Environment Canada December 14, 2012

10-Year Review of

Metal Mining Effluent Regulations

Discussion Paper

Prepared
by
Environment Canada

Table of Contents

APPENDICES

1 INTRODUCTION AND PURPOSE

Canada's abundance of natural resources has enabled the mining and minerals sector to become a major player internationally and a world leader in the production of many mineral and metal commodities. In 2009, Canada was the biggest producer of potash, and was ranked among the top five producers of aluminium, cobalt, diamonds, molybdenum, nickel, platinum group metals, salt, sulphur, titanium concentrate, tungsten, uranium, and zinc.

Mining is an important part of the Canadian economy. The Mining Association of Canada estimates that over $130 billion in mining investment in new and existing projects could take place over the next five years.

Exporting approximately $66 billion worth of minerals and metals in 2009, the sector accounted for approximately 18% of total Canadian exports, and contributed 2.7% of Canada's total gross domestic product.

Over 1400 mining companies are listed on the Toronto Stock Exchange (TSX) and TSX Venture Exchange, making Toronto and Vancouver two of the world's leading mining investment centres.

The mining sector employs over 300,000 people in Canada and is the largest private sector employer of Aboriginal people. Mining provides long term stable employment to many rural and northern communities, and wages are well above the national average for all industries.

Mining affects the environment in several ways, but one aspect in particular – effluent – is the focus of this paper.

Section 36 of the *Fisheries Act* prohibits the deposit of deleterious substances – such as mine effluent – in water frequented by fish unless authorized by regulations. Environment Canada has the lead responsibility for the administration of the pollution prevention provisions of the *Fisheries Act* - namely subsection 36(3) and the related provisions of the Act. Environment Canada develops sector-based strategies and undertakes activities to promote and secure compliance with the pollution prevention provisions of the *Fisheries Act.*

1.1 Metal Mining Effluent Regulations

Of all the different types of mines in Canada, for example metal, diamond, coal, and potash, only metal mines have a regulation under the *Fisheries Act*: the Metal Mining Effluent Regulations (MMER). The MMER include effluent limits on releases of arsenic, copper, cyanide, lead, nickel, zinc, radium-226 and total suspended solids. The MMER also impose limits on the pH of effluent and prohibit the discharge of effluent that is acutely lethal to fish. The MMER require effluent monitoring and reporting, environmental effects monitoring, and provide the authority for metal mines to dispose of their waste rock and tailings in water frequented by fish, where authorized.

The MMER were published in the *Canada Gazette*, Part II in June 2002 and came into force on December 6, 2002. The number of mines subject to the MMER has increased since then, and now number over 100 across Canada (see Figure 1).

Past Amendments to the MMER

The MMER have been amended on several occasions since they were first introduced. In 2006, there were substantive amendments to address lessons learned through the implementation period. In 2012, there were some additional amendments to improve the EEM provisions and add selenium and electrical conductivity to the list of parameters for effluent characterization and water quality monitoring (see Appendix 1 for more detail).

Non-metal mines

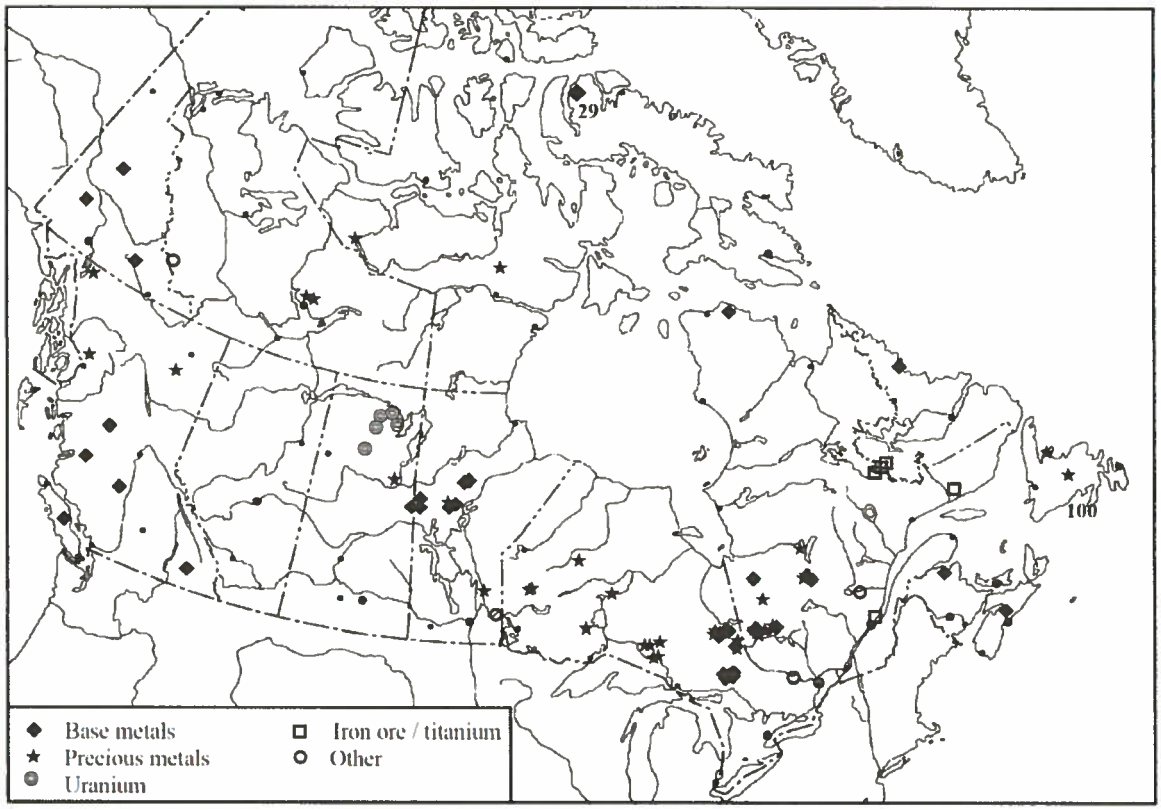
Non-metal mines are subject to the *Fisheries Act* prohibition against depositing deleterious substances in waters frequented by fish. Some non-metal mining companies have indicated that uncertainty with respect to complying with the prohibition is problematic for them, and have requested the same degree of certainty as metal mines vis-à-vis the *Fisheries Act*.

1.2 Federal environmental guidance for metal mines

In addition to being subject to the MMER, metal mines in Canada are encouraged to implement the *Environmental Code of Practice for Metal Mines*, published by Environment Canada in 2009. The objective of the Code is to identify and promote recommended best practices to facilitate and encourage continual improvement in the environmental performance of mining facilities throughout the mine life cycle.

Proponents who propose to dispose of waste rock or tailings in a water body frequented by fish are required to do an assessment of alternatives, and are strongly urged to adhere to the *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*, published by Environment Canada in 2011.

Figure 1: Map of metal mines in Canada



1.3 Rationale for the 10-year review

The decision for a review of the MMER at this time is based on several factors.

