmental performance that is achievable with currently available pollution prevention and control technology.

Regulatory Option

A regulatory option under the Fisheries Act consisting of prescribed effluent criteria and a requirement for environmental effects monitoring was considered to be the most appropriate measure to achieve the objective of improved management of mining effluents. The proposed regulatory approach will help ensure there are national baseline minimum standards of environmental performance for all Canadian metal mines while providing a scientifically defensible basis for assessing the need for more stringent measures to protect fish, fish habitat and fisheries on a site-specific basis.

Tools such as economic instruments and voluntary approaches were not considered practical for the management of mine effluents, as the purpose of this initiative is to provide improved protection for fish and fish habitat exposed to effluents from metal mines.

Repealing Alice Arm Tailings Deposit Regulations (AATDR)

Status Quo

Maintaining the existing AATDR was not viewed as an acceptable option since this approach would provide an exemption to the new MMER. The MMER are to apply to all metal mines operating in Canada. Allowing for the continuation of the AATDR would undermine the intent of the MMER and would be inconsistent with the recommendation of the federal government's 1994 Regulatory Review report.

Repeal the AATDR

Repealing the AATDR will help to ensure the consistent application of the proposed MMER to all Canadian metal mines and is in accordance with the recommendations of the 1994 Regulatory Review report. Since there is no longer a mining operation at the Kitsault Mine site, repealing of the AATDR would have no measurable impact on the mining sector.

Benefits and Costs

Costs to Industry

The mining industry will incur additional costs to comply with the proposed new MMER due to:

the broadened application of the new regulations, i.e., to gold mines that use cyanide in the milling process and mines in operation before 1977;

upgrading of existing effluent treatment systems to enable all mines to achieve the new regulatory requirements for total suspended solids, cyanide, pH and the production of non-acutely lethal effluent;

new requirements for monitoring of acute lethality; and

the development and implementation of EEM programs.

Costs for Upgrading of Effluent Treatment Facilities

A study (see footnote 5) was conducted to estimate the costs that would be associated with the upgrading of effluent treatment facilities to meet the new requirements of the proposed MMER. This study involved a survey and analysis of mines outside of the Province of Ontario to determine if: (a) their existing operations would be compliant with the requirements of the new MMER; and (b) what, if any, additional capital and operational expenditures would be required to become compliant. Ontario mines were excluded from this review since they already need to comply with regulatory requirements that are at least as stringent as those of the new MMER.

A total of 67 operating mines were identified as being potentially impacted by the new MMER. Information was available for 61 of these mines. Sources of information included direct contact with mine operators, Environment Canada MMLER compliance data, and published Québec Directive 019 compliance data. For the six mines for which data could not be obtained, assumptions were made regarding the potential additional treatment requirements and costs.

The capital cost associated with the upgrading of effluent treatment facilities has been estimated in the range of $280 to $460 million. This range is defined as low range and high range in the following Table 4. The increase in annual operating costs is estimated in the order of $6 to $22 million. These annual operating costs of the additional treatment are assumed to be carried over a period of 15 years. Thus at discount rates of 5 percent and 10 percent, the present value of these costs (including capital cost) is between $242 and $284 million for the low range, and between $536 and $618 million for the high range (the higher cost figures here refer to the lowest discount rate; the opposite is true for the lower cost figures).

Table 4: Overview of Estimated Effluent Treatment Costs

Industry Effluent Treatment Costs
Mining Sub-sectorCost RangeCost
$ MillionsPresent Value
$ Millions
(Over 15 Years)
CapitalAnnual OperatingDiscount
Rate 5%Discount
Rate 10%
Base MetalHigh Range65.94.6113.6100.9
Low Range21.21.738.834.1
GoldHigh Range 133.015.8297.0253.2
Low Range24.14.469.857.6
Iron & other minesHigh Range259.61.4207.6182.1
Low Range238.40.4175.6150.1
UraniumHigh Range0000
Low Range0000
TotalHigh Range458.521.8618.2536.2
Low Range283.76.5284.2241.8

Costs for Acute Lethality Testing

Acute lethality testing is a bioassay test procedure in which a fish and an aquatic invertebrate species (rainbow trout and Daphnia magna in the case of the MMER) are exposed to undiluted effluent for a prescribed period of time under prescribed conditions. If at least 50 percent of the test species survive this exposure, the effluent is considered to have passed the test and to be "non-acutely lethal" to the species in question.

