Proposed Approach for Coal Mining Effluent Regulations

Consultation Document

November 2017

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Introduction

Environment and Climate Change Canada (ECCC) has prepared this consultation document to inform interested parties and solicit feedback on the key elements of proposed coal mining effluent regulations under the *Fisheries Act*. An approach for all coal mines is presented in Parts 1-3 of this document; Part 4 proposes an alternate approach for existing mountain coal mines. Interested parties may comment in writing by mail or e-mail (see Part 5 of this document for details)**.**

Background

In January 2017, ECCC shared a consultation document, *Proposed Regulatory Framework for Coal Mining* (the *Framework*), with industry, environmental non-governmental organizations (ENGOs), Indigenous Peoples, provincial governments, and other interested parties. The *Framework* broadly outlined how ECCC plans to regulate coal mining effluent. The objective was to seek feedback from interested parties on the contents of the *Framework*.

Additionally, in February and March 2017, ECCC held a series of consultation sessions in four locations across the country. The objectives of these sessions were to provide participants with contextual information and answer questions about the proposed *Framework*. ECCC also met with a number of Indigenous organizations and their representatives in June 2017.

Comments received at the various consultation sessions and through written submissions, covered a broad range of issues and perspectives and are summarized in ECCC's *National Consultation Report, February to April 2017*. A key theme of the comments was for ECCC to provide a more detailed proposal for consultation prior to publishing the proposed regulations in *Canada Gazette*, Part I (CGI) in 2018. In response, ECCC has developed this more detailed proposal and is seeking feedback from interested parties.

This document is intended to provide an overview of the anticipated content of the proposed regulations. A number of focus questions and information requests have been included throughout the document. ECCC welcomes responses to these questions and other feedback from all interested parties. ECCC will consider all responses received during the consultation period prior to drafting and publishing the proposed regulations in CGI.

The proposed regulations are intended to be published in CGI in fall 2018. This provides another opportunity to provide comments on the proposed regulations. Final regulations would then be developed for publication in the *Canada Gazette*, Part II (CGII) in 2019.

Objective

The objective of the regulations under consideration would be to reduce the threats to fish, fish habitat and human health from fish consumption by decreasing the level of harmful substances discharged to surface water from coal mine effluent.

Part 1. Proposed Approach for All Mines

1.1 Application

The proposed regulations would apply to all coal mines in Canada. A coal mine would become subject to the regulations if it meets the following criterion:

- *Effluent Discharge*: The regulations would apply to any coal mine once it discharges 50 m^3 of effluent in a day from its operations area and deposits effluent in a fish frequented water body, or that may enter a fish frequented water body. This would include mines where the effluent is discharged to land, but enters a water body after being discharged.

It is proposed that the regulations apply to mines and mines under development. The regulations would not apply to mines currently under care and maintenance, unless they resume commercial operation after the regulations come into force. Exploration projects are intended to be excluded from the scope of the proposed regulations until they begin mine development. Closed and abandoned mines would also be excluded from the scope of the proposed regulations unless they resume commercial operation. For strip (or prairie) mines, it is intended that reclaimed areas be excluded from the regulations (see part 3.4.2 of this document for details).

Coal mines in Canada that ECCC has identified as being currently in commercial operation are shown in Annex A.

1.2 Key Definitions

- *Coal Mine*: a coal mine includes all activities related to the extraction, processing and storage of coal that occur at a facility designed or used to produce coal. Extraction would include both surface and underground extraction methods. Processing would include screening, crushing, grinding, washing and other processing of coal that occurs at a coal mining facility (i.e., coal preparation facilities). All of these activities are proposed to be captured by the regulations since they are capable of generating effluent. The definition of a coal mine is proposed to include its operations area.

- *Effluent*: includes liquid discharge from a coal preparation facility, liquid discharge from a mine waste disposal area; water that is pumped from or flows out of any underground works, or open pits; water from a polishing pond, treatment pond, settling pond or water treatment plant or from any mine water treatment facility other than liquid discharge from a sewage treatment facility; liquid discharge from a coal-fired power plant that is combined with any of the above liquid discharge originating from a coal mine; and any seepage or surface runoff that flows through or out of a mine's operations area.

- *Operations Area*: includes an area within which the activities related to the extraction, processing and storage of coal occur or have occurred. This area should include all infrastructure designed or used to extract or process coal, including supporting infrastructure, mine waste management infrastructure (including the mine waste itself),

coal preparation and storage facilities, and cleared or disturbed areas that are adjacent to these areas.

1.3 New Mines and Expansions

It is proposed that the regulations distinguish between existing mines, new mines and expansion projects. Elements of the regulations would contain distinct provisions for existing and new mines, as well as expansions. Together, the provisions for new mines and expansions would support continuous improvement in the management of mine waste while recognizing capital turnover rates and the costs that existing mines could incur to meet new requirements.

- *Existing mines* would refer to mines that are in commercial operation at the time of publication of the final regulations, or that enter commercial operation within 3 years of publication.

- *Expansions* of existing mines would refer to new coal preparation or storage facilities, new open pits or underground mines, new mine waste disposal areas including mine waste piles, or new treatment ponds or facilities. ”New” is intended to refer to infrastructure constructed 3 years or more after publication of the final regulations. Where a new Final Discharge Point (FDP) is constructed at an expansion project, the FDP would be subject to effluent limits for new mines.

- *New mines* would refer to mines that enter commercial operation 3 years or more after publication of the final regulations, including mines that resume commercial operation at least 3 years after publication of the final regulations.

Focus question:

Do you support ECCC’s proposed definition of expansion? If not, please provide information that would be helpful in establishing an alternative definition.

1.4 Deleterious Substances and Effluent Discharge Limits

ECCC is proposing to establish national baseline effluent standards for deleterious substances. It is proposed to regulate total selenium, total nitrate and total suspended solids (TSS). Details about considerations in proposing effluent limits can be found in Annexes B and C.

1.4.1 Key Definitions

- *Final Discharge Point (FDP)*: would refer to an identifiable discharge point of a mine beyond which the operator of the mine no longer exercises control over the quality of the effluent.

- *Grab sample*: would refer to the quantity of undiluted effluent collected at a given point in time.

- *Monthly mean concentration*: would refer to the average value of the concentrations measured in all samples collected from each FDP during each month there was a discharge.

All effluent originating from a mine would be required to be collected and discharged through defined FDPs. Effluent limits are proposed to apply at all FDPs at Canadian coal mines. Mines would be prohibited from combining water with effluent for the purpose of diluting effluent before it is deposited. ECCC would not impose any requirements on the number of FDPs at a mine. Therefore, a mine may have multiple FDPs.

1.4.2 Total Suspended Solids (TSS)

The following effluent limits are being considered for TSS. These limits would apply at all times:

		Existing Mines		***New Mines and Expansions***	
Deleterious Substance	**Unit**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**
TSS	mg/L	35	70	35	70

Testing for TSS in effluent would be required once per week during discharge at all FDPs. Additional detail on testing frequencies can be found in Annex D.

1.4.3 Nitrate

The following effluent limits are being considered for total nitrate. These limits would apply at all times:

		Existing Mines		***New Mines and Expansions***	
Deleterious Substance	**Unit**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**
Total Nitrate	mg-N/L	10	20	3	6

Testing for nitrate in effluent would be required once per week during discharge at all FDPs. The frequency of testing would be reduced to once per calendar quarter at FDPs where effluent concentrations are consistently less than 10% of the proposed monthly mean effluent limit. Additional detail on testing frequencies can be found in Annex D.

1.4.4 Selenium

1.4.4.1 Selenium in Fish Tissue Studies

Existing mines would be required, within 3 years of publication of the final regulations, to conduct a study of the selenium concentration in fish tissue from water frequented by fish that is exposed to effluent. New mines would be required, within 3 years of becoming subject to the regulations, to conduct a study of the selenium concentration in fish tissue from water frequented by fish that is exposed to effluent.

Measurements would be done on whole fish or muscle and, if possible, in female fish ovaries and eggs. Mines would report the concentration of selenium on a dry weight basis in µg/g, in addition to the % moisture content. A selenium in fish tissue study would be required to be conducted every 3 years. Provisions for mines to cease conducting selenium in fish tissue studies are being considered (see section 1.4.4.4.).

Additional requirements are being considered for selenium in fish tissue studies that could include specifications related to the number, size, gender or life stage of specimens to be studied, seasonality requirements for conducting studies, location of study within the area exposed to effluent, as well as other requirements.

Additional information on selenium in fish tissue can be found in Annex C.

1.4.4.2 Selenium Management at Existing Mines

For existing mines ECCC proposes a tiered approach to regulatory compliance that includes fish tissue.

1.4.4.2.1 Key Definitions

- *Baseline limit*: a national, baseline effluent limit that all existing mines must meet, at a minimum, at all FDPs at all times.

- *Triggered limit*: a technology-based effluent limit that must be met at all FDPs that exceed a fish tissue trigger.

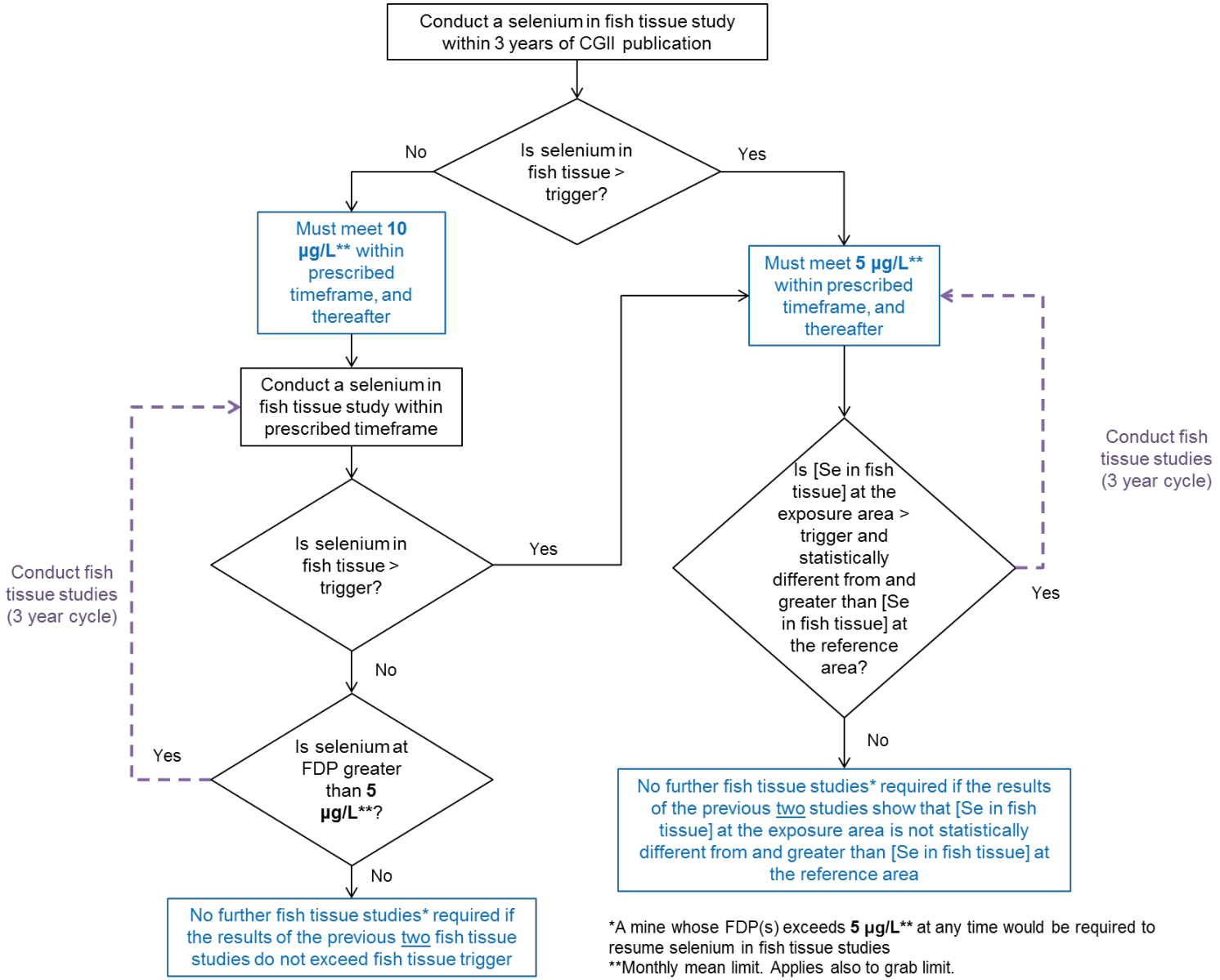
- *Fish tissue trigger*: a concentration of selenium in fish tissue, which, if exceeded, would trigger the requirement for FDPs to meet the triggered limit at all times.

It is proposed that compliance be tied to concentrations of selenium in fish tissues, according to the following approach:

- Selenium concentration would be measured in effluent at all FDPs.
- There would be two sets of effluent limits, a baseline limit and a triggered, technology-based limit.
- All mines must, at a minimum, meet the baseline limit at all FDPs.
- Mines must meet the triggered effluent limit at all FDPs where an exceedance of a selenium in fish tissue trigger occurs in an area exposed to effluent from those FDPs.

