

# **MANAGING SOIL AND GROUNDWATER RISKS AT MINE SITES: A BRITISH COLUMBIA REGULATORY OVERVIEW**

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## **ABSTRACT**

This intent of this paper is to map out the regulatory process for managing soil and groundwater contamination during the operation and reclamation life stages of a mine in British Columbia.

There are numerous Federal and Provincial acts and regulations, protocols, guidelines and codes, that set out legal requirements for environmental remediation, risk assessment and risk management at a mine site. There are also multiple regulatory authorities involved in managing environmental protection at mine sites in British Columbia including the British Columbia Ministry of Energy, Mines and Petroleum Resources, the Ministry of Environment and Climate Change Strategy and Fisheries and Oceans Canada. Depending on the life stage of the mine and the activities being permitted, there are differences in the environmental regulatory process between active mines, suspended operations and abandoned mines. This paper will provide an overview of the regulatory permit, authorization, reporting and notification requirements under the different scenarios that can be encountered when managing contaminated soil and groundwater at a mine site.

The intent of this paper is not to provide a legal interpretation of the law related to environmental management at a mine sites, but rather to provide insight to the regulatory process for managing and remediating contamination at these sites.

**Keywords:** mine site, contamination, risk assessment, remediation, regulations

## **INTRODUCTION**

The remediation of contamination at a mine site in British Columbia is governed by both Federal and Provincial regulations and involves multiple jurisdictions. In addition to the acts and regulations there are numerous protocols and codes that must be adhered to and guidance documents that are expected to be followed unless there is justification to deviate from a recommended practice. There can also be overlapping Federal and Provincial requirements placed on a mine site. An environmental practitioner is expected to provide sound advice to mining companies wishing to comply with environmental acts and regulations with respect to the remediation and management of contamination at a major mine site.

The following sections will outline the various major acts and regulations involved in the remediation and management of contamination at mine sites. How they interact with each other and in combination with the mine permit determine the requirements for remediation of contamination.

## **OVERVIEW OF MAJOR APPLICABLE ACTS AND REGULATIONS**

A brief overview of the major applicable acts and regulations involved in remediation of a mine site are described below and presented on Figure 1. The following section is intended to highlight significant details from applicable acts and regulations.

### Provincial

#### *Environmental Management Act and the Waste Discharge Regulation*

The EMA identifies who is responsible for the remediation of a mine site. Under the Environmental Management Act (EMA) no person is allowed to introduce waste into the environment in such a manner as to cause pollution. Pollution is loosely defined as "the presence in the environment of substances or contaminants that substantially alter or impair the usefulness of the environment". This leads into the Waste Discharge Regulation (WDR) which requires an authorization from Ministry of Environment and Climate Change Strategy (MOE). Regardless if an authorization is required or not, no person can cause "pollution" under EMA. MOE is the regulatory authority for the EMA and the WDR. Under this system, mines require an authorization to discharge waste into the environment through effluent, refuse and air discharge permits. These permits are issued by the MOE Regional Operations Branch (ROB). The EMA permit stays into effect until the mine no longer discharges to the environment or meets the requirements of the EMA permit.

The EMA also sets jurisdictional limits of a mine site by limiting MOE authority to issue remediation orders within the core area of an active or past producing mine site. The EMA defines the core area of a mine site as the areas where the ground was disturbed by mechanical means, where waste rock or tailings are placed, access roads associated with the mine or any other prescribed area under the mine permit.

#### *Mines Act and the Health and Safety and Reclamation Code*

Under the Mines Act and the accompanying Health, Safety and Reclamation Code (the Code), the Ministry of Energy, Mines and Petroleum Resources (EMPR) is mandated to create regulations respecting standards for environmental protection and reclamation. Under the Code a mine site must be reclaimed to an end-land use approved by the Chief

Inspector that considers previous and potential uses. Further, the Code states that where there is a significant ecological risk, reclamation procedures shall ensure that levels are safe for plant and animal life and, where this cannot be achieved, other measures shall be taken to protect plant and animal life.

Site remediation and reclamation is specified in the Reclamation Plan as part of the Mine's Act Permit. The permit holder is responsible for site remediation and reclamation. As per the Code, reclamation obligations of a mine are deemed to be fulfilled if the chief inspector is satisfied that conditions of the permit and standards outlined in the Code are satisfied. This generally means that the land is returned to the satisfaction of the Chief Inspector to as near as practical to pre-mine conditions.

#### *Contaminated Sites Regulation and Spill Reporting Regulation*

The Contaminated Sites Regulation (CSR) defines what a contaminated site is based on predefined numerical standards. The numerical standards are dependent on the current and anticipated land use and the groundwater use that is applicable to a site. In addition to defining what constitutes a contaminated site, the CSR also defines what is considered a remediated site. Similar to a contaminated site, the definition of a remediated site is based on the predefined numerical standards or site-specific standards developed for a site as well as risk-based standards. Under this system a site can be both a contaminated site and a remediated site at the same time.