In May 1999, Environment Canada conducted a cost survey of Canadian laboratories in order to determine the cost of the single concentration of effluent test. Based on this survey, the average cost of these tests for

exposure of rainbow trout and Daphnia magna were around $170 and $160 respectively. Ontario mines are already required to conduct these tests under the provincial MISA program and thus are not impacted by the new test requirements of the MMER. Assuming that all other mines would be required to perform these tests once each month, the total annual industry cost for acute lethality testing would be as summarized in Table 5.

Table 5: Estimated Costs for Acute Lethality Testing

Test	Cost per Test	Tests per Year	Total Cost per year and per Mine	Number of Mines	Total Cost per Industry
Rainbow Trout	$170	12	$2,040	57	$116,280
Daphnia magna	$160	12	$1,920	57	$109,440
Total	$330		$3,960		$225,750

The present value of these costs for acute lethality, based upon 5 and 10 percent discount rates, would be $2.3 and $1.7 million, respectively, over a 15-year period.

Costs for Sampling and Analysis

Incremental costs exist for both sampling and analysis of cyanide and radium-226. With respect to cyanide, the best available information suggests that one-half of Canadian metal mines do not use cyanide as a process reagent. Assuming a cost of $40 per sample and an on-going weekly requirement for cyanide sampling and analysis at one-half of Canadian metal mines, total annual costs are estimated at approximately $98,000. It should be noted that the regulations have a provision to reduce sampling frequency if sample results are less than 10 percent of the allowable monthly authorized mean concentration for one year.

In the case of radium-226, it is assumed that all mines will be required to conduct sampling on an on-going basis. Based on a required sample once per week, total annual costs in this scenario are approximately $605,000. Provisions also exist in the regulations for non-uranium mines to fall back to quarterly testing if 10 consecutive test results are less than 10 percent of the authorized monthly mean concentration.

On the basis of the above assumptions, total annual incremental costs to industry for sampling and analysis are estimated to be $703,000. The present value of these costs, based on 5 and 10 percent discount rates, are $7.3 million and $5.35 million, respectively over a 15-year period.

Costs for Environmental Effects Monitoring (EEM)

Since the nature of EEM is such that program requirements will be specific to each mine site and will have outcomes that are as yet unknown, it is difficult to estimate the cost of a "typical" EEM program. However, based on experience gained with the EEM program developed under the Pulp and Paper Effluent Regulations, it has been estimated that the cost of a three-year EEM cycle will be in the order of $115,000 to $145,000 for each mine. Therefore, on an annual basis, the cost for the three-year EEM cycle would be in the range of about $38,000-$48,000 for an individual mine.

Not included in these estimates are administrative costs associated with the preparation and review of EEM study proposals, field audits, EEM sample collection, and the review of EEM study results. It has been estimated that the effort associated with these administrative functions is three months per EEM cycle or one month per year. Assuming an annual cost of $60,000 and 20% overhead per FTE, total administrative costs are estimated at $558,000 across all 93 mines.

Based on the above assumptions and a population of 93 mines, it is estimated that the average costs of EEM for the industry will be in the order of $4.6 million per year. More specifically, over a 15-year period, the present value of these EEM costs, based upon 5 and 10 percent discount rates, would be $47.7 and $34.9 million respectively. A breakdown of these estimated costs is presented in Table 6.

Table 6: Estimated EEM Costs

EEM Activity	Cost Range per mine (for a Three-Year EEM Cycle)
Fish Monitoryin	$40,000 - $50,000
Benthic Invertebrate Monitoring	$20,000 - $25,000
Effluent Characterization	$6,000 - $8,000
Water Quality Monitoring	$11,000 - $15,000
Sublethal Toxicity Testing	$38,000 - $47,000
Administrative costs	$18,000
Total	$133,000 - $163,000
Average Annual Range for Mine	$44,333 - $54,333
Average Annual Range for Industry	$44,123,000 - $5,053,000
Median for Industry	$4,588,000

Summary of Industry Costs

Tables 7 provides a summary of the various industry costs. It outlines the Present Values of industry costs based upon two discount rates measured over 15 years. The range of costs is based upon the low and high cost estimates for EEM testing and the incremental capital and operating costs associated with upgrading of effluent treatment facilities.