- Mines that do not report a selenium in fish tissue concentration within the 3 year timeframe would be required to meet the triggered limit at all FDPs.
- The requirement to meet an effluent limit for selenium would come into force 6 years following CGII publication.
- If, at a later date, a mine becomes required to meet the triggered limit, that mine would then have 3 years to comply with that limit.
- FDPs at a mine required to meet the triggered limit would continue to be subject to the triggered limit thereafter.

The proposed selenium management approach for existing mines is described in the following diagram:



*A mine whose FDP(s) exceeds **5 µg/L**** at any time would be required to resume selenium in fish tissue studies
**Monthly mean limit. Applies also to grab limit.

The following effluent limits and fish tissue triggers are being considered for selenium[1]:

Existing Mines	***Effluent***				***Fish Tissue***
	Baseline Limit		**Limit triggered by fish tissue study result**		
Deleterious Substance	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**	**Trigger for reductions from *Baseline Limit* to *Triggered Limit***
Unit	µg/L				µg/g dry weight
Total Selenium	10	20	5	10	2.9 (whole body and muscle); 11.8 (egg/ovary)

1.4.4.3 New Mines and Expansions

For new mines and expansions, a technology-based effluent limit for selenium is proposed. The following effluent limits are being considered for total selenium:

Selenium Effluent Limits: New Mines and Expansions			
Deleterious Substance	**Unit**	**Maximum Authorized Monthly Mean Concentration**	**Maximum Authorized Concentration in a Grab Sample**
Total Selenium	µg/L	5	10

1.4.4.4 Testing Frequency for Selenium in Effluent and Fish Tissue

Testing for selenium in effluent for new and existing mines would be required once per week during discharge at all FDPs. The frequency of testing would be reduced to once per calendar quarter at FDPs where effluent concentrations of selenium are consistently less than 10% of the proposed monthly mean effluent limit. Additional detail on testing frequencies can be found in Annex D.

[1] It is proposed that the trigger for reduction in effluent concentration be based on a Predicted No-Effect Concentration (PNEC) for selenium in fish tissue. The PNEC was established by ECCC and Health Canada in the draft screening assessment report for selenium and its compounds, published in July 2015 in *Canada Gazette*, Part I. The PNEC may be subject to change with publication of the final screening assessment report for selenium and its compounds. It is proposed that the fish tissue trigger align with the PNEC in the final screening assessment report once it is published. In the absence of a PNEC for muscle tissue, the PNEC for whole body would be used

There are two scenarios under which a mine would no longer be required to conduct a selenium in fish tissue study:

1) If a mine meets the triggered limit at all FDPs and if the results of the 2 previous consecutive studies show that the concentration of selenium in fish tissue is less than the fish tissue trigger in an area exposed to effluent.

2) In the event of a fish tissue trigger exceedance, if a mine meets the triggered limit at all FDPs and if results of the previous two studies show that the concentration of selenium in fish tissue collected from a sample in the area exposed to effluent is not greater than and not statistically different from that of a sample collected in an area that is not exposed to effluent.

A mine that exceeds the proposed triggered effluent limit for selenium would be required to resume selenium in fish tissue studies.

Focus question:

Do you support ECCC's proposed effluent limits and triggers for total selenium, total nitrate and TSS? Is there any additional information that ECCC should consider for establishing limits for existing or new mines and expansions?

Do you support ECCC's proposal to require more stringent effluent limits for new mines and expansions of existing mines?

1.5 Non-Acute Lethality Requirements

Effluent would be required to be non-acutely lethal to fish and invertebrates. Acutely lethal would mean that undiluted effluent kills more than 50% of test organisms[2] subjected to it for a specified period of time, based on a grab sample. If a test results in an acute lethality failure, the owner or operator of a mine would be required to identify and report the cause of the failure and indicate the remedial measures planned or implemented in response to the failure. A mine would be non-compliant with the regulations if it failed an acute lethality test.

Acute lethality testing would be required once per month for both the fish and invertebrate species at all FDPs. The frequency of testing for each species would be reduced to once per calendar quarter at FDPs where effluents are non-acutely lethal for 12 consecutive months for that species. Similarly, failed tests for a given species would increase testing frequency by testing twice per month for that species. A FDP required to increase testing frequency could return to testing once per month once 3 consecutive tests are non-acutely lethal. Additional detail on testing frequencies can be found in Annex D.

1.5.1 Rainbow Trout

ECCC proposes that the requirement for effluent to be non-acutely lethal to fish be met by passing an acute lethality test of effluent to rainbow trout (Reference Method EPS 1/RM/13).

[2]Acute lethality tests are conducted on laboratory test organisms. Test organisms would not be taken from the vicinity of a mine to meet this requirement.

1.5.2 *Daphnia Magna*

ECCC proposes that the requirement for effluent to be non-acutely lethal to invertebrates be met by passing an acute lethality test of effluent to *Daphnia magna* (Reference Method EPS 1/RM/14).

1.5.3 Alternate Marine Species

The proposed regulations would also add alternative marine species to test for non-acute lethality in scenarios where saline effluent is being released into marine receiving environments.

- For rainbow trout, the alternate marine species would be the three-spined stickleback. The non-acute lethality tests would be used when the salinity value of effluent is greater than 10 parts per thousand. The test would be carried out according to method EPS 1/RM/10, 2nd Edition.

- For *Daphnia magna*, the alternate marine species would be *Acartia tonsa.* The non-acute lethality tests would be used when the salinity value of the effluent is greater than 4 parts per thousand; a test method is currently under development.

1.6 pH range

ECCC proposes a range of 6.0 – 9.5 for pH for Canadian coal mine effluents. This range of pH would be maintained at all times, based on a grab sample, and be measured at all FDPs. Testing for pH in effluent would be required once per week during discharge at all FDPs. Additional detail on testing frequencies can be found in Annex D.

1.7 Effluent Monitoring Conditions

1.7.1 Volume of Effluent

ECCC proposes that the owner or operator of a mine record a total monthly volume of effluent discharged from each FDP for each month where there is an effluent discharge. The total monthly volume of effluent could either be determined on the basis of the flow rates or by using a monitoring system that provides a continuous measure of the volume of effluent deposited.

1.7.2 Loading of Deleterious Substances

The proposed regulations would require the owner or operator of a mine to record the loading of total selenium, total nitrate, and TSS discharged through each FDP. This recording would be done on a monthly basis.

1.8 Mine Waste Disposal Areas

Mine waste includes tailings (coal rejects), waste rock and overburden. Disposal of mine waste into water bodies frequented by fish would be allowed under certain conditions. This would be similar to *the Metal Mining Effluent Regulations.* Proponents seeking to dispose of mine wastes into natural water bodies frequented by fish would be required to conduct an assessment of alternatives that conforms to section 2 of the *Guidelines for the Assessment of Alternatives for Mine Waste Disposal* (Environment Canada, 2011), as amended from time to time by ECCC. A fish habitat compensation plan would also be required.

1.9 Emergency Response Plan

An Emergency Response Plan (ERP) is a plan that describes the actions a mine would take in the event of an environmental emergency that causes the discharge of a deleterious substance. ECCC proposes that the owner or operator of a mine prepare an ERP that describes the measures to be taken to prevent, prepare for, respond to and recover from any situation or impending situation which the owner or operator of a mine is unable to control or manage, that results or may result in the deposit of a deleterious substance, as defined under the *Fisheries Act*. The requirements for the ERP would be intended to align with the *Environmental Emergency Regulations*, where practicable. The proposed requirements would require the owner or operator of a mine to:

- keep the ERP and any updates readily available at the mine site so they are accessible to the individuals responsible for carrying out the plan in case of an emergency;
- update and test the ERP on an annual basis; and
- prepare and keep a record summarizing the tests of the ERP and any subsequent amendments to the ERP.

Part 2. Environmental Effects Monitoring (EEM)

It is proposed that all coal mines would be required to conduct Environmental Effects Monitoring (EEM) as a condition governing the authority to deposit effluent to the receiving environment. EEM studies are designed to detect and measure changes in aquatic ecosystems receiving effluent. EEM is an iterative system of monitoring and interpretation phases that is used to assess the adequacy of the regulations, by evaluating the effects of effluents on fish, fish habitat and the use of fisheries resources by humans.

EEM studies would consist of:

- effluent and water quality monitoring studies consisting of
  - effluent characterization;
  - water quality monitoring;
  - sublethal toxicity testing of effluent; and

- biological monitoring studies in the aquatic receiving environment to determine if effluent is affecting fish, fish habitat, or the use of fisheries resources, and if impacts are occurring, the cause of those impacts and determining solutions for eliminating impacts. Coal mines would need to consider all relevant data, analysis, scientific information, as well as Indigenous Knowledge for the purpose of meeting the EEM requirements.

Additional detail on EEM studies is provided in Annex F.

2.1 Key Definitions

- *Exposure area*: means all fish habitat and waters frequented by fish that are exposed to effluent.
- *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.
- *Sampling area*: means the area within a reference or exposure area where representative samples are collected.

2.2 Effluent Characterization

Effluent characterization would be conducted by analyzing a sample of effluent at each FDP and recording the required parameters listed below. In addition to these parameters, coal mines would also be required to monitor calcite formation by calculating a calcium carbonate saturation index based on effluent characterization measurements. Effluent characterization would be required once per calendar quarter and not less than one month apart. Analytical requirements, including method detection limits, accuracy and precision would be defined in the regulations (see part 3.1.2).

Proposed effluent characterization parameters:

- Hardness
- Alkalinity
- Electrical Conductivity
- Temperature
- Aluminum

- Ammonia
- Arsenic
- Calcium
- Cadmium
- Carbon dioxide, dissolved
- Chromium
- Cobalt
- Copper
- Lead
- Iron
- Mercury
- Manganese
- Nickel
- Nitrite
- Phosphorus
- Sulphate
- Total Dissolved Solids
- Uranium
- Zinc

2.3 Water Quality Monitoring

Samples for water quality monitoring would be collected from the exposure area surrounding the point of entry of the effluent into water from each FDP and the related reference areas, as well as from the sampling areas selected for biological monitoring studies. Water quality monitoring would be conducted once per calendar quarter and during biological monitoring studies. The substances measured for effluent characterization (Part 2.1) would be measured and recorded in addition to the deleterious substances set out in Part 1.4. Dissolved oxygen concentrations would be recorded for all samples. In the case of effluent deposited into freshwater, the pH, hardness, electrical conductivity and alkalinity would be recorded. In the case of effluent deposited into estuarine waters, salinity would be measured in addition to the parameters recorded in freshwater. In the case of effluent deposited into marine waters, only the salinity would be recorded. Mines would also be required to monitor calcite formation by calculating a calcium carbonate saturation index based on water quality measurements.

2.4 Sublethal Toxicity Testing of Effluent

Sublethal toxicity (SLT) testing would be conducted on the effluent from a mine's FDP that has the most potential adverse environmental impact. This testing monitors effluent quality by measuring survival, growth and/or reproduction endpoints in marine or freshwater organisms in a controlled laboratory environment. In the case of effluent deposited into marine, estuarine and freshwater environments, SLT testing would be required on a fish species, an invertebrate species and an algal species, and an additional plant species test would be required for freshwater environments. Tests would be conducted according to the methods referred to in the regulations (for additional detail, see Annex F).

ECCC is proposing to require mines to conduct SLT testing using all required tests twice per calendar year for the first three years. Using the test results from the first three years, mines would then be required to determine the most responsive test. In all subsequent years, mines would be required to conduct the most responsive test four times a year.

2.5 Biological Monitoring Studies

The biological monitoring study component of EEM studies would be conducted every three to six years. The requirements for each study would be dependent on the results of previous studies. Conducting and reporting EEM biological studies would involve submitting a study design, which includes a site characterization (see Annex F for additional information), conducting biological monitoring, conducting data assessment, and submitting an interpretive report.

Biological monitoring studies would consist of:

- a fish population study to assess fish health,
- a benthic invertebrate community study to assess fish habitat, and
- a mercury fish tissue study to assess the usability of fisheries resources by humans,

The table below presents the three biological monitoring study types, as well as the criteria which would trigger the requirement to conduct each study.

Table 1. Biological monitoring study types and associated triggers.

Study Type	**Trigger**
Fish Population	Effluent concentration in the exposure area is greater than 1% beyond 250 m from FDP
Fish Habitat (Benthic Invertebrate Community)	Effluent concentration in the exposure area is greater than 1% beyond 100 m from FDP
Mercury in Fish Tissue	Effluent characterization reveals an annual mean concentration of total mercury that is greater or equal to 0.10 µg/L

Mines would also be required to report the presence of any fish or invertebrate lesions, tumours, parasites or other abnormalities.

Biological monitoring studies would require sampling of the fish population and the benthic invertebrate community in areas exposed to effluent and in reference areas to assess effluent effects on specific indicators. The fish population study indicators would include age, weight at age, relative gonad size, relative liver size, and weight at length (condition). The benthic invertebrate community indicators would include density, evenness index, taxa richness and the similarity index. If a comparison between reference and exposure areas for a given indicator reveals statistical differences equal to or greater than the predefined critical effect size[3], further studies would need to be conducted by performing additional monitoring to investigate potential causes of the effects and solutions to mitigate these effects; Environment Canada 2010, Environment Canada 2012.