In British Columbia there is the Spill Reporting Regulation (SRR), also under the EMA, which requires a notification to be made to the Provincial Emergency Program (PEP) if a substance listed in the regulation is released into the environment in excess of prescribed quantities.

#### *Hazardous Waste Regulation*

The Hazardous Waste Regulation (HWR) defines what constitutes a hazardous waste. This is typically done through testing the leachate potential of the contaminant in the soil. Often, contaminated soils also meet the definition of hazardous waste. When managing contaminated soil, the HWR does not apply until soil defined as hazardous waste is removed from a site. Typically, a site is defined as a legal parcel(s) or through metes and bounds descriptions in special circumstances. A mine site is defined by the mining lease which gives the mining owner the right to occupy the lease for the purpose of mining. The mining lease is considered a single site. When hazardous waste is removed from a site for off-site disposal or treatment there are registration requirements, tracking and special handling requirements that must be met under the HWR. Off site treatment can only be completed at a permitted hazardous waste treatment facility.

### Federal

#### *Fisheries Act, Metal and Diamond Mine Effluent Regulation and the Coal Mining Effluent Regulation*

In addition to the provincial regulations described above metal and diamond mines are also regulated under the Metal and Diamond Mine Effluent Regulation (MDMER) of the Fisheries Act. The Fisheries Act restricts or prohibits the introduction of a "deleterious substance" into a water body frequented by fish.

Under the Fisheries Act, the MDMER regulates the use of water bodies frequented by fish to deposit certain metals and suspended solids below prescribed concentrations.

Similar to metal and diamond mines, coal mines are proposed to be regulated under the Coal Mining Effluent Regulation (CMER) of the Fisheries Act. The CMER will also restrict or prohibit the introduction of a “deleterious substance” into a water body frequented by fish from effluent generated from coal mining operations.

In summary, the MOE is responsible for permitting waste discharges of mine site in a way that pollution is not created in accordance with the EMA by meeting the conditions contained in the effluent, refuse and air permits. These conditions are typically based on the Water Quality Guidelines (WQGs) or Science Based Environmental Benchmarks (SBEB). The EMPR is responsible for ensuring that the land is restored to a comparable pre-disturbance condition.

### **AUTHORIZE DISCHARGE, ACCIDENTIAL RELEASE AND REMEDIATION**

There are two ways that soil and groundwater contaminants are released into the environment at a mine site, either through an authorized discharge or from spills.

As part of mining operations tailings and/or effluent may need to be released to the environment. The release is done in compliance with the WDR and the MDMER. When the WDR and the MDMER are complied with and waste, as defined by the EMA and the WDR or a deleterious substance under the Fisheries Act, is released then pollution, as defined by the EMA or deleterious effects to fish and fish habitat, should not occur. If pollution or deleterious effects to fish or fish habitat should occur then a management or remediation strategy needs to be implemented by the responsible person.

There are historical mine sites, many of which are now considered “orphan mine sites”, that operated prior to the existence of guidelines and regulations. Due to typical practices at the time for managing waste, releasing substances into the environment resulted in generating soil, groundwater or surface water contamination as defined under the CSR. In some cases, the contamination may have resulted in pollution or deleterious effects to fish or fish habitat.

#### Spills and Remediation

Spills of fuel, lubricants, coolant or other substances that can cause contamination, pollution or deleterious effects to water bodies through the normal operation of a mine. A spill is defined by EMA as the introduction into the environment, other than as authorized, of a substance that has the potential to cause adverse impacts to the environment, human health, or infrastructure.

The cleanup of a spill will fall into one of two categories: spill response and remediation. The SRR requires that immediate measures be taken to minimize the effects of the spill on the environment. The EMA permit and the Mines Act permit will also stipulate the response required during a spill as part of the emergency response plan (ERP). Following the requirements of the SSR and the ERP is known as the initial spill response. When the initial spill response is completed there are often residual environmental impacts. This is when a spill would move into the remediation stage. Once the initial spill response is completed often a remediation is required that would be considered satisfactory to the EMPR.

During the cleanup of a release, a notification is completed to the PEP when prescribed quantities are exceeded during the release. Additional reporting is also required to be submitted to the ROB as part of the annual reporting required by a mine permit.

## **CLOSURE PLANNING**

As part of the mine closure process investigations are required under the Mines Act so they can be used to prepare the mine closure plans. Final mine closure plans are typically submitted 12 months prior to final closure. The mine closure plan should contain a plan to characterize the nature and extent of soil and groundwater contamination that may be present.