1. The *Cabinet Directive on Regulatory Management* calls for the periodic review and evaluation of regulations; 2012 marks the tenth anniversary of the MMER.
2. An analysis of mine performance and an analysis of the results of *Daphnia magna* (water fleas) monitoring point to areas where the MMER could be improved and strengthened to improve the protection of fish and fish habitat.
3. Two national assessments of environmental effects monitoring at metal mines provide feedback on the effectiveness of the MMER. The most recent one, the Second National Assessment of Environmental Effects Monitoring Data From Metal Mines subjected to the Metal Mining Effluent Regulations *(MMER)* shows that fish downstream of some metal mines are thinner, older and slower growing.
4. Experience with the metal mining environmental effects monitoring program, plus developments in the monitoring programs for pulp and paper and wastewater systems, have led to the identification of possible amendments to improve and enhance the metal mining environmental effects monitoring program.
5. Finally, experience with implementing the MMER has shown that certain regulatory elements require clarification.

1.4 Purpose

The purpose of this Discussion Paper is to:

- Lay out the key proposed changes and additions to the MMER, organized in two parts:
    - Part A includes sector-specific chapters on:
        - metal mining effluent limits;
        - diamond mining effluent limits; and
        - coal mining effluent limits.
    - Part B applies to all the mining sectors and includes chapters on:
        - effluent monitoring;
        - acute lethality;
        - environment effects monitoring; and
        - timelines for taking effect.
- Seek feedback from industry, non-governmental organizations, Aboriginal groups, experts, and provinces and territories on these proposed changes, and invite input on effluent limits for new substances that are proposed as additions to the MMER.

Please note that this paper does not seek to outline all of the changes that may arise if the regulations are revised. Should the department decide to amend the MMER, it is expected that there will also be changes to: improve the existing regulations, including changes to clarify the regulations; adjust some definitions (e.g., add tailings re-processing to the definition for mills); add some new definitions (e.g., diamond mine, coal mine); and remove transitional authorization provisions and other provisions in the regulations that are no longer applicable. Any additional changes will be included in the revised regulations when they are pre-published in *Canada Gazette*, Part I.

Concept: the Mining Effluent Regulations

Adding non-metal mines to the MMER would effectively transform them into the *Mining Effluent Regulations*. The concept would be to have specific effluent limits for the different types of mines, e.g., metal mines, diamond mines, and coal mines.

This Discussion Paper is written as a summary document to elicit feedback on the key proposed changes to the MMER and input on the proposed additions. Technical information is found in the appendices. Additional background information and analysis may also be found in the consultants' reports on coal and diamond mines done in anticipation of this review.

1.5 Path Forward

Environment Canada will consider all of the feedback received from interested parties when formulating advice on the MMER to the Minister of the Environment. Environment Canada plans to phase-in the amendments to the MMER, when possible, on a sector basis.

PART A

2 METAL MINING EFFLUENT

2.1 Current and proposed metal mines in Canada

In 2010, 105 metal mines in Canada were subject to the MMER. Another 60 or so are proposed and going through the federal environmental assessment process.

2.2 Federal regulatory regime

Environment Canada plays a stewardship role in achieving a clean, safe and sustainable environment. One of the department's three strategic outcomes is, "Threats to Canadians and their environment from pollution are minimized."

The MMER are one of Environment Canada's important regulations designed to help reduce these threats; specifically the MMER are part of the department's program activity whose goal is:

> "Threats to Canadians and impacts on the environment posed by harmful substances and waste are reduced."

The MMER prescribe effluent discharge limits for a specific list of deleterious substances. These federal effluent limits for metal mines are found in Schedule 4 of the MMER; the maximum authorized monthly mean concentration limits are also shown in Table 2-2.

Overall, in 2010 the metal mining sector achieved over 99% compliance with the prescribed limits for arsenic, copper, nickel, zinc, radium 226 and pH, and a 100% compliance rate for cyanide and lead. Only a few sporadic exceedances were reported for arsenic, copper, nickel, zinc, radium 226 and pH. The overall compliance rate achieved with respect to meeting the total suspended solids limits was 95.6%. For more information, please see the *Summary Review of Performance of Metal Mines Subject to the Metal Mining Effluent Regulations in 2010*.

However, despite this compliance rate, the Second National Assessment of Environmental Effects Monitoring Data From Metal Mines subjected to the Metal Mining Effluent Regulations *(MMER)* shows that "exposed fish [downstream of metal mines] were on average, older, thinner, and slower growing, with smaller livers and with more of a tendency toward reduced gonad size. " These effects "may have a variety of causes, such as direct inhibitory effects of the effluent on fish and/or food limitation resulting from habitat alteration and inhibitory effects on prey organisms, such as benthic invertebrates." Benthic invertebrates are insects that live at the bottom of the lake, river or stream. To date, all sites have reported some of these biological effects.

Overall, the majority of sites that have completed two phases of biological monitoring are reporting effects on one or more biological monitoring endpoints that are above thresholds which are indicative of a potential higher risk to the environment. In addition, results of sublethal toxicity testing indicate that effluent from a large number of mines is

able to cause responses such as reduced growth rate or reproductive impairment in laboratory tests. Sublethal toxicity testing results can be indicative of the level of risk that effluent may pose.

2.3 Provincial and territorial regulatory regimes

All provinces and territories have established effluent limits for metal mines, either by regulations, permits, licenses, or certificates of approval. The limits are generally the same as those in the MMER, or more stringent to address site-specific or jurisdiction-specific circumstances. Appendix 2 includes a series of charts comparing the metal mine effluent limits among Canadian and international jurisdictions, substance by substance. The most stringent provincial/territorial effluent limits are shown in Table 2-2.

2.4 International regulatory regimes

Generally, effluent limits for metal mines in the US, South Africa, Spain, and Chile – all major mining countries – are the same or more stringent than the MMER. Appendix 2 includes a series of charts comparing the metal mine effluent limits among Canadian and international jurisdictions, substance by substance. The leading international effluent limits are shown in Table 2-2.

2.5 Proposed changes to Schedule 4 of the MMER

Given Environment Canada's goal of reducing threats posed by harmful substances, the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* provide a useful reference point. The Guidelines lay out science-based recommended levels that should result in negligible risk to biota, their functions, or any interactions that are integral to sustaining the health of ecosystems. These guidelines are available on the Canadian Environmental Quality Guidelines page of the Canadian Council of Ministers of the Environment website.

Given the above and given the results of the Second National Assessment of Environmental Effects Monitoring Data From Metal Mines, one of the objectives for the 10-year review of the MMER is to propose, for consideration, national effluent requirements for metal mines that minimize threats to Canada's water resources and aquatic ecosystems, taking into account best available techniques/technologies economically achievable (BATEA).

With this objective, and considering the effluent limits in leading Canadian and international jurisdictions, **Environment Canada proposes** to make the Schedule 4 effluent limits more stringent because of mining's environmental effects on downstream aquatic ecosystems. The two exceptions are the limit for total suspended solids, which is considered to be world leading, and the limit for radium 226, which is considered to be sufficiently protective. Table 2-1 shows the proposed revised limits. One-third of metal mines are already discharging at the lower levels, which can be achieved using BATEA.