[3]A critical effect size (CES) is a threshold that indicates that an effect may be of high risk.

2.6 Non-discharging Facilities

If a facility has not discharged effluent since the previous biological monitoring study was conducted (e.g., a period of 36 consecutive months without discharge) the mine would not be required to conduct: the subsequent biological monitoring studies, SLT, effluent characterization and water quality monitoring. However, the EEM requirements would resume when the facility continues effluent discharge.

Part 3. Testing, Reporting, Closure Requirements, Public Availability of Information and Coming Into Force

3.1 Testing

Testing and reporting would be required in effluent for deleterious substances (described in part 1.4), non-acute lethality (described in part 1.5), pH range (described in part 1.6) and other information concerning effluent to be measured. Testing and reporting would also be required under EEM (described in part 2). A summary of testing requirements is located in Annex D.

3.1.1 Extension of Time to Collect Samples

ECCC proposes that the testing frequencies for collecting samples of effluent be extended if unforeseen circumstances cause safety concerns or access problems for the collection of samples. This extension would be conditional on the owner or operator of a mine notifying ECCC of the circumstances and when they expect to collect samples, as well as samples being collected without delay when the circumstances permit.

3.1.2 Analytical Requirements

The regulations would establish analytical requirements for the testing of effluent at all FDPs, water quality in the reference and exposure areas, and fish tissue. These requirements would include Method Detection Limits for substances, as well as precision and accuracy requirements. Proposed analytical requirements are outlined in Annex G. Additional requirements may be established for conducting selenium in fish tissue studies.

The regulations would establish effluent limits based on grab samples and monthly mean concentrations, and non-acute lethality requirements based on grab samples.

Focus question:

Effluent limits have been proposed on a grab and monthly mean basis. Another sampling technique, not currently proposed, is a composite sample. A composite sample is a mixture of grab samples taken at different times or locations over a defined period of time. Samples are pooled together to provide one sample. Composite sampling may also be taken by collecting a sample continuously over a defined period of time.

Do you support ECCC's proposal to establish requirements for effluent limits based only on grab samples and monthly means? If not, please explain.

3.2 Reporting and Recordkeeping

Reporting requirements and a defined frequency of reporting to ECCC would be established for the provisions of the regulations, including:

- identifying information about the owner or operator of the mine, including the name and address of both the owner and operator, and the parent company of the mine. This information would be submitted when a mine becomes subject to the regulations, when ownership of a mine in transferred, or any time this information changes;

- information pertaining to each FDP, including a general description, plans and specifications and its location, how it is designed and maintained, and the name of the receiving body of water;
- results of testing (e.g., deleterious substances, acute lethality testing results, pH);
- monitoring equipment information, including a description of the equipment and the results of calibration tests of the equipment;
- EEM requirements (effluent characterization, sublethal toxicity, water quality monitoring and biological monitoring studies); and
- Emergency Response Plans.

Mines may be required to keep records of the information reported. Additional requirements for reporting and recordkeeping may also be established.

3.3 Public Availability of Information

Information related to deleterious substance concentrations in effluent, pH, acute lethality, selenium in fish tissue, volume of effluent at all FDPs, as well as EEM would be made publicly available and accessible.

3.4 Closure

3.4.1 Key Definitions

- *Reclaimed Area*: means the surface area of a strip mine which has been re-contoured and on which revegetation (specifically, seeding or planting) work has been completed, and the surface area is no longer required for commercial operation.

- *Strip Mine*: a mine that is worked from the earth's surface by the stripping of topsoil and overburden in long cuts or strips in areas with flat terrain.

3.4.2 Reclaimed Areas at Strip Mines

ECCC proposes that reclaimed areas of strip mines be eligible to be excluded from the regulations.

Areas of land at strip mines that have already been reclaimed and are no longer depositing effluent are intended to be excluded from the regulations. For areas that become reclaimed after publication of the regulations, in order to be excluded from the regulations, the mine would be required to:

- provide written notice of the intention for the reclaimed area to become excluded from the regulations, where the written notice includes identification of the reclaimed area within the operations area;
- provide written notice that revegetation of the reclaimed area has been completed; and
- cease depositing effluent from the reclaimed area for a continuous period of 3 years.

Additional requirements for reclaimed areas are being considered. Once a reclaimed area of a strip mine has completed all of the above requirements, the area would be excluded from the

regulations. Despite ECCC's proposal for reclaimed land, effluent management infrastructure at strip mines (e.g., effluent from end pit lakes) would not be eligible for exclusion from the regulations.

Focus Question:

Do you support ECCC's approach for reclaimed areas at strip mines?

To further develop this approach, ECCC is seeking information related to progressive reclamation practices at strip (prairie) mines. Specifically, ECCC would like to better understand:

- how pre- and post-reclamation areas are differentiated in provincial coal mining regulations or permits;
- provincial requirements that mines must meet in order to become officially recognized as having reclaimed (portions of) their operations areas;
- time between reclamation activities (re-contouring, revegetation) and official recognition that an area is reclaimed;
- provincial requirements imposed on effluent during and following the reclamation process, including requirements for biological monitoring studies;
- effluent management infrastructure in place following reclamation (e.g., end pit lakes).

3.5 Coming into Force

The proposed regulations are expected to be published in the *Canada Gazette*, Part I (CGI) in 2018. Publication of the final regulations in *Canada Gazette*, Part II (CGII) would likely occur 12 to 18 months following CGI.

Most provisions of the regulations would come into force 3 years following CGII publication to allow time for facilities to meet the requirements. These include the requirement to collect and discharge all effluent through one or more FDPs, effluent limits for nitrate and TSS, the requirement for effluent to be within a defined pH range, and the requirement for effluent to be non-acutely lethal.

For selenium, the requirement to meet an effluent limit would come into force 6 years following CGII publication. A selenium in fish tissue study would be required within 3 years following CGII publication.

EEM provisions would come into force six (6) months following CGII publication.

Part 4. Existing Mountain Mines with Non-Point Source Discharge

Due to historical mine design and operational practices, an alternative regulatory approach is proposed to manage non-point source effluent for some existing mountain mines. The approach would include establishing a limit for deleterious substances in the receiving environment to be achieved at a specified location away from the point of entry of the non-point effluent.

This approach would not apply to mines that meet the definition of new mines or mine expansions.

4.1 Key Definitions

- *Environmental Compliance Point (ECP)*: means at least one point within the exposure area downstream of effluent deposited by a mine that is reflective of the maximum effluent contribution to the exposure area.

- *Mountain Mine*: means a surface coal mine where the coal seam or seams, prior to extraction, runs through a mountain, ridge or hill.

- *Non-Point Source Effluent*: means effluent that cannot be collected and discharged through a FDP.

4.2 Application process

ECCC proposes that the authorization for non-point source effluent would apply to the owner or operator of a mine if certain criteria are met concerning the nature of the non-point source effluent.

An application to the Minister of the Environment would be required. The deadline for submitting an application for such an authorization would be 6 months following publication of the regulations in CGII. Following this 6-month period, no mine would be eligible to apply for this authorization. The application would include, at a minimum, the following information:

- A detailed description of the mine, including:
  - Size of the mine, in square kilometres;
  - Location of the current operations area of the mine;
  - Site plan, which identifies:
    - the name and location of all known FDPs at the mine;
    - the name and location of all water bodies within the operations area, including identification of which water bodies are fish frequented;
    - the location of all mine waste; and
    - the location of all monitoring (including environmental effects monitoring) and/or compliance sites other than FDPs, and identification of all parameters and media monitored at each site;

- Description of the local geography, including:
  - topography, e.g., the elevation range of the mine; and
  - climate and hydrology.

- Effluent management practices, including:
  - A description of the effluent treatment systems in place and planned, with information such as design rated and nominal treatment capacities;
  - Volume of effluent treated at each FDP;
  - Identification of all non-point sources of effluent;
  - Effluent plume delineation conducted according to ECCC's *Revised Technical Guidance on How to Conduct Effluent Plume Delineation Studies*[4] and outlining locations that are reflective of the maximum effluent contribution to the exposure area;
  - Volume of non-point source effluent;
  - Volume of clean water diverted around the mine; and
  - A description of effluent (including non-point source effluent) authorized to be deposited by a provincial jurisdiction.

- Historical and current mine waste management practices, including:
  - Proximity of mine waste to water bodies; and
  - Size of mine waste areas (volume and area).

- A proposal for locations of environmental compliance points (ECPs), taking into consideration the effluent plume delineation and locations that are reflective of the maximum effluent contribution to the exposure area. The proposal should include a detailed analysis of all locations considered, and rationale for the ECPs proposed.

Additional information may be required.

4.3 Authorization

ECCC would review all applications, and may, upon receipt of an application, take the following action:

- Authorize a mine to deposit non-point source effluent from a mine; however, this would not be an authorization to stop using current FDPs; or
- Reject an application to authorize a mine to deposit non-point source effluent, in which case a mine would be required to discharge effluent through FDPs.

The authorization would be based on an approach that considers the surface area of current waste rock piles, the quantity of effluent currently not collected, and the distance of the nearest waste rock piles to a fish-bearing water body. To determine whether or not to authorize the deposit of non-point source effluent, ECCC proposes to establish a system of points that takes into account the current conditions at a mine. The proposed system is illustrated below:

[4] National Environmental Effects Monitoring Office. National Water Research Institute. Environment Canada (March 2003). https://www.ec.gc.ca/esee-eem/E93AE5BC-89C6-4701-AED7-FEF2A4AC2D7A/Plume_Delineation_Report_e.pdf

CONDITION	CRITERIA	AUTHORIZATION POINTS
Surface area of current waste rock piles (km^2)	< 1 km^2	0
	1 - 5 km^2	5
	>5 to <10 km^2	10
	≥ 10 km^2	20
Quantity of effluent not collected (m^3/year)	< 10,000 m^3/year	0
	10,000 - 250,000 m^3/year	5
	>250,000 to <500,000 m^3/year	10
	≥ 500,000 m^3/year	20
Distance of waste rock piles to nearest fish-bearing waterbody (m)	≥ 33 m	0
	>10 to <33 m	5
	1 - 10 m	10
	< 1 m	20

A mine would receive an authorization with a total of 45 authorization points or more. Conditions that current FDPs continue to be used would be included. In addition, the authorization would establish the location of the ECP(s).

4.4 Regulatory Requirements

The authorization would impose conditions on mine owners or operators associated with the deposit of non-point source effluent. All provisions proposed in Parts 1-3[5] of this document would also apply to mines who receive an authorization to deposit non-point source effluent, unless otherwise stated in Part 4 of this document. In particular, for TSS, nitrate, selenium and pH, a receiver-based compliance approach is being considered. Additional conditions would also apply to mines authorized to deposit non-point source effluent, as described below.

4.5 Environmental Compliance Points

The discharge of effluent from non-point sources means that establishing conditions associated with FDPs may not capture all effluent discharged from a mine. Therefore, ECCC proposes to establish Environmental Compliance Points (ECPs), in the receiving environment downstream of the mine. The location of ECPs would be established in the authorization to deposit non-point

[5]Mountain mines would not be eligible for provisions related to progressive reclamation as they would not meet the definition of strip mine.

source effluent and would be based on the information provided in the application, including effluent plume delineation.

The intent of establishing ECPs would be to manage all effluent coming from a mine. Therefore, more than one ECP may be established at each mine, e.g., where a mine discharges into multiple receiving environments. Additionally, more than one ECP may be established in the same receiving environment.

It is acknowledged that as mining progresses over time the location of ECPs could be subject to change. A mine would be required to submit information to ECCC periodically to support the location of its ECP.

Focus questions:

To further develop this approach, ECCC is seeking additional information:

- How many environmental compliance points should be required at a mine authorized to discharge non-point source effluent?
- For current provincial compliance points in the receiving environment, if they exist, how was the location determined?

4.6 Management of Effluent and Deleterious Substances

Additional conditions would also apply only to mines with an authorization to deposit non-point source effluent, as described below.

4.6.1 TSS

ECCC is considering that all effluent discharged through FDPs be required to comply with the proposed TSS effluent limit at all FDPs, as described in part 1.4.2.

In addition, mines authorized to discharge non-point source effluent would be required to meet a TSS limit at all ECPs. TSS at the ECP would not exceed a 10% change above the TSS concentration in the reference area of a mine at any time.

The approach is represented by the following example:

- A mine has the authorization to deposit non-point source effluent, at the end of 2019, and its ECP has been determined
- A mine measures a grab sample in its Reference Area having a TSS concentration of 50 mg/L
- The grab compliance limit at the ECP would be 50 + (50 x 10%) = 55 mg/L.

It is proposed that all samples collected in the reference area and at the ECP be taken no more than 24 hours apart.

4.6.2 Selenium

For mines authorized to deposit non-point source effluent, ECCC is proposing to establish effluent limits for selenium at FDPs only if there is no non-point source effluent discharged to that water body (i.e., no downstream ECP).