Table 7: Estimated Present Value of Industry Costs Industry Costs

ActivityPresent Value $ Millions
(Over 15 Years)
Discount Rate Discount Rate
5%10%
Sampling and Analysis7.35.4
Acute Lethality Testing2.31.7
Environmental Effects Monitoring
($4 million per year) 47.734.9
Upgrading Effluent Treatment
(low cost range)284.2241.8
Upgrading Effluent Treatment
(high cost range) 618.2536.2
Total (low cost range)341.5283.8
Total (high cost range)975.5578.2

Costs to Government

Enforcement

For the first five years after making the new Regulations, enforcement by Environment Canada is expected to require an additional annual budget of $599,000 broken down as follows: 5.5 full time equivalents (FTEs) at an approximate cost of $396,000 (based on an average salary of $60,000 per FTE and a 20 percent allowance for monetary benefits); $165,000 for operational costs; and $38,000 for laboratory costs. These additional costs will be associated with administrative compliance verifications, site inspections and, as necessary, the conduct of investigations, prosecutions and other enforcement actions.

Management of Compliance Data of the MMER

The management, analysis and reporting of compliance is expected to require one additional FTE and an incremental operational cost in the order of $50,000 per year. Based on a salary of $50,000 and a 20 percent allowance for benefits, the total cost associated with the management of compliance data is expected to be in the order of $110,000 per year.

EEM Management

The review and interpretation of site-specific EEM programs by Environment Canada are based upon the following functions:

the review of each study design proposed by the owner or operator of a metal mine;

the conduct of field audits of EEM programs;

the review of each Interpretive Report;

the review of ongoing monitoring data;

ensuring the validity of ongoing monitoring data;

preparing regional synopses; and

tracking of EEM requirements for each mine.

Overall, it is expected that these activities will require an additional 11.8 FTEs of employee time each year and an incremental operational cost of approximately $539,000 per year. Based on an average salary of $50,000 per FTE and a 20 percent allowance for benefits, the total government cost associated with EEM management is expected to be in the order of $1.25 million per year.

Initial Implementation of the MMER

Initial implementation of the new MMER will require additional resources by regional Environment Canada offices to improve awareness of the new regulatory requirements, review information on planned final discharge points, and process applications for some transitional authorizations. These costs would only be incurred during the first year of implementation. It is estimated that these tasks will require a commitment of an additional five FTEs of employee time and an incremental operational cost of approximately $110,000. Based on an average salary of $50,000 per FTE and a 20 percent allowance for benefits, the total cost associated with initial implementation is expected to be in the order of $410,000.

Summary of Costs to Government

Based on the above, the total first-year cost to Government is estimated to be in the order of $2.4 million. The total annual cost following the first-year implementation stage is expected to be in the order of $2 million. A summary breakdown of these costs is presented in Table 8.

Table 8: Summary of Estimated Annual Costs to Government

Activity	Annual Cost
Enforcement	$599,000
Management of Compliance Data	$110,000
EEM Management	$1,245,000

Initial Implementation (first year only)	$410,000
Total	$2,366,000

The present value of these government costs over a 15-year period would be approximately $20.3 million and $14.9 million assuming discount rates of 5 and 10 percent respectively.

Total Costs — Industry and Government

Based upon the estimates given in the previous sections, the total costs (Present Value over 15 years) for both industry and Government would be as summarized in Table 9.

Table 9: Present Value of Estimated Costs to Industry and Government

Total Costs — Present Value Over 15 Years $ Millions

Cost	Discount Rate 5%	Discount Rate 10%
Industry (Low Range)	341.5	283.8
Industry (High Range)	675.5	578.2
Government Costs	20.3	14.9
Total PV Costs (Low Range)	361.8	298.7
Total PV Costs (High Range)	695.8	593.1

Summary of Benefits

The fundamental objective of the new MMER is to improve the management of metal mine effluents with a view toward improving the protection of fish, fish habitat and fisheries. This enhances the opportunity for future use of natural resources and thus promotes the concept of sustainable development.