Furthermore, **Environment Canada proposes** to add four new substances -- aluminum, iron, selenium and ammonia -- to Schedule 4 for metal mines. These substances are harmful or potentially toxic, and in some cases potentially fatal to fish, and they are present in effluent from a wide range of metal mines. Environment Canada invites stakeholders to engage in determining the appropriate limits for these substances.

Table 2-1: Proposed Schedule 4: Authorized Limits of Deleterious Substances

Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample
Arsenic	0.100 mg/L	0.150 mg/L	0.200 mg/L
Copper	0.050 mg/L	0.075 mg/L	0.100 mg/L
Cyanide	0.500 mg/L	0.750 mg/L	1.000 mg/L
Lead	0.050 mg/L	0.075 mg/L	0.100 mg/L
Nickel	0.250 mg/L	0.375 mg/L	0.500 mg/L
Zinc	0.250 mg/L	0.375 mg/L	0.500 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
Aluminum	tbd **	tbd	tbd
Iron	tbd	tbd	tbd
Selenium	tbd	tbd	tbd
Total ammonia (as Nitrogen)	tbd	tbd	tbd

NOTE: All concentrations are total values.

** To be determined

Environment Canada does not propose any changes to the requirements for total suspended solids, radium 226, pH and acute lethality for rainbow trout because they are considered to be sufficiently protective, and, in some cases, are world leading standards as they exist. Table 2-2 compares the proposed effluent limits with the current MMER limits and with limits in the leading jurisdiction. In most cases, the leading jurisdiction is a Canadian province or territory. Appendix 2 provides a more detailed analysis of the rationale for the proposed effluent limits and proposed additions to Schedule 4.

Table 2-2: Comparison of Effluent Discharge Limits for Metal Mines (maximum authorized monthly mean concentration)

Deleterious Substance	MMER limit	Most stringent international limit	Most stringent provincial / territorial limit	Proposed new MMER limit
Arsenic (mg/L)	0.5	0.1 (multiple)	0.1 (BC*)	0.1
Copper (mg/L)	0.3	0.02 (S. Africa)	0.05 (BC)	0.05
Cyanide (mg/L)	1.0	0.5 (multiple)	0.1 (BC)	0.5
Lead (mg/L)	0.2	0.05 (Chile)	0.05 (BC)	0.05
Nickel (mg/L)	0.5	0.1 (US)	0.2 (BC)	0.25
Zinc (mg/L)	0.5	0.3 (S. Africa)	0.2 (BC)	0.25
Total suspended solids	15.00	15.00 (Canada)	15.00 (ON & QC)	15.00 (no change)
Radium 226 (Bq/L)	0.37	0.37 (US)	0.37 (BC & SK)	0.37 (no change)
Aluminum (mg/L)	none	1.0 (multiple)	0.5 (BC)	tbd**
Iron (mg/L)	none	0.3 (S. Africa)	0.3 (BC)	tbd
Selenium (mg/L)	none	0.01 (Chile)	0.05 (BC)	tbd
Total ammonia as Nitrogen (mg/L)	none	1.0 (S. Africa)	1.0 (BC)	tbd

* Note that the BC numbers are objectives for effluent discharged into sensitive environments, rather than regulated limits. These objectives may be considered in the development of site-specific permits in BC.

** To be determined

2.6 Benefits and costs

If effluent discharge limits for substances currently on Schedule 4 are reduced as proposed in Table 2-2, and effluent limits are developed for aluminum, iron, selenium and ammonia, taking into consideration BATEA and the effluent limits in leading Canadian and international jurisdictions, then the environmental benefit of these proposed amendments to the MMER would be reduced loadings of deleterious substances to water frequented by fish. For example, loading reductions for substances now on Schedule 4 would range from a 7% reduction for lead to a 56% reduction for arsenic.

Furthermore, environmental effects monitoring results to date support a prudent approach with respect to lowering existing limits and adding substances, particularly ammonia and selenium, to Schedule 4, in order to improve the degree of environmental protection provided by the Regulations.

The majority of metal mines discharge at levels well below the regulated limits on Schedule 4 of the MMER. Many mines are also already below the proposed revised limits for Schedule 4. As a result, in aggregate:

- about two-thirds of mines would already be considered to be complying with the revised effluent limits proposed in this paper;
- about 20% of the mines would have minimal to low impacts as a result of the revised effluent limits, meaning that, based on current performance, they have had only occasional exceedances of proposed limits for one or two parameters;
- about 15% of mines would need to take measures to address more frequent exceedances of the proposed limits for one or two parameters.

Questions:

Do you agree with the proposed changes to Schedule 4: the revised effluent limits and the proposed additions? If not, why not? What would you propose, and why?

What are your views on the appropriate effluent limits for the four proposed new substances (aluminum, iron, selenium and ammonia) for metal mines?

Do you have other comments on metal mining effluent?

3 DIAMOND MINING EFFLUENT

3.1 Current and proposed mines

In the last two decades, Canada has become a major producer of gem-quality diamonds, with four operating mines.

The first Canadian diamond deposit was discovered at Lac de Gras in the Northwest Territories (NWT) and led to the establishment of Canada's first diamond mine, EKATI, which began production in 1998. Since then, the Diavik Diamond Mine, located just south of the EKATI mine, began production in early 2003. Still in the NWT, the De Beers Snap Lake project commenced operation in 2008. And in the same year, De Beers also opened the Victor diamond mine in the James Bay Lowlands of northeastern Ontario.

Jericho, Nunavut's first and only diamond mine, operated from 2006 to 2008, and then went into bankruptcy protection. In July 2010, Shear Minerals Ltd. purchased the mining assets; the company is currently assessing the possibility of reopening the mine.

Three potential diamond mine projects are in the environmental assessment (EA) process: the Gahcho Kué project in the NWT, the Star-Orion project in Saskatchewan, and the Renard project in Quebec. These proposed mines could be in production in the next few years.