ECCC is considering a receiver-based approach to compliance for selenium at each ECP, including a series of increasingly stringent compliance limits every 5 years with a goal of meeting a selenium concentration of 2 µg/L in the local receiving water by 2050. This approach takes into consideration the lag time between the installation of treatment and other mitigation measures (e.g. clean water diversion, reclamation) and reductions in selenium concentration in the receiving environment. The proposed approach is as follows:

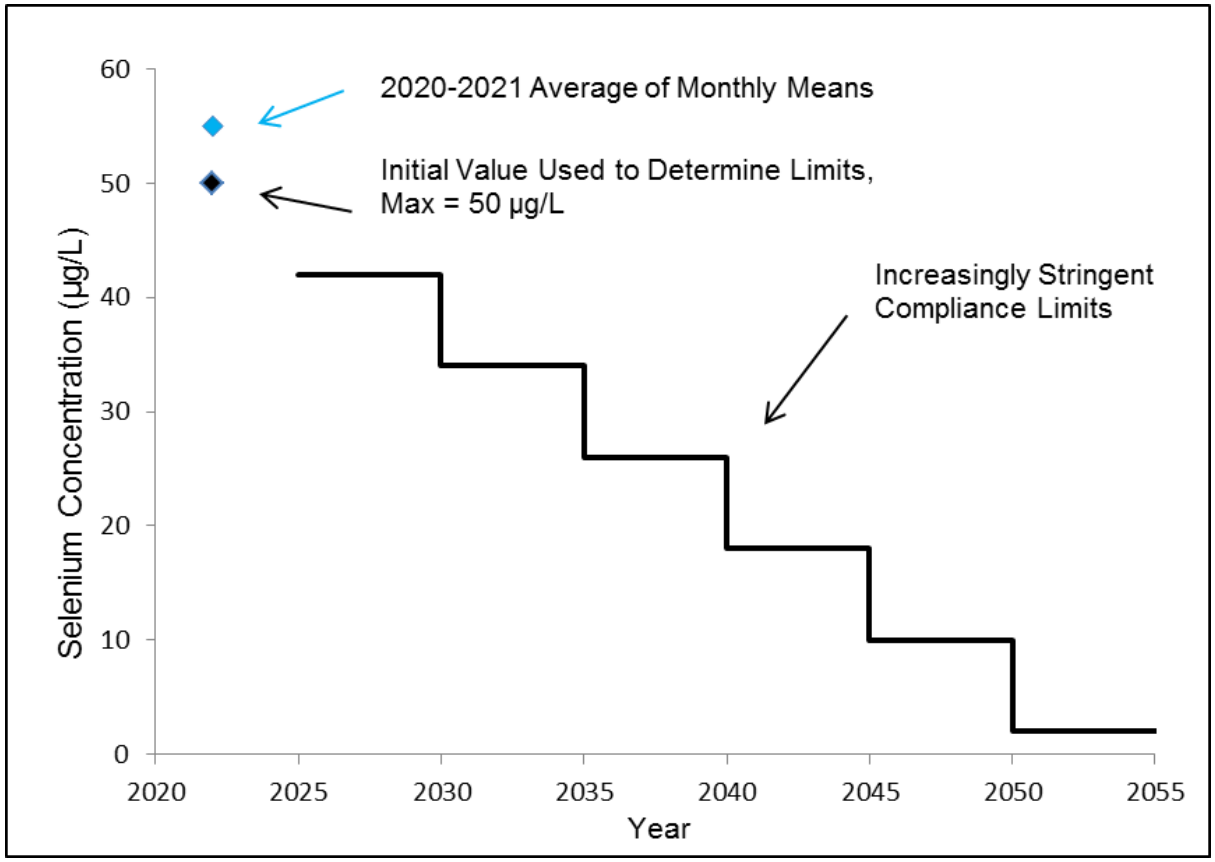
- Starting one year after publication of the regulations in CGII, the mine would determine its monthly mean concentration of selenium at each ECP for two years.
- The average of these monthly mean selenium concentrations would be considered as the mine's 'current performance' at that ECP.
- Within the next three years, a mine would be required to reduce the selenium concentrations by 8 µg/L from the current performance or from 50 µg/L (whichever is lower) at the ECP.
- A reduction in selenium concentration of 8 µg/L every 5 years, thereafter, would repeat for the next 25 years or until the monthly mean concentration at the ECP is less than or equal to 2 µg/L.
- The concentration of selenium would be required to be measured once per week at the ECP, with no opportunity for reducing frequency.
- Compliance would be based on a monthly mean limit and include a grab limit, which would be twice the monthly mean limit.

The approach is represented by the following example:

- The regulation is published in CGII in 2019
- A mine has the authorization to deposit non-point source effluent, at the end of 2019, and its ECP location has been determined
- From 2020 – 2021, the mine collects weekly selenium concentration data at its ECP
- Its current performance (average of all monthly mean selenium concentrations for two years) at its ECP is 55 µg/L
- Its current performance is > than 50 µg/L. Therefore, 50 µg/L is used as the starting point to determine the compliance limit at that ECP.
- The compliance limits would be as follows:

Timeframe	Determination of compliance limit		Compliance Limit (Monthly Mean)	Compliance Limit (Grab)
			µg/L	µg/L
2025 – 2029	8 µg/L reduction from initial concentration	= 50 µg/L - 8 µg/L	42	84
2030 – 2034	8 µg/L reduction from previous limit	= 42 µg/L - 8 µg/L	34	68
2035 - 2039	8 µg/L reduction from previous limit	= 34 µg/L - 8 µg/L	26	52
2040 – 2044	8 µg/L reduction from previous limit	= 26 µg/L - 8 µg/L	18	36
2045 - 2049	8 µg/L reduction from previous limit	= 18 µg/L - 8 µg/L	10	20
2050 onward	8 µg/L reduction from previous limit	= 10 µg/L - 8 µg/L	2	4

In this example, the following diagram represents the compliance limits:



4.6.3 Nitrate

For mines authorized to deposit non-point source effluent, ECCC is proposing to establish effluent limits for nitrate at FDPs only if there is no non-point source effluent discharged to that water body (i.e., no downstream ECP).

ECCC is considering a receiver-based approach to compliance for nitrate at each ECP, including a series of increasingly stringent compliance limits every 5 years with a goal of meeting 3 mg-N/L in the local receiving water. This approach takes into consideration the lag time between the installation of treatment and other mitigation measures and reductions in nitrate concentration in the receiving environment.

The proposed approach would follow the approach proposed for selenium, with an initial reduction of 2.2 mg-N/L from the current performance or from 16 mg-N/L (whichever is lower) at the ECP. The reduction would be followed by a 2.2 mg-N/L reduction every 5 years thereafter until 2050, or until the monthly mean concentration at the ECP is less than or equal to 3 mg-N/L. The timelines for establishing 'current performance' data, as well as timing of compliance limits, would align with those proposed for selenium.

4.6.4 pH

ECCC is considering that all effluent discharged through FDPs be required to comply with the proposed pH range at all FDPs, as described in part 1.6.

In addition, mines authorized to discharge non-point source effluent would be required to meet a pH range at all ECPs of between 6.5 and 9.0 at all times.

4.6.5 Non-Acute Lethality Requirements

ECCC proposes that all effluent discharged through FDPs be required to comply with the proposed non-acute lethality requirements at all FDPs, as described in part 1.5. In addition, all non-point source effluent would be required to be non-acutely lethal.

Focus question:

Do you support ECCC's proposed approach for mines authorized to discharge non-point source effluent?

4.7 Additional Conditions

All provisions described in this document as applying at FDPs, including proposed testing, reporting, analytical and administrative requirements would also apply at all ECPs. Analytical requirements (e.g., method detection limits) applying at the ECPs may be more stringent for mines authorized to discharge non-point source effluent than analytical requirements proposed for all mines.

ECPs would not be eligible for reduced frequency of testing for deleterious substances and pH. Testing for deleterious substances and pH would occur on a weekly basis. Monitoring the flow and calculation of loading of deleterious substances at each ECP would also be conducted on a

weekly basis. Mines would also be required to estimate the volume of non-point source effluent being deposited from the mine on a periodic basis. Additional detail on testing frequency requirements can be found in Annex E.

4.8 Environmental Effects Monitoring

All proposed EEM requirements in Part 2 of this document would also apply to existing mountain mines authorized to deposit non-point source effluent. However, the EEM approach would include additional requirements including increased frequency and additional sampling areas, as described below.

A table summarizing the required EEM studies for mines authorized to deposit non-point source effluent is provided in Annex F.

4.8.1 Key Definitions

- *Bank length:* means the length of the water body which receives effluent from the mine.

4.8.2 Environmental Monitoring Point

The discharge of effluent from non-point sources means that standard EEM methods for characterizing reference and exposure areas around a FDP may not capture all effluent discharged from a mine. Therefore, ECCC proposes to establish Environmental Monitoring Points (EMPs) in the receiving environment.

A first EMP would be located in the receiving water body where effluent (point source or non-point source) is initially detected. A second EMP would be required for mines that have a bank length that is equal to or greater than 20 km that receives effluent from the mine. This second EMP would be located between the first EMP and the ECP. The second EMP would be selected by the mine and would represent the area that is most adversely affected by the point-source and non-point source discharges.

4.8.3 Effluent Characterization and Water Quality Monitoring

As described in Part 2.2, water quality monitoring includes monitoring for all effluent characterization parameters, as well as monitoring of deleterious substances and pH. Coal mines authorized to deposit non-point source effluent would conduct effluent characterization and water quality monitoring as described in Parts 2.1 and 2.2.

In addition, these mines would also be required to sample water at all ECPs and EMPs, as well as the area surrounding the point of entry of effluent from the FDPs, and characterize them according to the effluent characterization parameters. Effluent characterization and water quality monitoring would be required monthly. Sampling at ECPs and EMPs would coincide with SLT and ECP monitoring for deleterious substances and pH. Water quality monitoring would also be required during biological monitoring studies.

4.8.4 Sublethal Toxicity Testing of Effluent

Sublethal toxicity (SLT) testing would be conducted as per Part 2.3. In addition, mines authorized to deposit non-point source effluent would also be required to conduct SLT at the most impacted ECP.

4.8.5 Biological Monitoring Studies

Mines authorized to deposit non-point source effluent would be required to conduct all biological monitoring study components (site characterization, fish population study, a mercury is fish tissue study and a benthic invertebrate community study) as outlined in Part 2.4. There would be no criteria that would trigger the requirement to conduct these studies. Mines would be required to conduct biological monitoring studies in reference and exposure areas, with sampling areas at ECPs and EMPs. Mines with a bank length equal to or greater than 20 km would be required to perform additional sampling at a second EMP located between their first EMP and the ECP.

4.9 Coming Into Force

The ability to apply for an authorization to deposit non-point source effluent would come into force at the time of CGII publication and would expire 6 months following CGII publication.

All provisions applying at each ECP, e.g., compliance limits, the requirement to be within a defined pH range; testing, reporting, analytical, and administrative requirements would come into force immediately upon being authorized to deposit non-point source effluent.

4.10 Summary

The following table compares the requirements proposed for mines who receive an authorization to deposit non-point source effluent and all other mines. Additionally, Annex H presents a conceptual location of FDPs, ECPs, reference areas and exposure areas.

Proposed Requirement	Mines Authorized to Discharge non-point source effluent	All other mines
Non-Acute Lethality	All Final Discharge points (FDPs) and All non-point source effluent	All FDPs
pH range	All FDPs and All Environmental Compliance Points (ECPs)	All FDPs
Monitor volume to within +/- 15%		
Limit for TSS		
Limit for nitrate	All ECPs	
Limit for selenium		
Study of selenium in fish tissue	Exposure Area	Exposure Area
Environmental Effects Monitoring (sublethal toxicity testing)	1 FDP, with potential for most adverse environmental impact and 1 ECP, with potential for most adverse environmental impact	1 FDP, with potential for most adverse environmental impact
Environmental Effects Monitoring (effluent characterization and water quality monitoring)	All FDPs All ECPs All EMPs Reference Area and Exposure Area	All FDPs Reference Area and Exposure Area
Environmental Effects Monitoring (biological monitoring studies):	Reference Areas and Exposure Areas (EMPs + ECPs)	Reference Area and Exposure Area
· Site characterization		
· Same core endpoints for fish and benthos		
· Two consecutive studies to confirm absence or presence of effects		
· Investigation of cause for confirmed effects		
· Investigation of solutions to mitigate effects		
· Final study upon notice that mine will be closing		
· Exemption from fish and benthos if effluent <1% at designated distance	None	Eligible for exemption
· Exemption from Mercury in Fish Tissue if concentration of total mercury is < 0.10 µg/L	None	Eligible for exemption

Part 5. Next Steps

The key targets for regulatory development are outlined below:

January 31, 2018	Interested parties are welcome to provide feedback on the *Proposed Approach for Coal Mining Effluent Regulations* to ECCC by January 31, 2018 (refer to the additional information below about providing feedback).
2018	Proposed coal mining effluent regulations under the *Fisheries Act* published in *Canada Gazette* Part I for a 60-day comment period.
2019	Final coal mining effluent regulations under the *Fisheries Act* published in *Canada Gazette* Part II.