The benefits associated with implementation of the new MMER relate primarily to the following:

National Standards

Application of the regulations to all Canadian metal mines (from approximately 30 mines in 1998 to approximately 90 mines in 2002) creates minimum national standards and a level playing field of environmental performance across the country for the mining sector.

EEM

The EEM program will help ensure that the MMER achieve Fisheries Act objectives by providing a scientific evaluation to determine the effects of effluent on fish, fish habitat and fisheries. The information obtained through the EEM program can be used to determine the effectiveness of the MMER and provide a basis for determining the need for enhanced site-specific or national pollution prevention and control measures.

TSS

Application of the new TSS standard to all Canadian metal mines will result in significantly reduced deposits of TSS from many mine sites. Elevated levels of TSS can reduce light penetration in streams and lakes thereby affecting ecosystem productivity. Other effects can include abrasion of fish gills and membranes, fish habitat alteration and sedimentation of benthic communities (Task Force on Water Quality Guidelines 1995). The lack of historical loading information makes it difficult to quantify the benefit of the new standard on an industry-wide basis. However, an analysis of 13 mines that are expected to require additional treatment to meet the standard indicates that TSS loading could be reduced by up to 95 percent at some sites (the average reduction for the 13 mines studied was 49 percent).(see footnote 6)

Non-acutely Lethal Effluent

The requirement for mines to produce non-acutely lethal effluent helps to ensure that there is a minimum standard in place across the sector for the protection of fish, fish habitat and fisheries, which is a fundamental objective of the Fisheries Act.

Other Benefits

Other benefits of these Regulations, while potentially significant, are difficult to quantify. These benefits fall into the two major categories discussed below.

Benefits to Users of Watercourses

Benefits to watercourse users include:

an improvement in commercial and sport fishing, as well as in recreational use;

protection of aboriginal fisheries;

an increase in the value of properties located in close proximity to affected watercourses;

a reduction in future costs of restoring polluted water courses and remediating altered fish habitat; and

a general improvement in the quality of local ecosystems.

Quantifying the economic value of these benefits is extremely difficult. However, an indication of the importance of maintaining water quality in the vicinity of mine sites is provided by the 1996 Nature Survey (see footnote 7) which estimated that Canadians spent approximately $11 billion in nature-related activities. While the economic benefits of nature-related activities directly related to areas adjacent to mining operations is not known, an analysis of the geographical locations of metal mines and the geographic destinations of participants of nature-related activities from the 1996 Nature Survey suggests that approximately 1.3 million people participate in direct nature-related activities within a 50-kilometre radius of metal mine sites each year.

Benefits to Non-users of Watercourses

The regulations will also benefit non-users of watercourses. These intrinsic benefits are related to:

the "existence value" society places on preserving water resources for their own sake and passing improved environmental conditions on to future generations;

the "assurance value" society places on preserving the option to use water resources in the future; and

the value placed on knowing that the water quality has been improved.

Non-allocative Effects

Non-allocative effects are those that do not affect production or consumption by society, but can affect its distribution or composition. The MMER will require investment in new construction and equipment in order for all metal mines to comply with the new effluent criteria. This activity will result in new construction employment during the construction and installation stage. It is expected that there may be increased employment in the longer term to ensure continued compliance with the new effluent limits in the areas of maintenance, operations and engineering. The application of the new MMER will enhance opportunities for the export of Canadian expertise and technology to other jurisdictions.

Finally, in terms of impact, the estimated incremental annual costs represent an increase in current operating costs in the order of less than half of one percent for the industry. With this small portion it is therefore expected that the implementation of the proposed new MMER will have an indiscernible impact on the Canadian economy as a whole. These data relative to the total industry costs are summarized in the following Table 10.