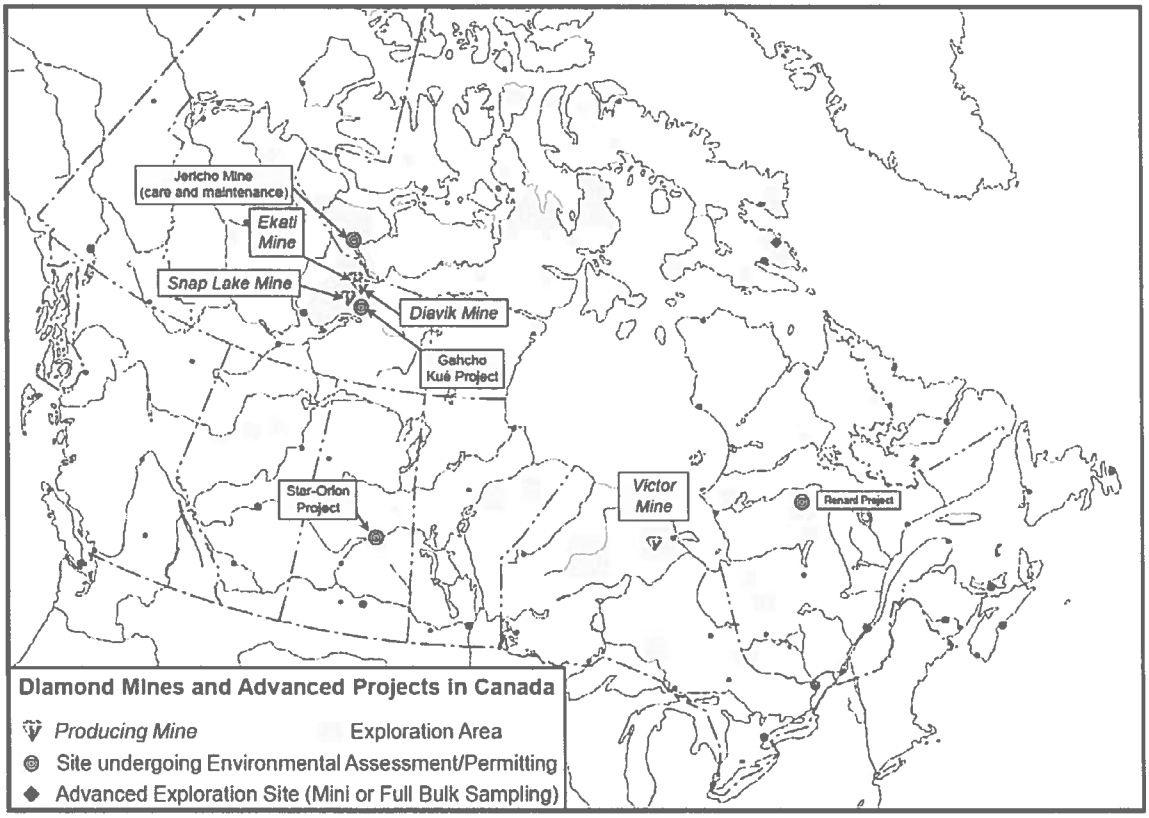
With ongoing exploration projects in the NWT and Nunavut, as well as in Alberta, Saskatchewan, Ontario and Quebec, additional diamond discoveries are likely. As a result, there could be continued growth in Canada's diamond production capacity. See Table 3-1 and Figure 3-1 for more detail.

Table 3-1: Current and Proposed Diamond Mine Projects

Mine	Production year	Company Name	Location	Mine Status	Production Rate	Expected Life Time
Past and Present Producers						
EKATI	1998	BHP Billiton	NWT	Producing	18 000 t/d*	20 years
Diavik	2003	Rio Tinto	NWT	Producing	4 500 t/d	17+ years
Jericho	2006	Shear Minerals	Nunavut	Past producer/ may reopen	925 t/d	8+ years
Snap Lake	2008	De Beers	NWT	Producing	3000 t/d	22 years
Victor	2008	De Beers	Ontario	Producing	7 000 t/d	20 years
Mines Undergoing an Environmental Assessment						
Gahcho Kué	2015	De Beers	NWT	EA	8 000 t/d	11 years
Star-Orion		Shore Gold	Sask.	EA	45 000 t/d	20 years
Renard	2015	Stornoway	Quebec	EA	7000 t/d	25 years

* t/d: tonnes per day

Figure 3-1: Diamond Mines and Deposits: Canadian overview



3.2 Federal regulatory regime

Diamond mines are subject to Section 36 of the *Fisheries Act*, the general prohibition against the deposit of deleterious substances into water frequented by fish.

3.3 Provincial and territorial regulatory regimes

In the Northwest Territories, the Mackenzie Valley Land and Water Board – established under the *Mackenzie Valley Resource Management Act* – and the Wek'eezhii Land and Water Board issue land permits and water licences for projects. In Nunavut, the Nunavut Water Board issues water licences. The Boards take into account the pristine nature of the water in the North when setting effluent limits. These effluent limits are generally more stringent than the MMER. See Appendix 3 for the diamond mine limits.

In Quebec, mines must comply with *Directive 019* on mining (*Directive 019 sur l'industrie minière)*. The Directive includes, among other things, effluent limits that apply to metal and non-metal mines. The limits are the same as those in the current Schedule 4 of the MMER, except for arsenic, which is more stringent in the Directive.

In Saskatchewan, mines that obtain an approval to discharge any liquid effluent to the environment must ensure that the concentration of any pollutants in the effluent does not

exceed the concentrations set out in *The Mineral Industry Environmental Protection Regulations, 1996*. In addition to the MMER parameters for which the same limits apply, the Regulations also include limits for uranium, thorium 230, lead 210 and un-ionized ammonia. The Regulations do not include limits for pH and TSS or a requirement for effluent to be non-lethal to rainbow trout or *Daphnia magna*. However, the Regulations state that the approval may include more stringent limits than those specified in the Regulations and that additional pollutants and their associated limits may be included in the approval as specified by the Minister.

Ontario has a regulation for the metal mining sector (Regulation 560/04) and one for the industrial minerals sector (Regulation 561/94), but neither one includes diamond mines. The effluent limits in Ontario's Certificate of Approval for the Victor Diamond Mine can be found in Appendix 3.

3.4 International regulatory regimes

Based on 2009 value, Russia was the lead producer of diamonds, primarily industrial grade, with 27% of the global diamond market. Botswana and Canada were both in second place at 17%, followed by Angola at 14%, and South Africa at 10%. (The United States has no diamond mines.)

Information on effluent limits at most international diamond mines is not readily available; however, effluent limits for diamond mines in South Africa are. They reflect minimum standards, with efforts underway to integrate water quality considerations into future licenses. South African effluent limits for two substances that are also found at Canadian diamond mines are: 25 mg/L for total suspended solids, and 10.0 mg/L for ammonia.

3.5 Proposed effluent limits

The objective for the 10-year review of the MMER is to propose, for consideration, national requirements for diamond mines that minimize threats to Canada's water resources and aquatic ecosystems, taking into account best available technology economically achievable.

Ammonia and total suspended solids are the most common contaminants of concern at diamond mines, and are present in the effluents at all sites.

Total suspended solids are present in mine water, run-off water, and process water as a direct result of process operations. Total suspended solids are an extremely important cause of water quality deterioration and can lead directly to a decline in fisheries resource and serious ecological degradation of aquatic environments. Total suspended solids are already included in the MMER for metal mines. **Environment Canada proposes** that this same limit also be applied to diamond mines.

The effect of ammonia in mining effluent is also well known; it is an important toxicant in aquatic environments, and, at relatively low concentrations can be detrimental to fish. Ammonia and other species of nitrogen such as nitrate, which are highly soluble, are present in mine effluent because of the use of explosives at the mine site.

Because ammonia is harmful to aquatic ecosystems and is present in diamond mining effluent, **Environment Canada proposes** that ammonia be regulated. Nitrate is excluded from the proposed list of regulated parameters because limiting the total ammonia release will also reduce the concentration of nitrate in the effluent.

Chloride has been reported at two diamond sites, and has been raised as a concern at a proposed diamond mine. **Environment Canada proposes** that chloride be regulated.