Providing Feedback

We would like to invite all interested parties to provide comments and feedback on the proposed approach for coal mining effluent regulations as discussed in this document. Please send your feedback in writing to:

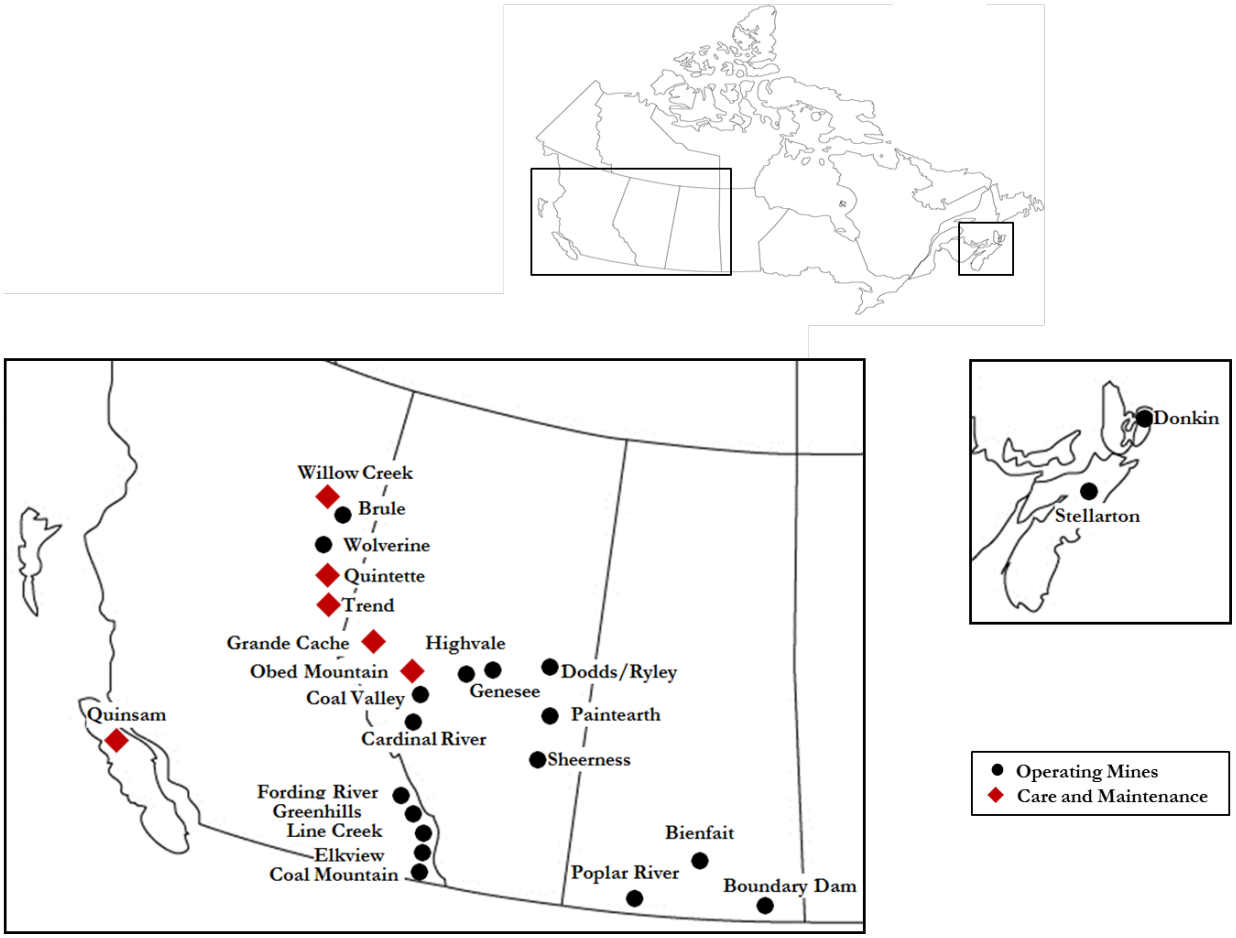
James Arnott

Mining and Processing Division
Environment and Climate Change Canada
Place Vincent Massey
351 Blvd St-Joseph, 18th Floor
Gatineau, Quebec K1A 0H3
E-mail: ec.ermc-cmrd.ec@canada.ca

ANNEXES

ANNEX A. Existing Coal Mines in Canada

There are 25 coal mines located in four provinces within Canada: British Columbia, Alberta, Saskatchewan and Nova Scotia. The following diagram shows the approximate locations of the coal mines in Canada, and provides an indication of their current operating status:



ANNEX B. Deleterious Substances and Effluent Limits

The impacts of selenium, nitrate and total suspended solids on the aquatic environment are described in the *Framework*. In proposing effluent limits, a number of key factors have been considered, including:

- Regulated substances and permitted effluent limits in other domestic and international coal producing jurisdictions;
- Performance of existing coal mines;
- Performance achieved by treatment technology that has been commercially proven at the industrial scale; and
- Potential aquatic effects of harmful substances.

ANNEX B1. Review of Effluent Limits in Other Jurisdictions

The purpose of this annex and the tables in Annexes B3-B5 is to provide interested parties with an overview of the key provisions in some of the existing environmental management instruments that apply to coal mines in other jurisdictions. These annexes are intended to be used as a quick reference and pertain only to limits for those deleterious substances proposed for federal regulation. The summaries provided herein are not meant to be exhaustive or comprehensive of the environmental management requirements in other jurisdictions.

Provincial Requirements

All provinces in which coal mines are located have established effluent limits, through regulations, guidelines, objectives and/or operating permits. Selenium, nitrate and TSS are the most common substances with effluent limits in provincial operating permits. For TSS, all but one coal mine have provincially permitted effluent discharge limits. For selenium and nitrate, provincially permitted effluent or receiving environment-based limits[6] are in place for almost half of existing mines. Several additional mines have been required to submit and implement Selenium Management Plans. The establishment of effluent limits in provincial operating permits provides an indication that these substances pose a risk to the aquatic environment.

Regulations, Guidelines and Objectives

Most provinces in which coal mines are located have regulations, guidelines or objectives for effluent quality in place for coal mining effluent. In BC, effluent quality objectives apply to mining and other industrial sectors. In Alberta, guidelines are specific to the coal mining sector. In Saskatchewan, regulations apply to the mineral industry.

Coal Mining Operating Permits

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 (EAs) prior to start-up, and they may also trigger federal EAs for such things as potential impact to fish habitat, impingement on or proximity to federal or First Nations lands, and involvement with cross-provincial or international transportation (e.g., ports).

Once operating, coal mines are subject to provincial regulatory requirements. These include standards for the effluent and receiving environment quality that are established through the provincial permitting process. Provinces also require that receiving waters downstream of the mine site meet the applicable ambient water quality guidelines. Many provinces have established processes whereby guidelines can be modified on a basin or site-specific basis into water quality objectives to address specific parameter issues such as relatively high background levels, or the need for lower targets to protect impaired systems or to address cumulative impact concerns. Objectives are specified in discharge permits, along with the associated monitoring requirements.

International Standards

[6] Includes compliance point limits, order station requirements and site-performance or reach-specific objectives

A key element of ECCC's approach to proposing effluent limits was to examine effluent limits that are currently in place in some major coal producing countries in the world, including the U.S., India, Germany, South Africa and Australia, all of which are among the top 10 global producers for coal and have readily available national baseline effluent standards. Regulatory approaches in non-major coal producing jurisdictions have also been reviewed. These jurisdictions include Spain, Portugal and Chile. The purpose of this analysis has been to help identify effluent discharge levels of proposed deleterious substances that are regulated in these jurisdictions.

United States

In the U.S., coal mining is regulated by a number of federal regulatory programs and associated state programs. The United States Environmental Protection Agency (USEPA) regulates water quality in the U.S. through the *Clean Water Act,* which provides a set of criteria for ambient water quality. The USEPA also establishes effluent standards for individual industries which are based on available technology, although the proponent may use whatever technology they wish in order to achieve these standards. Three levels of criteria are used: Best Practicable Control Technology Currently Available, Best Conventional Pollutant Control Technology and Best Available Technology Economically Achievable. New mining projects are held to Best Available Technologies standards or better. The provisions in Title 40: Protection of Environment Part 434, are applicable to discharges from the coal mining sector.

In additional to the national standards established in Title 40, the USEPA also uses the National Pollutant Discharge Elimination System (NPDES) which is a permitting approach that uses water quality-based limits as well as technology-based end of pipe limits. States may then adopt recommended NPDES limits in permits or legislation.

The activity surrounding the design, testing and data collection of effluent pollution control technologies is widespread and significant in the U.S. For this reason, ECCC focused its review on regulated and permitted effluent limits in major coal producing states. According to the U.S. Energy Information Administration (EIA), the top coal producing states in 2015 were Wyoming, West Virginia, Kentucky, Illinois, Pennsylvania and Montana (USEIA, 2016).

According to the EIA, in 2015 there were over 1,100 coal mines in the US. ECCC's review of NPDES permits targeted operating mines in the top coal producing states. Further, ECCC targeted mines with the largest production, and included a mix of surface and underground mines in various topographical regions. ECCC's review was limited to permits that were accessible and readily available.

Additional parameters of potential concern are proposed to be included in the Environmental Effects Monitoring (EEM) provisions (see Part 2). By monitoring these parameters, ECCC would be able to gather information which could help to determine if effluent limits for these parameters would be required in the future.

Given ECCC's regulatory objective, the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* provide a useful reference point. These guidelines are available on the Canadian Environmental Quality Guidelines page of the Canadian Council of Ministers of the Environment website. Guidelines exist for selenium, nitrate and TSS.

ECCC has obtained effluent concentration data for 21 coal mines across Canada, and has compared effluent concentrations of proposed deleterious substances to their respective guidelines. Generally speaking, effluent concentrations for selenium and nitrate for the sector substantially exceed their respective guidelines. These exceedances provide an indication that the release of these substances in coal mining effluent poses a risk to the aquatic environment.

ANNEX B2. Performance of Coal Mines in Canada

Coal Mining Effluent Data Analysis

ECCC has analyzed effluent data from the coal mining sector in Canada. Data were obtained from publicly available provincial databases, and through information requests with provincial governments and owners or operators of mines. The current analysis focused on the 4 most recent years for which ECCC received data, that is, 2012-2015. The quality of data (i.e., number of samples taken, number of years of data, substances monitored) varied depending on the mine.

The effluent data are presented in the chart below. Each point on the chart represents an annual average effluent concentration for a given FDP. FDPs with multiple years of data would be depicted as multiple data points on the chart. The bars on the chart represent the range of effluent concentrations at a FDP for a given year. The bars are intended to show the variability of the data.

The following Annexes provide a summary of coal mining effluent and receiving environment limits in other jurisdictions for selenium, nitrate and TSS; and show effluent concentration data analyzed by ECCC.

ANNEX B3. Total Suspended Solids

Where the following tables do not contain a numerical value, no limit has been identified.

Summary of Effluent Limits for TSS in Regulations, Guidelines and Objectives in Canadian Jurisdictions

Province	TSS Monthly Mean	TSS Grab	Reference
Unit	mg/L	mg/L	
Alberta	50	350	(AER, 2014)
BC	-	25-75	(BCMOE, 1979)

Summary of International Effluent Limits for TSS in Codes and Regulations

Jurisdiction	TSS Monthly Mean	TSS Grab or Daily Max	Reference
Unit	mg/L	mg/L	
United States[1]	35	70	(US, 2002)
India[2]	-	100	(India, 2000); (India, 1993)
South Africa	-	90	(SA, 1984)
Germany	-	80	(Germany, 2004)
Spain	-	150	(Spain, 1986)
Portugal	60	-	(Portugal, 1998)
Chile[1]	-	80-300	(Chile, 2010)