Table 10: Projected Impact of MMER on Industry O&M Costs

Comparison fo Current Operating Costs in the Canadian Metal Mining Sector (1997) with Incremental MMER Costs ($Millions)
Industry Operating Costs
Industry Cost - Materials & Supplies
Industry Cost - Electricity & Fuel
Industry Cost - Wages 4,040
670
2,130
Total Industry Operating Costs6,840
Incremental AnnualOperatin Costs
(Low Cost Range)
Industry Effluent Treatement Costs
Costs for Acute Lethality Tests
Costs for Environmental Effects Monitoring
Costs for Sampling and Analysis 6.5
0.2
4.0
0.7
Total Incremental Annual Operating Costs
(Low Cost Range)11.4
Incremental Annual Operating Costs
(High Cost Range)
Industry Effluent treatment Costs
Costs for Acute Lethality Tests
Costs for Environmental Effects Monitoring
Costs for Sampling and Analysis 21.2
0.2
4.0
0.7
Total Incremental Annual Operating Costs
(High Cost Range)26.1
Incremental Annual Operating Costs in Percentage of Total Industry Operating Costs
Low Cost Range
High Cost Range 0.17%
0.38%

Sources: Tables 4, 5 and 6 above

Statistics Canada, Metal Mines - 1997, Catalogue No. 26-223-XIB, 1999, Table 1, pages 8 and 9

Other Issues

The new requirements in the MMER could prompt some mining companies to become more efficient in their operations and to use new processes, control technologies and pollution prevention practices. With the requirements to install new capital equipment, mining firms may re-examine other aspects of their operations to achieve cost savings and improve productivity. They could reduce material inputs, re-engineer processes to reuse by-products, improve management practices and employee awareness, and employ substitutions for toxic chemicals.

The new MMER will provide a level playing field of environmental performance for all metal mines in the country. Establishing a uniform set of regulatory criteria will help to eliminate legislative distortions between jurisdictions which may negatively impact some metal mining companies and thereby harmonize the regulation of metal mining effluents in Canada.

Costs and Benefits — AATDR

Since the Kitsault Mine has not been in operation for 18 years and the mine site reclamation workplan has been completed, repeal of the AATDR has no cost impacts.

Repealing the AATDR will help to ensure consistent application of the proposed new MMER to all Canadian metal mines.

Consultation

MMER Development Activities

The new MMER are the result of an extensive consultation process spanning a period of approximately six years.

The AQUAMIN process, which was conducted from 1993 to 1996, involved approximately 100 representatives from federal departments, provincial ministries, industry, environmental non-governmental organizations, and First Nations groups. Over the course of the assessment, more than 700 reports related to 95 Canadian mine sites were reviewed and detailed case studies were conducted for 18 sites.

In response to the recommendations advanced in the AQUAMIN final report, a second consultation process for MMLER modernization was initiated. This involved a multi-stakeholder adviSORy group and several technical working groups to prepare recommendations for developing the proposed new MMER. As was the case with AQUAMIN, federal departments, provincial ministries, industry, environmental non-governmental organizations and First Nations groups were involved in the consultations. These groups met on a regular basis between 1997 and 1999 and shared drafts of various documents developed in support of the new Regulations.

During the course of these consultations, the main industry concerns were as follows:

Industry indicated that it supports the objective of producing effluents that are non-acutely lethal but argued that it should not be a regulatory requirement until such time as Best Available Technology Economically Achievable (BATEA) has been better demonstrated. The specific concern was that some mine sites may have difficulty identifying the cause of acute lethality and thus would not be able to address the problem despite best efforts to do so.

Industry indicated that the new TSS limit would be challenging for some mines to achieve and questioned the environmental benefit of a more stringent standard.

Industry expressed the opinion that some mines would need more time to achieve full compliance with the new requirements than was proposed. It was suggested that there should be a mechanism whereby mines could be granted an extended transitional authorization.

In developing the new MMER, Environment Canada has been sensitive to the concerns of the mining industry, while carefully considering the need to protect fish, fish habitat and fisheries. The new MMER effluent limits and non-acute lethality requirement reflect standards that are currently obtainable by the majority of Canadian metal mines and reflect similar provincial requirements in Ontario and Québec, where the majority of metal mines are located. With regard to industry concerns regarding the availability of BATEA for some sites, Environment Canada was guided by the advice provided by the AQUAMIN report, which states: "The term "economically achievable" does not imply that individual mine operators must have the economic and financial capacity to meet a proposed standard, but that technology must be affordable on a sectoral basis"(see footnote 8). The MMER allow for the opportunity for some mines, under specified conditions, to obtain a transitional authorization that provides additional time to come into compliance with the new effluent standards.