Phosphorus has been reported at two diamond mines. Groundwater and associated rock at Diavik and EKATI mines are sources of phosphorus, as is domestic sewage. Because phosphorus is an essential nutrient for plants and is the limiting nutrient in most fresh waters, even a modest increase in phosphorus can accelerate plant growth, which can lead to algae blooms, increased turbidity, decreased dissolved oxygen, and the death of certain life-stages of fish, invertebrates, and other aquatic animals. Considering that most diamond mines are discharging sewage to their processed kimberlite containment facility, sometimes after limited or no treatment, **Environment Canada proposes** that phosphorus be regulated.

Environment Canada invites stakeholders to engage in determining the appropriate limits for these substances. Appendix 3 provides more rationale for adding the proposed substances. Table 3-2 below provides an overview.

Table 3-2: Proposed New Schedule: Authorized Limits of Deleterious Substances (Diamond Mining Sector)

Deleterious Substance	Maximum Authorized Monthly Mean Concentration (mg/L)	Maximum Authorized Concentration in a Composite Sample (mg/L)	Maximum Authorized Concentration in a Grab Sample (mg/L)
Ammonia	tbd**	tbd	tbd
Chloride	tbd	tbd	tbd
Phosphorus	tbd	tbd	tbd
Total Suspended Solids	15.00	22.50	30.00
pH	6.0 – 9.5		

NOTE: All concentrations are total values.
** To be determined

More information on diamond mine effluent is available in the Worley Parsons report, *Identification of Best Available Control Technologies Applicable to Canadian Diamond Mining Effluent*, prepared for Environment Canada, August 2009.

Questions:

Do you agree with adding limits for diamond mines? If not, why not?

Do you agree with the proposed effluent limit for total suspended solids? If not, why not? What would you propose, and why?

What are your views on the appropriate effluent limits for ammonia, chloride and phosphorous?

Do you have other comments on diamond mining effluent?

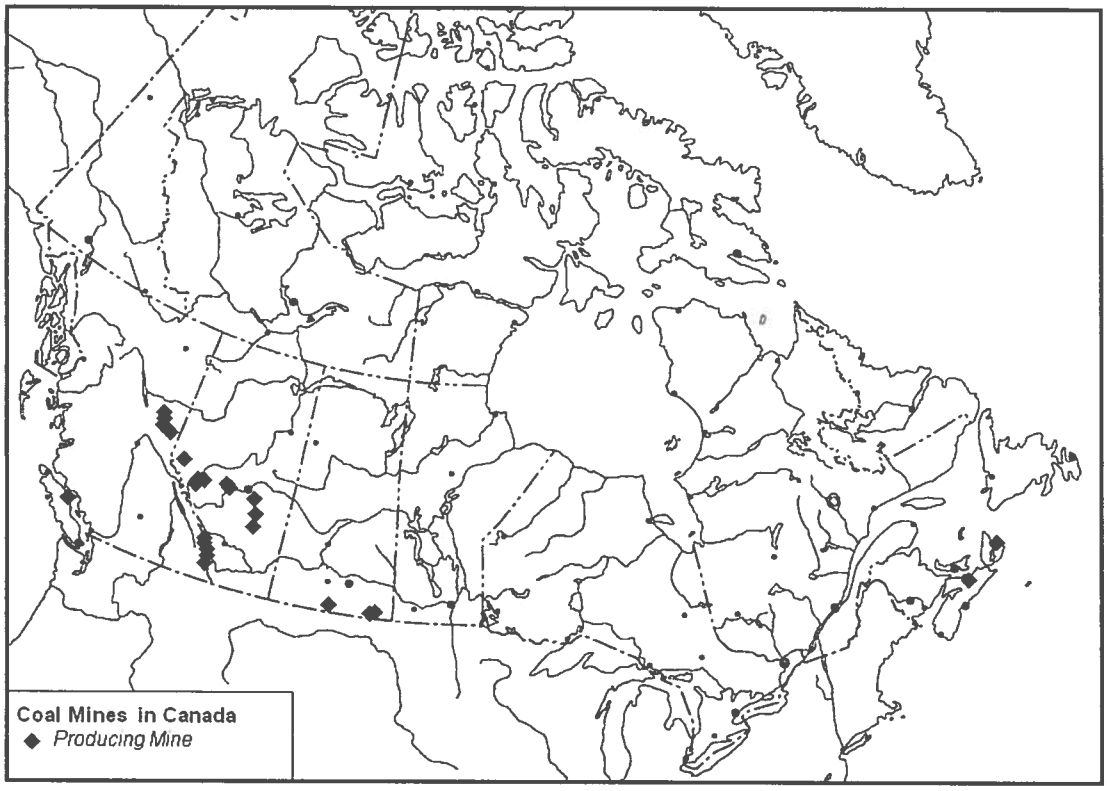
4 COAL MINING EFFLUENT

4.1 Current and proposed mines

There are 24 major active coal mines in four provinces in Canada (Alberta, British Columbia, Saskatchewan and Nova Scotia). . Twelve new proposed mines are currently undergoing federal environmental assessments, along with proposed expansions at five existing mines.

In Alberta and Saskatchewan, coal is primarily used for electric power production, while BC's metallurgical coal is exported to steel-makers.

Figure 4-1: Active Coal Mining Operations in Canada



4.2 Federal regulatory regime

Coal mines are subject to Section 36 of the *Fisheries Act*, the general prohibition against the deposit of deleterious substances into water frequented by fish.

4.3 Provincial and territorial regulatory regimes

In Canada, provincial departments and agencies play an important role in the regulation of coal production in Canada.

Coal mining operations are subject to provincial environmental assessments prior to start-up, and they may also trigger a federal environmental assessment.

Once operating, coal mines are subject to provincial regulatory requirements. These include standards for the effluent quality that are established through provincial permitting process. Provinces also require that receiving waters downstream of the mine site meet the applicable provincial ambient water quality guidelines. Many provincial guidelines include basin or site-specific water quality objectives to address specific issues (e.g., high background levels of a particular substance) or to protect impaired systems or to address cumulative impact concerns. Objectives are specified in discharge permits, along with the associated monitoring requirements.

4.4 International regulatory regimes

Canada ranks 13th in global coal production (China is first), but second as a supplier of metallurgical coal.

The United States (U.S.), Australia, India, South Africa and the European Union (EU) all have regulatory frameworks in place. The frameworks in Australia and the EU are similar in approach to the Canadian and U.S. models. The regulatory programs in India, South Africa, Russia and China are less mature than those in North America and the EU, but they do exhibit many similar characteristics to them. In the U.S., coal mining is regulated by a number of federal regulatory programs and associated state programs. The activity surrounding the design, testing and data collection of effluent pollution control technologies is widespread and significant in the U.S., much more so than in any other jurisdiction examined.

4.5 Proposed effluent limits

One of the objectives of the 10-year review of the MMER is to propose, for consideration, national effluent requirements for coal mines that minimize threats to Canada's water resources and aquatic ecosystems, taking into account best available technology economically achievable.