[1]Daily Maximum

[2]Limit for TSS for irrigation is 200 mg/L

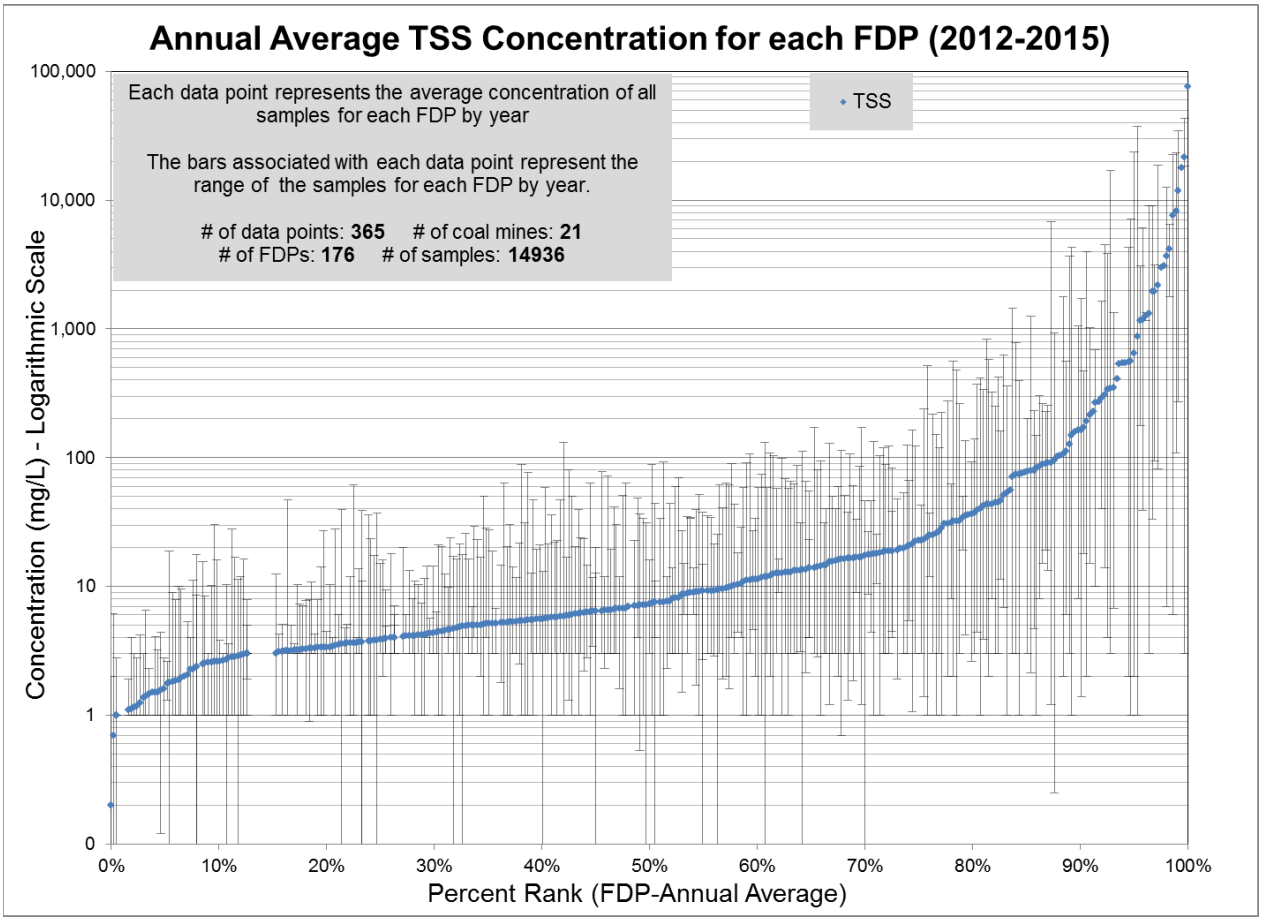
Summary of Effluent Limits for TSS in Provincial Mine Operating Permits

Permits Review - Effluent	TSS	
Number of Permits Reviewed	29	
Number of Permits with Limit	28	
Effluent Limits for Provincial Coal Mine Operating Permits	Monthly Mean	Daily Maximum or Grab
Unit	mg/L	
Lowest Limit	25	10
Median Limit	50	50
Maximum Limit	50	350

Summary of US Effluent Limits for TSS in Mine Operating Permits

US Permits - Effluent	TSS	
Number of Permits Reviewed	29	
Number of Permits with Limit	29	
Effluent Limits for US Coal Mine Operating Permits	**Monthly Mean**	**Daily Maximum or Grab**
Unit	**mg/L**	
Lowest Limit	35	70
Median Limit	35	70
Maximum Limit	100	300

Performance of Canadian Coal Mining Effluent - TSS



ANNEX B4. Total Nitrate

Where the following tables do not contain a numerical value, no limit has been identified.

Summary of Effluent Limits for Nitrate in Regulations, Guidelines and Objectives in Canadian Jurisdictions

Province	Nitrate Monthly Mean	Nitrate Grab	Reference
Unit	mg-N/L	mg-N/L	
Alberta	Implement Best Management Practices		(AER, 2014)
BC	-	10-25[1]	(BCMOE, 1979)

[1]Nitrate/Nitrite

Summary of International Effluent Limits for Nitrate in Codes and Regulations

Jurisdiction	Nitrate Monthly Mean	Nitrate Grab	Reference
Unit	mg-N/L	mg-N/L	
India[1]	-	10	(India, 2000); (India, 1993)
Australia (Queensland)[2]	-	1.1	(ECCC, 2017)
Spain	-	12	(Spain, 1986)
Portugal	11.3	-	(Portugal, 1998)

[1]Limit for nitrate based on general standards for all industrial sectors.

[2]Effluent trigger level to investigate impacts

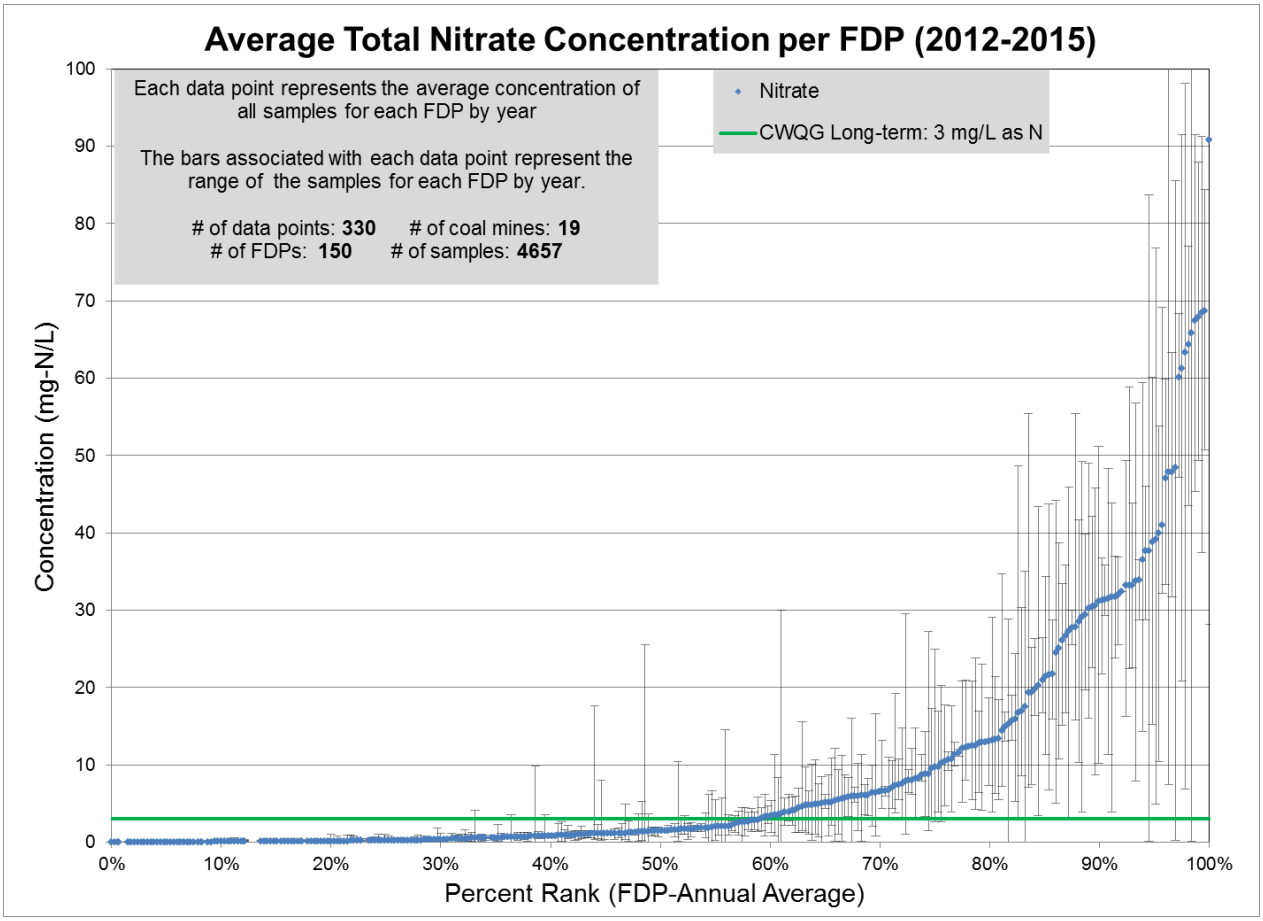
Summary of Effluent Limits for Nitrate in Provincial Mine Operating Permits

Permits Review - Effluent	Nitrate	
Number of Permits Reviewed	29	
Number of Permits with Limit	3	
Number of Mines Represented by Permits with Limit (some permits cover multiple mines)	6	
Effluent Limits for Provincial Coal Mine Operating Permits	**Monthly Mean**	**Daily Maximum or Grab**
Unit	**mg-N/L**	
Lowest Limit	10	3
Median Limit	15	3
Maximum Limit	20	141

Summary of US Effluent Limits for Nitrate in Mine Operating Permits

No US permit reviewed has limits for nitrate.

Performance of Canadian Coal Mining Effluent - Nitrate



CWQG means Canadian Water Quality Guideline for the Protection of Aquatic Life

ANNEX B5. Total Selenium

Where the following tables do not contain a numerical value, no limit has been identified.

Summary of Effluent Limits for Selenium in Regulations, Guidelines and Objectives in Canadian Jurisdictions

Province	Selenium Monthly Mean	Selenium Grab	Reference
Unit	µg/L	µg/L	
BC	-	50-500[1]	(BCMOE, 1979)

[1]Dissolved

Summary of International Limits for Selenium in Codes and Regulations

Jurisdiction	Selenium Monthly Mean	Selenium Grab	Reference
Unit	µg/L	µg/L	
India[1]	-	50	(India, 2000); (India, 1993)
South Africa	-	50	(SA, 1984)
Australia (Queensland)[2]	-	10	(ECCC, 2017)
Spain[3]	-	30	(Spain, 1986)
Chile[4]	-	10	(Chile, 2010)

[1]Limit selenium based on general standards for all industrial sectors.

[2]Effluent trigger level to investigate impacts

[3]Dissolved

[4]Maximum daily concentration

Summary of Effluent Limits for Selenium in Provincial Mine Operating Permits

Permits Review - Effluent	Selenium	
Number of Permits Reviewed	29	
Number of Permits with Limit	3	
Number of Mines Represented by Permits with Limit (some permits cover multiple mines)	6	
Effluent Limits for Provincial Coal Mine Operating Permits	**Monthly Mean**	**Daily Maximum or Grab**
Unit	**mg-N/L**	
Lowest Limit	10	*16*
Median Limit	20	168
Maximum Limit	70	320
Permits with no limit, but with Selenium Management Plan	4	

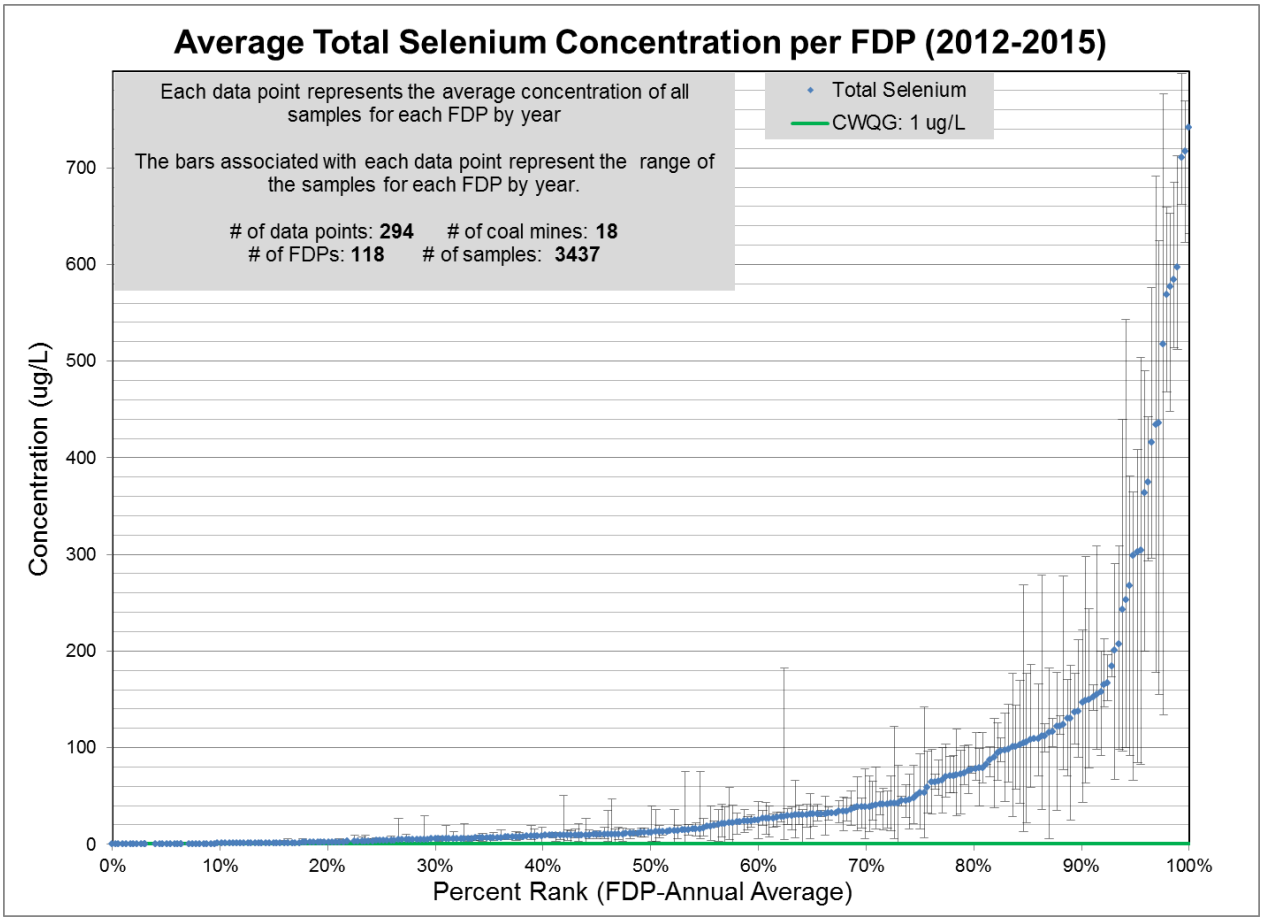
Italicized means dissolved

Summary of US Effluent Limits for Selenium in Mine Operating Permits

US Permits - Effluent	Selenium	
Number of Permits Reviewed	29	
Number of Permits with Limit	13	
Effluent Limits for US Coal Mine Operating Permits	**Monthly Mean**	**Daily Maximum or Grab**
Unit	**µg/L**	
Lowest Limit	1.6	*0.25*
Median Limit	5	20
Maximum Limit	46	79