Benchmark criteria is required for the core area of a mine site to assess soil and groundwater conditions as part of mine closure. The criteria could consist wholly or in part the numerical standards defining a contaminated site that are found in the CSR; however, this criterion should be based on the most appropriate information/standards.

The mine permit application should also identify remedial strategies to be used to mitigate and/or remediate contamination in the core mining area as defined by the appropriate benchmark criteria. The mine permit and/or the EMPR will typically require contamination of non-core areas to be assessed and remediated as prescribed in the CSR.

### Management Criteria of Contamination at a Mine Site

There are differences in the management of contamination for core areas of a mine site and non-core areas. The core area of a mine site that is permitted under the mines act is subject to the requirements Mines Act and the Code with respect to soil and ground water assessment and remediation. Non-core areas of a permitted mine site and historic mine sites are assessed and remediated under the CSR using either numerical or risk-based standards. As previously discussed, the closure plan will determine the level of cleanup required for soil and groundwater contamination for the core area of a permitted mine site. The Mine Act permit closure requirements may be met while soil and groundwater contamination remain as the Mines Act and the Code require a risk-based closure approach. The Code, which must be followed in addition to the closure plan and the Mines Act, stipulates that *“where there is a significant ecological risk, reclamation procedures shall ensure that levels are safe for plant and animal life and, where this cannot be achieved, other measures shall be taken to protect plant and animal life”*. Additionally, the code stipulates that *“if water quality from any component of the mine results in exceedances of applicable provincial water quality standards in the receiving environment, when required by the chief inspector, remediation strategies shall be implemented for as long as is necessary to mitigate the problem”*. Pollution or deleterious substances or exceedances of applicable water standards would need to be managed (i.e. risk assessed or remediated) to meet the requirements of the Mines Act or the EMA prior to a mine owner being released from their obligations under the Mines Act or the EMA.

Remediation of contaminated soil, soil vapour, groundwater and surface water at a mine site poses a significant challenge. Historically, mine sites are known to have caused contamination due to the lack of environmental regulations as well as historical mining practices. Newer mine sites can also cause soil and groundwater contamination. Assuming acid rock drainage was properly managed, even placement of waste rock normally found underground at surface can contain metals in higher concentrations than would normally be found in a location. Reject coal placed at surface can contain polycyclic aromatic hydrocarbons and/or selenium in locations that normally would not contain these substances. The CSR has numerical standards that are used to determine if a site is a remediated site. These are typically used as a benchmark for evaluation unless more appropriate

criterion are identified; however, remediation criteria for a permitted mine are risk based. For permitted sites under the Mines Act, a risk-based approach is required. For non-core areas or historic mines sites, the use of remediation to risk-based standards is authorized under the CSR. However, under the EMA, the feasibility benefit of alternative remedial strategies must be considered.

A risk assessment can be completed by developing site specific numerical standards. However, more often remediation by risk assessment relies on the following:

- Determining if a contaminant pathway is present.
- Modeling potential exposure to a receptor to quantify risk.
- Quantifying actual impacts a substance may be having on the environment.

The general approach to completing risk assessments for soil and groundwater contamination in British Columbia are broken down into the following three types of assessments;

- 1) Qualitative to semi-quantitative risk assessment where the focus is on the contaminant pathway.
- 2) Preliminary Quantitative Risk Assessments (PQRA) which evaluates the potential risks to human and ecological receptors that may be present as a result of potential exposures to identified impacts in both soil and groundwater.
- 3) Detailed Quantitative Risk Assessments (DQRA) which are more suited to large spills, complicated hydrogeology, and quantification of actual environmental impacts at reclaimed sites.

A mine site is considered one site under the Mines Act and the EMA. However, for practical purposes to manage contamination, the mine site will be broken down into numerous sites of varying sizes. As a result, it is likely that a number of risk assessments would be required. If an unacceptable risk is present, then deleterious effects to fish or fish habitat may be occurring and/or or pollution may be present in the environment. Under the Code, if risk thresholds are exceeded and an unacceptable risk is identified, then remediation to lower the risk to acceptable levels would be required. If it is not feasible to remediate contaminants so that the risk is below acceptable thresholds then the risk must be managed, typically through containment and remediation systems.

## **MANAGEMENT OF PETROLEUM HYDROCARBON CONTAMINATED SOIL AT AN OPERATING MINE SITE**

During the operation of the mine soil can become contaminated with petroleum hydrocarbons through accidental releases or normal operation from wash bays, fueling, separators and equipment maintenance. Treatment of hydrocarbon contaminated soil on the mine site is typically completed through bioremediation of hydrocarbons which is the destruction of hydrocarbons by microbial activity. Bioremediation is typically completed in a land treatment facility (LTF)

The construction of the LTF at a mine needs to be authorized by the Mine Act Permit. To allow for the placement of hydrocarbon contaminated soil into an LTF, a waste discharge authorization under the EMA is required. A new EMA permit may be required or an existing one could be amended to include the placement of soil into an LTF. The LTF design and an operating plan needs to be submitted to the MOE during the EMA permitting process.