With this objective, and considering provincial and U.S. coal effluent limits, **Environment Canada proposes** to regulate seven substances in coal mine effluent (arsenic, aluminum, ammonia, iron, manganese, selenium, and total suspended solids (TSS)) plus pH and acute lethality:

- TSS can be particularly high at coal mines in mountainous and hilly terrains due to erosion, is commonly included in provincial permits for coal mines, and is already on Schedule 4 of the MMER for metal mines;

- ammonia in coal mine effluents is typically associated with the use of explosives in blasting operations, and is also a proposed addition to Schedule 4 of the MMER for metal mines;
- aluminum, iron and manganese are contaminants of concern at coal mines as they relate to acid rock drainage, and are also included in some provincial permits;
- arsenic and selenium effluent discharge limits are not included in any provincial permits, but both are contaminants of concern at coal mines; arsenic is already on Schedule 4 of the MMER for metal mines, and selenium, which causes deformities in fish, is a proposed addition to Schedule 4 for metal mines.

Table 4-2 shows the proposed limits. Appendix 4 provides a more detailed rationale for adding these particular substances, and additional background information is provided in Appendix 8.

Table 4-2: Proposed New Schedule: Authorized Limits of Deleterious Substances (Coal Mining Sector)

Deleterious Substance	Maximum Authorized Monthly Mean Concentration (mg/L)	Maximum Authorized Concentration in a Composite Sample (mg/L)	Maximum Authorized Concentration in a Grab Sample (mg/L)
TSS	50	75	100
Arsenic	0.1	0.15	0.2
Ammonia	tbd**	tbd	tbd
Aluminum	tbd	tbd	tbd
Iron	tbd	tbd	tbd
Manganese	tbd	tbd	tbd
Selenium	tbd	tbd	tbd
pH	6.0 – 9.5		

** To be determined

More information on coal mine effluent and selenium treatment technology is available in the Stantec report, *Study on Canadian Coal Mining Effluents Final Report,* prepared for Environment Canada, May 2011.

Questions:
Do you agree with adding limits for coal mines? If not, why not?

Do you agree with the proposed effluent limit for TSS and arsenic? If not, why not? What would you propose, and why?

What are your views on the appropriate effluent limits for ammonia, aluminum, iron, manganese and selenium? Do you have other comments on coal mining effluent?

5 SUMMARY OF PROPOSED EFFLUENT LIMITS

The table below compares the current effluent discharge limits in Schedule 4 of the MMER, to the proposed new effluent limits for metal mines, diamond mines and coal mines.

Parameter		MMER: Metal		Coal	Diamonds
		Current Limit	Possible Limit		
Metals and Metalloids (mg/L)					
Arsenic	Monthly	0.5	0.1	0.1	No limit
	Grab	1.0	0.2	0.2	No limit
Copper	Monthly	0.3	0.05	No limit	No limit
	Grab	0.6	0.1	No limit	No limit
Nickel	Monthly	0.5	0.25	No limit	No limit
	Grab	1.0	0.5	No limit	No limit
Lead	Monthly	0.2	0.05	No limit	No limit
	Grab	0.4	0.1	No limit	No limit
Zinc	Monthly	0.5	0.25	No limit	No limit
	Grab	1.0	0.5	No limit	No limit
Aluminum	Monthly	No limit	tbd**	tbd	No limit
	Grab	No limit	tbd	tbd	No limit
Iron	Monthly	No limit	tbd	tbd	No limit
	Grab	No limit	tbd	tbd	No limit
Manganese	Monthly	No limit	No limit	tbd	No limit
	Grab	No limit	No limit	tbd	No limit
Other Contaminants of Concern					
TSS (mg/L)	Monthly	15	No change	50	15
	Grab	30	No change	100	30
Cyanide (mg/L)	Monthly	1.0	0.5	No limit	No limit
	Grab	2.0	1.0	No limit	No limit
Radium 226 (Bq/L)	Monthly	0.37	No change	No limit	No limit
	Grab	1.11	No change	No limit	No limit
Ammonia (mg/L)	Monthly	No limit	tbd	tbd	tbd
	Grab	No limit	tbd	tbd	tbd
Selenium	Monthly	No limit	tbd	tbd	No limit
	Grab	No limit	tbd	tbd	No limit
Phosphorus (mg/L)	Monthly	No limit	No limit	No limit	tbd
	Grab	No limit	No limit	No limit	tbd
Chloride (mg/L)	Monthly	No limit	No limit	No limit	tbd
	Grab	No limit	No limit	No limit	tbd
pH		6.0 – 9.5	No change	6.0 – 9.5	6.0 – 9.5
Acute lethality		Rainbow trout	Rainbow trout and *Daphnia magna*	Rainbow trout and *Daphnia magna*	Rainbow trout and *Daphnia magna*

** To be determined

PART B

6 EFFLUENT MONITORING

6.1 Analytical requirements for effluent monitoring

Schedule 3 of the MMER specifies analytical requirements for the measurement of deleterious substances currently listed on Schedule 4 of the Regulations. This includes the maximum acceptable accuracy and precision for each substance, as well as the maximum acceptable method detection limit (MDL) for each substance. The MDL is the lowest concentration of a substance that can be distinguished from zero with 99% confidence. As a minimum, MDLs should be at least an order of magnitude lower than the maximum authorized grab sample concentration for a given substance.

The MDLs currently specified in Schedule 3 are significantly higher than MDLs that are routinely available at commercial analytical laboratories. **Environment Canada proposes** that MDLs specified in Schedule 3 be lowered to be in line with those currently commercially available. This would improve data quality with no incremental cost, since most laboratories no longer routinely offer chemical analyses at MDLs currently specified in Schedule 3.

As described in chapter 2, Environment Canada proposes that aluminum, iron, selenium and ammonia be listed on Schedule 4 for metal mines. In addition, as described in chapters 3 and 4, Environment Canada proposes that manganese be included on Schedule 4 for coal mines, and that phosphorus and chloride be included on Schedule 4 for diamond mines. **Environment Canada proposes** that all substances included on Schedule 4 for metal, coal and diamond mines would be included on Schedule 3 (see Table 6-1). For any substances not currently on Schedule 3, MDLs would be specified which are in line with those currently routinely available commercially.

6.2 Mercury

Measuring mercury is currently required as part of effluent characterization and water quality monitoring. The reason is that, if mercury concentrations in effluent exceed a concentration specified in the Regulations, then mines are required to conduct fish tissue monitoring as part of the biological monitoring component of the environmental effects monitoring program to assess the fish usability by man. Health Canada has a fish consumption guideline for mercury which is 0.5 µg/g of mercury in fish tissue.

Because the mercury concentrations in effluent are a trigger for fish tissue monitoring, Environment Canada currently recommends, but does not require, that a maximum MDL of 0.00001 mg/L (0.01 µg/L) be used for mercury analysis. However, data analysis indicates that some mines are not meeting this recommended MDL, which is potentially problematic given the importance of this measurement. Specifying a maximum regulated MDL for mercury would improve mercury data quality.

Therefore, **Environment Canada proposes** that mercury be added to Schedule 3, as proposed in Table 6-1. (Table 6-1 lists the substances in the same order as they are listed in the summary table in Chapter 5. If the MMER is amended, then the substances would be listed in alphabetical order in Schedule 3.)

Please also see Appendix 5 for more detail on the proposed changes to Schedule 3 of the MMER.