Italicized means dissolved

Performance of Canadian Coal Mining Effluent - Selenium



CWQG means Canadian Water Quality Guideline for the Protection of Aquatic Life

ANNEX B6. Management of Deleterious Substances

Best Management Practices

Best management practices may be used in order to reduce or limit or eliminate the contact of clean water with mining waste and activities. Best management practice may include the diversion of clean waters, progressive reclamation, use of covers and geomembranes, and refined mining practices.

As an example, the primary method to reduce the concentration of nitrates and ammonia in effluent is to practice best management practices for explosive use. Lower quantities of explosives and proper detonation will reduce the residual amount that may end up in water and snow melt.

Geomembranes

Geomembranes may be used to cover waste piles in order to prevent all or part of the water and snow melt from becoming contaminated in the first place. This reduces the level of active treatment needed for contaminated water.

Total Suspended Solids Treatment Technology

The most commonly used effluent treatment system at coal operations to treat for TSS is a pond-based system (i.e., sedimentation pond). In pond-based systems, the water is collected from the mining site into a pond where the water is allowed to accumulate and stay in order for the suspended solids to settle. Most, if not all, coal mines in Canada already employ some form of this treatment. Reagents such as coagulants and flocculants can be added at various stages to aid in the settling and removal of solids. Membrane filtration is another method that may be used to remove suspended solids.

Selenium Treatment Technology

There are currently three main categories of active treatment technologies available for the treatment of selenium, these include: bioreactors, ion exchange systems and filtration membranes.

Bioreactors

Bioreactors use microorganisms to alter the waste stream to remove contaminants, in this case selenium. There are various configurations and designs available for bioreactors (ponds, tanks, trenches). The designs that have demonstrated the ability to successfully treat selenium to low concentrations generally consists of tank vessel designs. Bioreactors are currently used in treatment operations for many mining sectors and subsectors in North America, including coal mining. There is one bioreactor currently operational at a coal mine in British Columbia.

Ion Exchange Systems

Ion exchange is a treatment option that can be used to treat selenium. Common substances used for the exchange and precipitation of selenium include iron and sulphur as they have similar chemical properties to selenium and a higher electronegativity.

Filtration Membranes

Membranes are typically applied in the treatment of selenium in conjunction with other treatment methods. The ion exchange treatment is an excellent example of this, where the precipitate (waste) can be collected through membrane filtration.

Nitrate Treatment Technology

In effluent, the technologies available to treat nitrates are the same technologies available to treat selenium. These include bioreactors/biological treatments and ion exchange, and in other industries, reverse osmosis has also been used.

ANNEX C. Selenium in Fish Tissue

Selenium can be found in many chemical forms within the aquatic environment. The various chemical forms of selenium depend on the environmental characteristics of the receiving media and exhibit different properties with regard to sorption, bioavailability, mobility and toxicity (Environment Canada, 2015).

The form of selenium that aquatic organisms are exposed to is important, because bioavailability varies between selenium species as well as the receiving environment (lentic or lotic). Despite this, there is a general agreement that freshwater fish appear more sensitive to selenium than any other taxa of aquatic organisms. The concentration of selenium in fish tissue is an indicator of selenium bioavailability, and also represents accumulation from all possible exposure pathways and selenium species.

As described in the draft screening assessment report for selenium and its compounds, published by ECCC and Health Canada in July 2015 in *Canada Gazette*, Part I (Environment Canada, 2015), a significant correlation of selenium concentration measured in fish ovaries and eggs with effects endpoints make them accurate predictors of selenium toxicity to fish. The Predicted No-Effect Concentrations (PNEC) for selenium in fish eggs and ovaries was derived using a chronic toxicity assessment that is based on a range of reproductive impairment endpoints for various freshwater fish species. The PNEC is based on the 5^{th} percentile hazardous concentration (HC_5), which is understood to be protective of most freshwater fish species.

The PNEC may be subject to change with publication of the final screening assessment report for selenium and its compounds. It is proposed that the fish tissue trigger align with the PNEC in the final screening assessment report, which is anticipated to be published in the coming months.

Selenium criteria for the protection of aquatic life (fish and water)

Jurisdiction	Selenium Guidelines					
	Fish (egg/ovary)	Fish (muscle)	Fish (whole body)	Water (lentic)	Water (lotic)	Reference
Unit	µg/g dry weight			µg/L		
Canada (PNEC for fish, Canadian Council of Ministers of the Environment Water Quality Guideline for the Protection of Aquatic Life for water)	11.8	N/A	2.9	1	1	(Environment Canada, 2015)
United States Environmental Protection Agency	15.1	11.3 (skinless, boneless filet)	8.5	1.5 (30 day)	3.1 (30 day)	(USEPA, 2016)
British Columbia	11	N/A	4	2	2	(BCMOE, 2014)
Kentucky (proposed)	19.3	N/A	8.6	5	5	(Payne, 2013)
West Virginia	15.8	N/A	N/A	5	5	(WVDEP, 2017)

N/A means not available

ANNEX D. Proposed Testing Frequency for All Mines

PROPOSED PROVISION	REGULAR FREQUENCY	REDUCED FREQUENCY	INCREASED FREQUENCY	NOTES
Selenium, nitrate testing	**Weekly** [≥ 24 hours apart]	**Quarterly** [≥ 1 month apart] • If monthly mean concentration at FDP <10% of monthly mean limit for 12 consecutive months		Notify Minister of Environment in writing, ≥30 days in advance of reduction
TSS testing	**Weekly**			
pH and temperature testing	**Weekly** [≥ 24 hours apart] Record pH at the time of collection	**Quarterly** [Temperature only - according to non-acute lethality testing frequency]		pH and temperature must be measured from the same sample as collected for selenium and nitrate measurement and non-acute lethality testing measurement
Acute Lethality testing	**Monthly** [≥15 days apart]	**Quarterly** [≥45 days apart] • Not acutely lethal for 12 consecutive months • Notify the Minister of the Environment in writing ≥ 30 days prior • Select sampling date ≥ 30 days prior	**Twice a month**, no less than 7 days apart, • If effluent determined acutely lethal • Also conduct effluent characterization on aliquot of each sample. • Resume testing at regular frequency after 3 consecutive tests are passed.	Collect sufficient volume for effluent characterization Record temperature and pH at time of the sample's collection
Volume measurement	**Monthly**			Record in m^3
Effluent Characterization	**Quarterly** [≥1 month apart]			Aliquot of effluent selenium, nitrate testing Mercury can be discontinued if [Hg] <0.1 µg/L in 12 consecutive samples
Sublethal Toxicity testing	**2x per year** for three years	**Quarterly** using the most responsive test after 3rd year		Aliquots from FDP with potentially the most adverse impact
Water Quality testing	**Quarterly** [≥1 month apart]			While mine is depositing effluent, on samples of water from exposure area at each FDP (point of entry) & reference area(s) associated Same time as biological monitoring

ANNEX E: Testing Frequency for Mines Authorized to Discharge Non-Point Source Effluent

This Annex relates to mines authorized to discharge non-point source effluent and the testing frequency requirements for all Environmental Compliance Points (ECP), as well as Environmental Effects Monitoring requirements

PROPOSED PROVISION	REGULAR FREQUENCY	REDUCED FREQUENCY	NOTES
Selenium, nitrate, TSS testing	**Weekly** [≥ 24 hours apart]		For TSS, must test reference area and Environmental Compliance Point (ECP) no less than 24 hours apart
pH and temperature testing	**Weekly** [≥ 24 hours apart] Record pH at the time of collection		pH and temperature must be measured from the same sample as collected for selenium, nitrate and TSS measurement and non-acute lethality testing measurement
Volume measurement	**Weekly** [≥ 24 hours apart]		Record in m^3
Effluent Characterization	**Monthly** [≥15 days apart]		Aliquot of effluent selenium, nitrate and TSS testing; All FDPs; All ECPs
Sublethal Toxicity testing	**2x per year** for three years	**Quarterly** using most responsive test after 3rd year	Aliquots from FDP and ECP with potentially the most adverse impact
Water Quality testing	**Monthly** [≥15 days apart]		On samples of water from exposure area at each FDP (point of entry), ECPs, EMPs & reference area(s) associated Same time as biological monitoring

ANNEX F. Environmental Effects Monitoring Studies

LIST OF ACRONYMS

BIC: benthic invertebrate community
CES: critical effect size
EC_{25}: 25% effect concentration
ECP: environmental compliance point
EEM: environmental effects monitoring
EMP: environmental monitoring point
FDP: final discharge point
IC_{25}: 25% inhibition concentration
IOC: investigation of cause
IOS: investigation of solutions
MMER: *Metal Mining Effluent Regulations*
SD: standard deviation
SLT: sublethal toxicity test

Effluent Characterization and Water Quality Monitoring

Data generated from effluent characterization and water quality monitoring would be used to:

- provide the necessary supporting data to understand acute lethality testing results;
- provide the necessary supporting data to understand sublethal toxicity testing results;
- provide the necessary supporting data to interpret the results of biological monitoring studies;
- help identify the causes of effects identified during biological monitoring studies; and
- provide important information to ECCC about the occurrence of potential contaminants of concern in effluent from mine sites across Canada.

The proposed effluent characterization and water quality parameters are included in table F1.

Table F1. Analytical parameters measured for effluent characterization and water quality monitoring

Effluent Characterization parameters	Water Quality parameters (EEM and Deleterious Substances)
Electrical conductivity	Electrical conductivity
Temperature	Temperature
Aluminum	Aluminum
Ammonia	Ammonia
Arsenic	Arsenic
Calcium	Calcium
Cadmium	Cadmium
Carbon dioxide, dissolved	Carbon dioxide, dissolved
Chromium	Chromium
Cobalt	Cobalt
Copper	Copper
Lead	Lead
Iron	Iron
Mercury*	Mercury
Manganese	Manganese
Nickel	Nickel
Nitrite	Nitrite
Phosphorus	Phosphorus
Sulphate	Sulphate
Total Dissolved Solids	Total Dissolved Solids
Uranium	Uranium
Zinc	Zinc
Hardness	Hardness (freshwater, estuarine)
Alkalinity	Alkalinity (freshwater, estuarine)
	Total selenium
	pH (freshwater, estuarine)
	Total nitrate
	Total suspended solids
	Salinity (estuarine, marine)

*The recording of the concentration of total mercury in effluent may be discontinued if that concentration is less than 0.10 μg/L in 12 consecutive samples and if the mine collects all effluent and discharges through final discharge points.

Sublethal toxicity

Sublethal toxicity (SLT) testing would be conducted according to the methods referred to in the regulations. The proposed sublethal toxicity test methods would be the same as in the *Metal Mining Effluent Regulations (MMER)* and are outlined in Table F2.

ECCC is proposing to require mines to conduct all SLT tests twice per calendar year for the first three years. Using the test results from the first three years, mines would then be required to determine the most responsive test[7]. In all subsequent years, mines would be required to conduct the most responsive test four times a year.

[7] The most responsive test would be selected by identifying the lowest geometric mean IC_{25} or EC_{25}.