## **INDEPENDENT REMEDIATION AND LEGAL INSTRUMENTS**

When contamination at a mine site requires remediation the EMA and the CSR allows for the site to be completed independent from oversight from the MOE, however, remediation activities must be report to EMPR in the annual reporting requirements. Even though MOE may not provide oversight, a Notification of Independent Remediation (NOIR) is required to be submitted to MOE within 3 days of commencing with the remediation for mine sites being reclaimed or historic mine sites. The NOIR is not required for remediation at active mines or when completing a spill response as notification is provided to the PEP. The remediation may require waste discharge authorizations and the remediation facility may require an amendment to the Mine Permit.

The work required to complete mine reclamation and close out mine permit obligations includes compliance with the EMA, the Mines Act and the closure plan, this typically does not include the application for a contaminated sites legal instrument. Legal instruments can include a Certificate of Compliance (CoC) which is recognition from MOE that a site is satisfactorily cleaned up or a Determination that a site is not contaminated. A CoC which has been issued for a Site will survive regulatory changes (i.e. lowering of environmental standards).

## **HISTORIC MINE SITES**

Under the Mines Act an abandoned mine is defined as “a mine for which all permit obligations under this Act have been satisfied and in respect of which the mineral claims have reverted to the government”. Many mines operated in BC prior to the enactment of the Mines Act and are classified as historical mine sites. The Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRO) operates the Crown Contaminated Sites Program (CCSP) to identify and remediate contaminated sites on crown land across the province that cannot be tied to a responsible party. FNLRO will screen sites with historical operations, mining or other, and look at potentially contaminated sites on Crown Land that are currently not tied to a responsible party. Once sites are put through a screening process a candidate list of sites is developed and updated. The candidate sites are assessed in accordance with the CSR. Once the sites have been assessed they are prioritized based on the investigation results and potential risk to human health and the environment. When risk to human health and the environment are identified remediation and/or risk management of contamination is completed followed by monitoring.

## **SUMMARY**

The remediation of soil and groundwater contamination at a mine site in BC involves multiple Federal and Provincial acts and regulations. Approvals of a major mine in BC are jointly completed by the MOE and the EMPR. This process will outline the requirements for discharging waste to the environment and the assessment and cleanup while the mine site is in operation.

During the operating phase of a major mine, accidental releases exceeding prescribed limits in the SSR are immediately reported to the PEP and annually reported to ROB. Subsequent cleanup of a residual impacts from a release are reported to ROB and may require a waste authorization from MOE as well as a mine permit amendment, depending on the type of remediation selected.

During the reclamation stage of a major mine, site remediation and reclamation is specified in the Mine Closure Plan as part of the Mine’s Act Permit. The permit holder is responsible for site remediation and reclamation. As per the Code, reclamation of a mine is deemed achieved if the chief inspector is satisfied that conditions of the permit are satisfied.

## **REGULATORY AND TECHNICAL ISSUES**

There are regulatory issues that may arise during the cleanup of contamination at a mine site. Often there is some question regarding when a spill cleanup becomes a site remediation. This is due to the fact that spills may be cleaned up over the period of several years. There appears to be an absence of guidance for when a spill is considered a site remediation.

There is presently a guidance document for the remediation of hydrocarbons at an active mine site using a land treatment facility. However, there is a lack of guidance for the use of other remediation technologies and for the remediation of substances other than hydrocarbons. A risk assessment is considered a remediation under the CSR even if a physical remediation was not completed. When would a NOIR need to be completed for a risk assessment at an operating mine? If an alternative remediation of hydrocarbons was completed such as landfarming, what is the regulatory process for an active mine site and how would that differ from a reclaiming mine site?

A site remediation under the CSR is well understood and there are a significant amount of resources available to assist a practitioner. The remediation of contamination at a mine site brings in additional Provincial and Federal acts and regulations. Due to the additional complexity and multiple jurisdictions involved there is currently a need for additional guidance from regulators to assist a practitioner and mine owners to maintain compliance with applicable acts and regulations.

## **CLOSURE**

Due to the brevity of this paper there are numerous requirements for remediation of contamination at a mine site that are not discussed. There are also other applicable acts and regulations that may not have been discussed. The intention of this paper is to highlight major components of the remedial process of a mine site. This paper is not intended to provide a legal opinion and it is recommended to consult with MOE and EMPR to confirm regulatory requirements when undertaking remediation of a mine site.



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