Table 6-1: Proposed Analytical Requirements for Mining Effluents

Deleterious Substance	Precision	Accuracy	Method Detection Limit (MDL)
Metals			
Arsenic	10%	100 ± 10%	0.0050 mg/L
Copper	10%	100 ± 10%	0.0050 mg/L
Nickel	10%	100 ± 10%	0.0050 mg/L
Lead	10%	100 ± 10%	0.0050 mg/L
Zinc	10%	100 ± 10%	0.0050 mg/L
Aluminum	10%	100 ± 10%	0.0050 mg/L
Iron	10%	100 ± 10%	0.0050 mg/L
Manganese	10%	100 ± 10%	0.0050 mg/L
Mercury	10%	100 ± 10%	0.00001 mg/L
Other contaminants of concern			
Total Suspended Solids	15%	100 ± 15%	2.000 mg/L
Cyanide	10%	100 ± 10%	0.0050 mg/L
Radium 226	10%	100 ± 10%	0.0100 Bq/L
Ammonia	10%	100 ± 10%	0.0500 mg/L
Selenium	10%	100 ± 10%	0.0005 mg/L
Phosphorus	10%	100 ± 10%	0.0500 mg/L
Chloride	10%	100 ± 10%	2.0000 mg/L
pH	0.1 pH unit	0.1 pH unit	Not applicable

7 ACUTE LETHALITY

Part 2, Division 2 of the MMER (on Effluent Monitoring Conditions) requires acute lethality testing to determine the acute lethality of effluent to rainbow trout. Acute lethality means an effluent at 100% concentration that kills more than 50% of the rainbow trout subjected to it over a 96-hour period.

7.1 Daphnia magna

Daphnia magna are water fleas. Their size and colour make them an ideal food source for fish whose selection of prey is on the basis of visibility and pigmentation.

The MMER require lethality testing on *Daphnia magna*, but do not require the effluent to be non-lethal. This decision was a result of the consultations leading up to the 2002 publication of the MMER, with the expectation at that time that Environment Canada would make a decision on whether or not to include a requirement for mine effluent to be non-acutely lethal to *Daphnia magna* once sufficient data was available.

Sufficient data are now available on *Daphnia magna* monitoring results, and Environment Canada has studied the data to evaluate:

- The potential relationships between the acute lethality of *Daphnia magna* and rainbow trout; and
- The potential relationships between acute lethality and various chemical characteristics of the mining effluent.

Environment Canada used statistical analyses, based on correlations and logistic regressions, to identify potential relationships between the lethality test results and each of the effluent parameters in the MMER.

The main conclusions from the analysis show that:

- Between 2003 and 2010, the overall compliance rate for
    - rainbow trout testing was fairly constant ranging from 95.2% to 97.86%; and
    - *Daphnia magna* monitoring tests ranged from 90.70% to 94 .20%, but constantly decreased from 94.2% in 2003 to 90.86% in 2010.
- The base metals mining subsector has the highest number of *Daphnia magna* monitoring tests that failed, followed by the precious metal and iron ore subsectors. The uranium subsector experienced only occasional test failures.
- The acute lethality test with *Daphnia magna* and mining effluent fails more frequently than with rainbow trout.
- Some of the effluent parameters analysed correlated to the toxicity of the mine effluent with *Daphnia magna* and rainbow trout.
- Hardness is the only effluent parameter that was consistently showing a relationship with the lethality of both *Daphnia magna* and rainbow trout.

- *Daphnia magna* lethality was significantly related to a different set of effluent parameters then the rainbow trout and these relationships were often opposite for the two species.

Appendix 6 provides the full analysis from this study.

7.2 Acute lethality requirements in other jurisdictions

Daphnia magna acute lethality testing is a compliance parameter (i.e., effluent must be non-acutely lethal) in Certificates of Approval for mining operations in both Ontario and Quebec. In 2010, these two provinces were home to 62 metal mines, out of a total of 105, or more than half.

The Northwest Territories and Nunavut also require that effluent from the diamond mines in their respective territories be non-acutely lethal to *Daphnia magna*.

7.3 Proposed amendments

Because of these findings, and given that environmental effects monitoring shows that some fish downstream from some metal mines are thinner, older and slower growing, it is important to protect *Daphnia magna* as a food source for fish.

Metal mines

Therefore, **Environment Canada proposes** to:

1. Add a *Daphnia magna* acute lethality test to the MMER, in conjunction with the existing rainbow trout lethality test, to be more protective of the receiving environment; and,
2. Add a requirement to conduct effluent characterization when a *Daphnia magna* acute lethality test failure occurs, as per the current requirement for rainbow trout. The additional characterization information would better enable the determination of the reason for the failed *Daphnia magna* test.

Diamond and coal mines

If diamond and coal mines are added to the MMER, to be consistent across mining sectors and to be equally protective of aquatic ecosystems, **Environment Canada proposes** to:

- apply the same requirements in #1 and #2, above, to diamond and coal mines; and
- apply the MMER requirement that effluent be non-acutely lethal to rainbow trout to diamond and coal mines.

7.4 Benefits and costs

Adding the *Daphnia magna* acute lethality test to the MMER, in conjunction with the existing rainbow trout lethality test, will better control the quality of metal mining effluents and therefore be more protective of the receiving environment to which treated effluent is discharged.

Metal mines

It is not possible to quantify the cost of this added requirement because compliance will be site-specific; however, it is possible to quantify the number of mines that will be affected. Based on an analysis of the 2008-2010 data, eleven facilities would need to make some adjustments to their treatment systems. Of these, it is anticipated that four facilities would be highly affected, two would be somewhat affected, and four would be slightly affected. Therefore the costs of compliance would not be sector wide, but limited to less than 10% of metal mines. Appendix 6 provides more detail on these mines.

Diamond mines

Because diamond mine effluent is already required to be non-acutely lethal to *Daphnia magna*, no additional costs are expected.

Coal mines

Finally, coal mines must already comply with the rainbow trout acute lethality test, therefore, the cost to comply with Environment Canada's proposal is limited to the cost of complying with the *Daphnia magna* acute lethality test. Costing information is not currently available.

Questions:

Do you agree with the proposed changes to Part 2, Division 2 regarding acute lethality? If not, why not? What would you propose, and why?

8 ENVIRONMENTAL EFFECTS MONITORING STUDIES

8.1 MMER requirements

Under Schedule 5 of the *Metal Mining Effluent Regulations* (MMER), regulated mines are required to conduct Environmental Effects Monitoring (EEM) as a condition governing the authority to deposit effluent in the receiving environment.

The EEM studies include effluent and water quality monitoring studies, and biological monitoring studies. Effluent and water quality monitoring studies consist of effluent characterization, sublethal toxicity testing, and water quality monitoring studies. Biological monitoring studies consist of:

- a site characterization,
- a fish population study to assess fish health,
- a fish tissue study to assess the usability of fisheries by man, and
- a benthic invertebrate community study to assess fish habitat integrity and capacity to sustain abundant and diverse wildlife.

The objective of the metal mining EEM program is to evaluate the effects of metal mining effluents on fish, fish habitat and the use of fisheries resources by humans. Environment Canada uses the information generated by the regulated mining sector to help assess the adequacy of the MMER to effectively protect these aquatic resources.