The main concerns expressed by environmental non-government organizations

(ENGOs) were as follows:
ENGOs expressed the opinion that the requirements of the new regulations are not stringent enough and should be more technology-forcing. They specifically took exception with the limits for metals, all of which they believe should be lower, and suggested that more metals be included. ENGOs also proposed that there be a regulatory requirement for effluent to be non-acutely lethal to Daphnia magna as well as rainbow trout. (Monitoring of acute lethality is required for both species.)
ENGOs expressed concern over the timing of the coming into force of the Regulations. They are of the opinion that there should be no transitional authorizations and that all mines should be in compliance with the regulations upon proclamation.
ENGOs were concerned that the new regulations do not provide a definitive regulatory requirement for mines to address effects that are determined during the conduct of EEM programs.
As per the recommendations of the AQUAMIN report, Environment Canada has based the proposed standards on the results of comprehensive studies of acute lethality data and treatment technologies applicable to the management of Canadian mining effluents, bearing in mind the AQUAMIN recommendation to develop a BATEA-based regulation. The timing of the coming into force of the new effluent requirements was developed taking into account the AQUAMIN recommendation that "there be a transition period to ensure that any mines that are not under regulation or not in

compliance have a reasonable period to improve their control systems"(see footnote 9) . EEM programs required under the proposed MMER are designed to evaluate the effects of effluent on fish and fish habitat. Once an unsustainable effect attributable to an effluent has been confirmed, mitigation and remediation strategies will be evaluated on a site-specific basis. In addition, site-specific information will be collated and assessed as a basis of evaluating the need for enhanced protection on a regional or national scale. Environment Canada will consult with stakeholders on how such evaluations will be conducted.
All views, comments, concerns and preferences of the various stakeholders were carefully evaluated and taken into consideration during the development of the new regulations. In addition, scientific and legal considerations had to be taken into account.
AATDR

In October 1999, the owner of the Kitsault Mine, Climax Canada Limited, was contacted about the repeal of these Regulations. No response had been received at the time of writing of this assessment.

The Nisga'a Tribal Council has opposed the AATDR since its inception and has been actively seeking its repeal since 1980. One environmental non-governmental organization (the David Suzuki Foundation) that expressed its opposition to the AATDR during the 1992-1994 regulatory review has also been informed about the repeal of these Regulations.

Activities Following Pre-Publication in the Canada Gazette, Part I

The regulations were pre-published in the Canada Gazette, Part I, on July 28, 2001. A total of 23 representations were submitted during the 60-day public review and comment period: thirteen from mining companies and associations; five from environmental groups (one represented seventeen organizations); two from private citizens; and one from each of academia, the consulting community, and provincial government.

Copies of the representations were compiled and distributed to all intervenors and were made available to other parties upon request.

There were no substantive differences between the policy perspectives that were documented as part of the Canada Gazette review process and those that were articulated by stakeholders during the extensive consultations that led to the development of the MMER.

Industry submissions collectively emphasized the need for harmonization of these Regulations with the regulatory requirements of other jurisdictions; suggested that the new limit for total suspended solids (TSS) would be challenging for some mines to achieve; and, questioned the environmental benefit of a more stringent TSS standard. It was also suggested that there should be no upper pH limit, and that some mines would need more time to achieve full compliance with the new requirements than was available under the proposed scheme for transitional authorizations.

Submissions from ENGOs and private citizens generally suggested that:

the proposed limits were too high, were not based on their interpretation of BATEA, and would not adequately protect fish and fish habitat;

the list of deleterious substances should be expanded to include, as a minimum, cadmium and mercury;

there should be an explicit regulatory trigger for the development of more stringent site-specific requirements in the event that an "effect" is determined by EEM; and

there should be specific regulatory requirements to provide all monitoring, inspection, prosecution and EEM data to the public in a timely manner.