Table F2: Proposed required sublethal toxicity tests and methodologies

Test description	Receiving Environment	Test species
Fish early life stage development	Marine	Inland Silverside (*Menidia beryllina*)[a] or Topsmelt (*Atherinops affinis*) [a]
	Freshwater	Fathead Minnow (*Pimephales promelas*)[1bc] or Rainbow Trout (*Oncorhynchus mykiss*) [bc]
Invertebrate reproduction	Marine	Echinoids (sea urchins or sand dollars)[d]
	Freshwater	Water Flea (*Ceriodaphnia dubia*)[e]
Plant and algae toxicity	Marine - algae	Barrel Weed (*Champia parvula*)[f]
	Freshwater - algae	Green Algae (*Pseudokirchneriella subcapitata*)[gh]
	Freshwater - plant	Lesser Duckweed or Common Duckweed (*Lemna minor*)[i]

1. Rainbow Trout are used where Fathead Minnows are not an indigenous species

a. Reference Method EPA/821/R-02/014. Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms. U.S. EPA

b. Report EPS 1/RM/22. Biological Test Method: Test of Larval Growth and Survival Using Fathead Minnows. ECCC

c. Reference Method EPS1/RM/28. Biological Test Method: Toxicity Tests Using Early Life Stages of Salmonid Fish (Rainbow Trout). ECCC

d. Report EPS 1/RM/27. Biological Test method: Fertilization Assay using Echinoids (Sea Urchins and Sand Dollars). ECCC

e. Report EPS 1/RM/21. Biological Test method: Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*. ECCC

f. Reference Method EPA/600/R-95-136. Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms. U.S. EPA

g. Report EPS 1/RM/25. Biological Test Method : Growth Inhibition Test using a Freshwater Alga ECCC

h. Methode de référence http://www.ceaeq.gouv.qc.ca/methodes/pdf/MA500Psub10.pdf. Détermination de la toxicité : inhibition de la croissance chez l'algue *Pseudokirchneriella subcapitata*. MDDELCC[2]

i. Reference Method EPS 1/RM/37. Biological Test Method: Test for Measuring the Inhibition of Growth Using the Freshwater Macrophyte, *Lemna minor*. ECCC

Biological monitoring

Mines would need to consider all relevant data, analysis, scientific information, and Indigenous Knowledge for the purpose of meeting the biological monitoring study requirements.

Site characterization

Site characterization information would be submitted as part of the EEM study design. The requirements for site characterization would be based on the proposed MDMER. For the first EEM study design, site characterization information would be included in detail. For subsequent EEM studies the site characterization information would be submitted in summary format, with new information updated in detail. In most cases, mines would have most site characterization information available from previous assessments and historical studies. Site characterization information would be used to identify suitable sampling areas that have similar habitats in the exposure and reference

areas, and to obtain information on other discharges and confounding factors that may affect the interpretation of data obtained from those areas. The proposed requirements for site characterization would be:

- a description of the manner in which the effluent mixes within each exposure area; where applicable estimate concentration of effluent in water at 100m and 250m from every point at which effluent enters the area from a discharge point;
- a description of the reference and exposure areas where the biological monitoring studies would be conducted, if required, that includes information on the geological, hydrological, oceanographical, limnological, chemical and biological features;
- the type of production processes and environmental protection practices used by the mine;
- a description of any anthropogenic, natural or other factors that are not related to the effluent but that may reasonably be expected to affect the results of any biological monitoring study, if required;
- information on the spatial distribution of calcification in the exposure area and how that impacts the study design; and,
- any additional information that would enable a determination as to whether studies would be conducted in accordance with generally accepted standards of good scientific practice;
- if studies are not required, a confirmation that triggers are not met.

Biological monitoring (fish, fish habitat, fish tissue)

Coal mines would be required to conduct biological monitoring under certain conditions and, if required, sampling would be conducted at no less than one reference and one exposure area or along a gradient with decreasing effluent concentrations.

Data collected on specific-effect endpoints (listed in table F3 and table F4) would be assessed to determine if statistical differences are present in order to establish if there are any effects on the indicators. An “effect” on the fish population or benthic invertebrate community would be defined as a statistical difference between data collected in exposure and reference areas, or in sampling areas within an exposure area, where there are gradually decreasing effluent concentrations at increasing distances from the effluent discharge. An effect on fish tissue from mercury would be defined as a concentration of mercury that exceeds 0.5 µg/g wet weight in fish tissue taken from an exposure area and is statistically significant from and higher than the total mercury concentration in fish tissue that is taken from a reference area.

In addition to the fish indicators, mines would be required to identify the presence of any lesions, tumors, parasites or other abnormalities present. Sediment would be sampled and the total organic carbon content, particle size distribution would be determined and reported during the benthic invertebrate study.

Table F3. Effect indicators and endpoints for fish population study

Effect Indicators	Effect Endpoints
Growth (energy use)	Size-at-age (body weight relative to age)
Reproduction (energy use)	Relative gonad size (gonad weight to body weight)
Condition (energy storage)	Condition (body weight to length) Relative liver size (liver weight to body weight)
Survival	Age

Table F4. Effect indicators and endpoints for benthic invertebrate community study

Effect Indicators	Effect Endpoints
Total benthic invertebrate density	Number of animals per unit area
Evenness index	Simpson's evenness
Taxa richness	Number of taxa
Similarity index	Bray-Curtis index

To focus biological monitoring investigation efforts where large effects are observed, Critical Effect Sizes (CES) (table F5), defined as thresholds above which effects may be indicative of a potential higher risk to the environment, have been developed for some fish population and benthic invertebrate indicators. These CES thresholds would be used to determine when mines are required to further investigate the cause and identify potential solutions for confirmed effects[9] and when mines could decrease monitoring effort.

Table F5. Proposed paths forward within the EEM program for benthic invertebrate community and fish population studies based on results of studies and assigned CES's.

Phase 1 results	Phase 2 results	Subsequent phase
No effect	No effect	Reduced biological field monitoring frequency (72 months)
Effect below CES	No effect	
No effect	Effect below CES	
Effect below CES	Effect below CES	
No effect	Effect above or equal to CES	Standard biological field monitoring (36 months) or Investigation of Cause (IOC) followed by Investigation of Solutions (IOS):
Effect below CES	Effect above or equal to CES	Investigation of Cause (IOC) (36 months); concurrently or followed by Investigation of Solutions (IOS)
Effect above or equal to CES	Effect below CES	
Effect above or equal to CES	Effect above or equal to CES	

[9] An effect is qualified as confirmed when there is a statistically significant difference in two consecutive studies for a given indicator, and this significant difference must be in the same direction for both studies.

After a facility completes IOS the facility would return to standard biological monitoring and submits an interpretive report in 36 months.

The biological monitoring study requirements would be decoupled. For example, if a facility confirms no effects in their benthic study but has an effect equal or greater than CES for in their fish study the next interpretive report containing the benthic component would be due in 72 months and an interpretive report containing the fish component would be due in 36 months.

Table F6. Critical effect sizes for metal mining environmental effects monitoring program.

Fish Effect Endpoints	CES[1]	Benthic Effect Endpoints	CES[1]
Weight-at-age	± 25%	Density	± 2SD
Relative fish gonad size	± 25%	Simpson's Evenness	± 2SD
Relative liver size	± 25%	Taxa Richness	± 2SD
Condition	± 10%		
Age	± 25%		

[1] Differences in fish population effect endpoints are expressed as percentage (%) of reference mean, while differences in benthic effect endpoints are expressed as multiples of within-reference-area standard deviations (SDs).

Environmental Effects Monitoring for Existing Mountain Mines with Non-Point Source Discharge

The EEM approach for mines who receive authorization to deposit non-point source effluent would include additional conditions including increased frequency and additional sampling areas. These conditions are summarized in Table F7.

Table F7. Sampling location (excluding FDPs) for coal mines authorized to discharge non-point source effluent.

Location		Effluent Characterization and Water Quality Monitoring	Sublethal Toxicity	Benthic Invertebrate Community		Fish Population		Mercury in Fish Tissue
				<20 km bank length	≥20 km bank length	<20 km bank length	≥20 km bank length	
Exposure area	First EMP	✓	-	-	✓	-	✓	✓
	Second EMP	✓	-	-	✓	-	✓	✓
	ECP	✓	✓	✓	✓	✓	✓	✓
Reference Area		✓	-	✓	✓	✓	✓	✓

Note: for FDP related monitoring see paragraphs on effluent characterization, water quality monitoring and sublethal toxicity testing.

ANNEX G. Proposed Analytical Requirements

Analytical requirements, including Method Detection Limits (MDL), precision and accuracy requirements are proposed to be included in the regulations. The Method Detection Limit (MDL) is the minimum quantity of an analyte (e.g., effluent) that should be observed to justify the claim to have detected the analyte with a specified risk (normally 5% or 1%) of making a false detection. Precision and accuracy can be defined as follows:

- *Precision*: Relative standard deviation at concentrations 10 times above the MDL.
- *Accuracy*: Analyte recovery at concentrations above 10 times the MDL.

For all mines, at a minimum, the following analytical requirements are proposed for selenium, nitrate, TSS and pH:

Analytical Requirements - Effluent and Water Quality			
Substance/pH	**Precision**	**Accuracy**	**MDL**
Nitrate	10%	100 ± 10%	0.3 mg/L, expressed as nitrogen (N)
pH	0.1	0.1	Not Applicable
Selenium	10%	100 ± 10%	0.0005 mg/L
TSS	15%	100 ± 15%	2.000 mg/L

Analytical Requirements - Fish Tissue			
Substance	**Precision**	**Accuracy**	**MDL**
Selenium	10%	100 ± 10%	0.5 µg/g, dry weight

In addition, ECCC will be establishing analytical requirements for all parameters proposed to be monitored.

ANNEX H. Conceptual Diagrams of Coal Mines

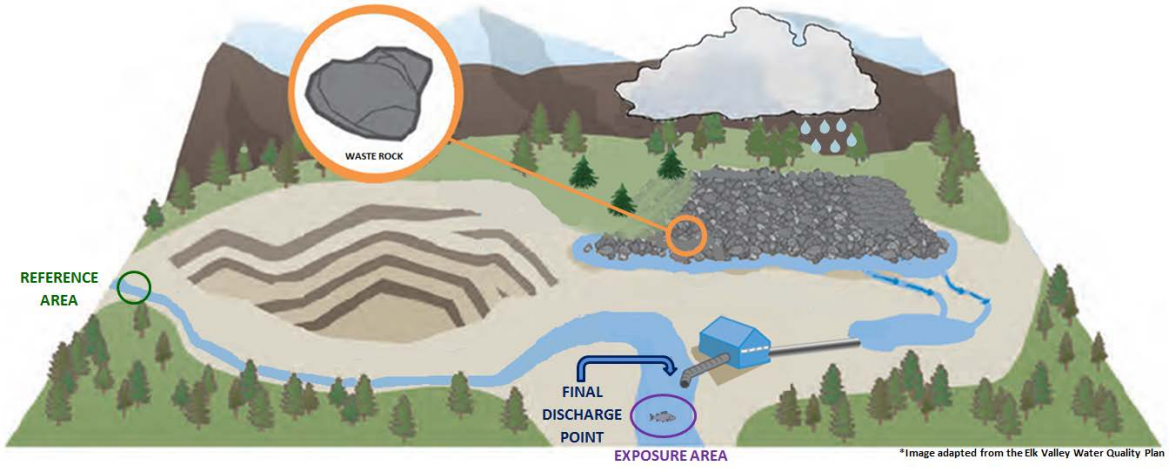


Figure H1. All coal mines.

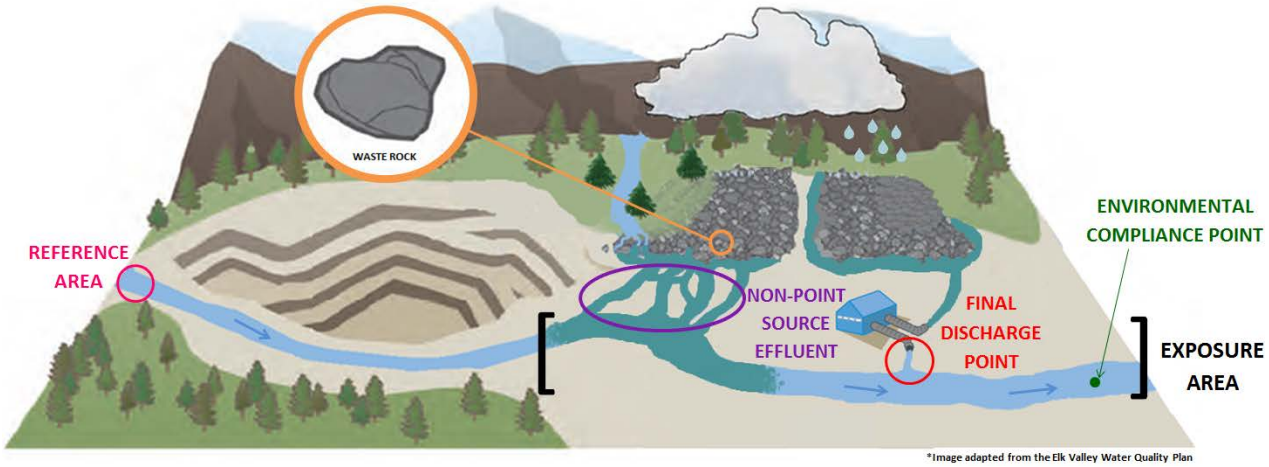


Figure H2. Existing mountain mines authorized to discharge non-point source effluent.

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