8.2 Proposed changes

As part of the 10-year review, Environment Canada reviewed Schedule 5 with the following objectives:

- Review and streamline, where possible, the Schedule 5 requirements without compromising the use of EEM to assess the adequacy of the MMER.
- Focus monitoring efforts by mines on sites with higher environmental risk, and, conversely, reduce level of effort when risks are lower.
- Improve the design of the EEM requirements that will allow mines to progress more rapidly into the EEM program thereby assessing and investigating effects in the receiving environment more rapidly.

Environment Canada considered various sources of information, such as the results and findings presented in the *First* and *Second National Assessment of Environmental Effects Monitoring Data from Metal Mines Subjected to the MMER (Environment Canada, 2012c)*. Environment Canada also took into consideration knowledge and experience from the EEM program under the *Pulp and Paper Effluent Regulations*, which was implemented in 1992.

Given the many different requirements of the EEM program, it is not possible to summarize in a few pages the scientific rationale for all of Environment Canada's proposed amendments to Schedule 5. Rather, please see Appendix 7 for an overview of

the EEM program and a detailed discussion of each proposed change to it, as well as costs and benefits.

Environment Canada proposes the following changes:

1. Accelerate EEM process by requiring **historical information** to be submitted as part of the first study design, 12 months after the day on which the mine becomes subject to the MMER. This proposal would remove a 12-month delay.
2. Prioritize monitoring by incorporating **critical effect sizes** to focus biological monitoring efforts where large effects are observed, instead of the current MMER requirement to investigate all confirmed effects.
3. Streamline monitoring steps and timelines for the benthic invertebrate community and fish population **studies separately**, rather than simultaneously, to focus efforts based on risk.
4. Follow through the monitoring cycle by incorporating "**Investigation of Solutions**" after identifying the cause of a mine-related effect. Currently, the MMER only requires an "Investigation of Cause" when effects are observed. Once a cause is identified, a solution should be sought.
5. Remove the requirement to conduct a **benthic invertebrate community study** if effluent concentration is less than or equal to 1% at 100 meters from the final discharge point.
6. Remove the requirement to conduct **biological monitoring studies** for mines not discharging effluent for an extended period of time. This exemption would reduce the burden on industry and free up Environment Canada to focus resources where risks to the environment are greatest.
7. Remove the requirement to determine the **geographic extent of an effect**, to accelerate the Investigation of Cause.
8. Modify the list of required parameters for **effluent characterization** and water quality to add: chromium, cobalt, manganese, thallium and uranium, as well as chloride, sulphate, and phosphorus. See Annex 1 to Appendix 7 for a detailed analysis and rationale for this proposal.
9. Streamline the requirements for **sublethal toxicity testing** by incorporating a tiered approach where the nature of tests required is dependent on effluent sublethal toxicity. This proposal addresses a gap in the MMER: the current frequency of testing is too low to capture changes in effluent quality over time.
10. Adjust the requirement for conducting analysis of **mercury in fish tissue**. Require mines to conduct a fish tissue survey based on an annual average concentration of mercury in effluent, instead of on a single measurement. The fish tissue studies assess fish usability by humans.
11. Ensure transparency by revising the MMER to indicate the **public availability of EEM data**, while respecting confidential business information.
12. Should **diamond and/or coal mines** be added to the MMER, all of the EEM requirements, including all the proposed changes, would also apply to them.

8.3 Benefits and costs

The main benefit of these changes is to reduce the burden and costs on the sector while maintaining the scientific rigor of the EEM program. Although Environment Canada is proposing to add some new requirements (e.g. investigation of solution, and some additional parameters for effluent characterization), the overall result is an improved program that focuses effort in areas of higher risk. The estimated cost savings for the metal mining sector are shown in Table 8.1, and are explained in more detail in Appendix 7.

Table 8.1: Proposed EEM modifications and potential costs/savings for metal mines

Proposed modifications	Estimated cost change per phase (for 3 years) for the sector
Application of proposals to biological monitoring studies: • Inclusion of Critical Effects Size • Decoupling	- $660,000
Addition of Investigation of Solution (IOS)	Cost for IOS similar to Investigation of Cause or joint field biological study
1% for Benthic Invertebrate Community	- $182,000
Non discharging	- $300,000
Removal of requirement to determine geographic extent	Up to - $1,425,000[1]
Effluent characterization and water quality parameters	+ $81,000[2]
Sublethal toxicity testing (tiered approach)	- $57,000
Mercury in fish tissue	- $50,000
Total	Up to - $2,593,000

[1]Cost for a standard study (fish, benthos) is estimated at $ 75,000. To estimate a magnitude and geographic extent (M&E) study cost, we used the high costs for each study (Karam, 1999) and indexed at 30%: the costs is estimated at $ 95,000. Cost saving for not doing an M&E study is $ 15,000 per mine. An estimated 95 mines, out of 110 mines in 2011, would be going to IOC, therefore would not conduct the M&E study.
[2] As indicated in section 4.6, the total incremental cost to industry of adding the proposed metals and other potential contaminants of concern to the list of parameters for effluent characterization and water quality monitoring would not be expected to exceed $ 27,000 per year (27,000 x 3 years = 81,000).

Questions:

Do you agree with the proposed changes to Schedule 5 on environmental effects monitoring? If not, why not? What would you propose, and why?

9 TAKING EFFECT

9.1 Metal, diamond and coal mines

Should the MMER be amended, Environment Canada welcomes input on the coming-into-force dates for the proposed effluent limits, analytical requirements, and acute lethality.

Questions:

Should the proposed effluent limits apply to all mines, new and existing? If not, why not?

Are there technical and/or engineering challenges that will influence the coming-into-force date? Do they differ for different sectors, or for different substances within a sector?

Should some requirements be phased in? Which ones, and why?

9.2 Environmental effects monitoring studies

Schedule 5, Part 1

The results of effluent, sublethal toxicity testing, and water quality monitoring studies are reported on an annual basis. If Schedule 5, Part 1 is amended, then having those amendments take effect mid-way through a calendar year would mean that monitoring and reporting requirements would change mid-way through that year, which would be potentially confusing and administratively challenging.

Environment Canada proposes that if there are substantive amendments to Schedule 5, Part 1, those amendments would take effect on January 1 of the calendar year following the year in which the amendments are registered.

Schedule 5, Part 2

The results of biological monitoring are documented in an interpretive report. As described in Schedule 5, Part 2, most mines are required to submit interpretive reports every 36 months. A small number of mines may be eligible to submit interpretive reports every 72 months.

If there are substantive amendments to Schedule 5, Part 2, it would be inappropriate, administratively complex and potentially confusing to have those amendments take effect mid-way through that 36-month period, for any given mine. Each mine is on a unique reporting cycle.

Therefore, **Environment Canada proposes** that if there are substantive amendments to Schedule 5, Part 2, those amendments would take effect at the end of the 36-month reporting period that each mine is in on the date of registration.

Questions:

Do you agree that the proposed amendments for EEM would take effect on the dates proposed? If not, why not? What would you propose, and why?