These were essentially the same views that were expressed by ENGOs representatives during the consultation phase.

The only government representation was submitted by the Newfoundland and Labrador Department of Mines and Energy. This intervention suggested that the iron ore mines located in Labrador should be exempted from the new MMER.

The submissions from academia and the consulting community were technical in nature, with the former providing a detailed assessment of current market and competitiveness issues facing the iron ore sector and the latter seeking clarification on two specific clauses in the regulatory text.

All aspects of the representations submitted by the various stakeholders were carefully considered and taken into account during the development of the final regulatory text. Particular attention was paid to the assessment of identified technical issues.

Changes made to the regulatory text proposed in the Canada Gazette, Part I include:

adjustment of the definition of "effluent" to specifically exclude effluent from sewage treatment facilities;

allowing for the deposit of waste rock into a tailings impoundment area;

requiring monitoring for cyanide only by those mines that use cyanide as a process reagent;

allowing for quarterly sampling for radium-226 at non-uranium mines following 10 consecutive tests results that are less than 10% of the authorized monthly mean concentration;

harmonizing the method detection limits and the calculation of loading with the approach of Ontario's MISA Program;

allowing for relief in monitoring frequency when unforeseen circumstances (e.g., winter storms) cause safety concerns o access problems and render the collection of samples of effluent impracticable;

allowing for the relocation of records from the mine site to another location in Canada once a mine becomes a recognized closed mine; and

allowing for a limited number of mines to apply for a second transitional authorization, for total suspended solids only, two years after the regulations come into effect; this transitional authorization may only be applied for if it can be demonstrated that there is no feasible alternative available to the mine operator based on documented evidence of engineering necessity.

Numerous editorial changes were also made to the text proposed in the Canada Gazette, Part I, to improve the clarity of meaning and intent.

Compliance and Enforcement

These Regulations will be enforced by Environment Canada in accordance with the provisions of the Compliance and Enforcement Policy for the Habitat Protection and Pollution Prevention Provisions of the Fisheries Act. Under this Policy, the following general principles apply:

Compliance with the habitat protection and pollution prevention provisions and their accompanying regulations is mandatory.

Compliance will be encouraged through communication with parties affected by the habitat protection and pollution prevention provisions of the Fisheries Act.

Enforcement personnel will administer the provisions and regulations in a manner that is fair, predictable, and consistent. Rules, sanctions and processes securely founded in law will be used.

Enforcement personnel will administer the provisions and accompanying regulations with an emphasis on preventing harm to fish, fish habitat or human use of fish caused by physical alteration or pollution of waters frequented by fish. Priority for action to deal with suspected violations will be guided by:

- the degree of harm to fish, fish habitat or human use of fish caused by physical alteration of habitat or pollution of water frequented by fish, or the risk of that harm; and/or
- whether or not the alleged offence is a repeat occurrence.

Enforcement personnel will take action consistent with this policy.

The public will be encouraged to report suspected violations of the Habitat Protection and Pollution Prevention Provisions of the Fisheries Act.

Compliance monitoring will be conducted to verify that metal mining activities are carried out in accordance with the regulations. Inspectors will verify compliance with injunctions and court orders. Compliance monitoring may also measure potentially harmful impacts on the environment associated with the suspected violations.

Means to accomplish compliance monitoring include:

inspections;

mandatory reporting;

sampling by enforcement officials; and
monitoring of releases.

In verifying compliance with these Regulations, inspectors will abide by the Enforcement and Compliance Policy which sets out a range of possible responses to offenses, including warnings, inspector's directions, ticketing, ministerial orders, injunctions, prosecution, and civil suits by the Crown for the recovery of costs. If an inspector confirms that an infraction has been committed, the inspector will select the appropriate response based on the following criteria:

nature of the offense;
effectiveness in achieving the desired result with the offender; and
consistency.

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Footnote 2

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Footnote 3
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Footnote 5
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Footnote 7
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NOTICE:
The format of the electronic version of this issue of the Canada Gazette was modified in order to be compatible with hypertext language (HTML). Its content is very similar except for the footnotes, the symbols and the tables.

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