



Ministry of
Environment and
Climate Change Strategy

Technical Guidance 10
Environmental Management Act

**Bioremediation and Discharge of
Hydrocarbon Impacted Soil at Producing Mine
Sites**

Non-Contaminated Site Management

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1.0 Background

At producing mine sites, soil contaminated by hydrocarbons (HC) is generated in mobile equipment wash facilities, oil water separators and as a result of accidental releases of hydrocarbons due to equipment malfunctions, maintenance, or dispensing spills. The transport and disposal of these contaminated soils to off-site treatment facilities or landfills is an added operating cost for mines. Contaminated soils that are not excavated and treated appropriately can present a risk to the receiving environment. Treating soils contaminated by hydrocarbons on the mine site through bioremediation technology can reduce the costs associated with these soils and mitigate risks to the environment. Bioremediation can include: phytoremediation, bioventing, bioleaching, landfarming, bioreactor, composting, bioaugmentation, rhizofiltration, mycoremediation and biostimulation.

The Ministry of Environment and Climate Change Strategy's (ENV) Land Remediation Section (LRS) and Regional Operations Branch (ROB) together regulate remediation and discharge of hydrocarbon contaminated soils under the *Environmental Management Act*.

2.0 Purpose

This document is intended to provide guidance to mine operators planning to construct, operate, and dispose of or otherwise use waste soil from a bioremediation facility. Guidance herein is intended to address the treatment and disposal of waste soil on the mine property where the contaminated soil was generated.

The scope of this guidance document covers soils impacted by hydrocarbons during routine mining operations (i.e., accidental spills and wash bay sumps) and is not intended to apply to the remediation of a contaminated site.

Soils contaminated with hydrocarbons, regardless of level of hydrocarbon contamination, can be treated at a mine's bioremediation facility as long as the contaminated soil was generated on the mine site. There is no requirement to characterize the soil as hazardous waste if it's managed on the site that it was generated. Soils that trigger a hazardous waste classification by presence of other materials, as defined in the HWR (i.e., PCBs, biomedical wastes, dioxins, asbestos, pesticides, tetrachloroethylene, corrosive wastes or PAHs) will not be eligible for onsite bioremediation.

Limited guidance is included on the design of a bioremediation facility and on the handling and management of soil contaminated by hydrocarbons for the purpose of a waste discharge authorization at a producing mine. Bioremediation facilities intended for contaminated site remediation may require additional design and or operational requirements and approvals.

3.0 Terminology

“Soil treatment facility” means an engineered structure designed to contain soils impacted by hydrocarbons while reducing concentrations of hydrocarbon constituents through biodegradation. Examples of soil treatment facilities include biocells, biopiles and windrows but do not include land farms.

“Land farming” means a method of reducing the concentrations of hydrocarbon constituents in soil through biodegradation, and characterized by spreading contaminated soil over a large surface area in the absence of engineered structures designed to contain the contamination.

“Hydrocarbon contaminated soil” means soil, sand, gravel, rock or similar naturally occurring material which is only contaminated with a petroleum product including, but not limited to, gasoline, diesel, fuel oil, hydraulic oil and lubricating oil.

4.0 Regulatory Environment

The relevant legislation pertaining to spill prevention and soil removal, treatment, disposal, and use on a mine site are the *Environmental Management Act* (EMA) and the *Mines Act* (MA). It is the mine operator’s responsibility to ensure that the requirements of all relevant regulatory authorities are addressed when dealing with contaminated soil generated through mine operations.

4.1 EMA Waste Discharge Regulation

A producing mine is a prescribed industry described in section 6 of EMA and is defined in section 2 of the Waste Discharge Regulation (WDR). Waste discharges on a mine site require authorization under section 14 of EMA. A refuse permit under EMA is necessary to discharge remediated hydrocarbon soil on a mine site.

The WDR also prescribes contaminated soil contaminant management as an activity that requires discharge authorization under EMA.

4.2 EMA Contaminated Sites Regulations

A contaminated site is described in section 39 of EMA and defined in section 11 of the Contaminated Sites Regulation (CSR). A contaminated site is defined as an area of land in which the soil or underlying groundwater or sediment contains a substance in an amount or concentration that exceeds provincial environmental quality standards. Identification, determination and responsibility for contaminated sites are described in Part 4 of EMA and in the CSR. The Land Remediation section of ENV administers the CSR.

Discharge of soil from a bioremediation facility requires a permit under EMA, as per the WDR. When this is tied to reclamation of a mine site, LRS processes the EMA permit application. When

soil remediation and discharge is related to operational activities of an active mine, ROB processes the EMA permit applications. The standards for soil used for reclamation will need to be discussed and approved in the mine's reclamation plan by the Ministry of Energy, Mines and Petroleum Resources (EMPR).

4.3 EMA Hazardous Waste Regulation

As a result of the 2016 Hazardous Waste Regulation (HWR) amendment, treatment and storage of hydrocarbon contaminated soil on the site on which it was generated is no longer regulated under the HWR. However, the HWR may apply if the soil is contaminated with substances other than hydrocarbons, or if the soil is being shipped off-site.

4.4 EMA Spill Reporting Regulation

The Spill Reporting Regulation governs when and how spills are to be reported to ENV.

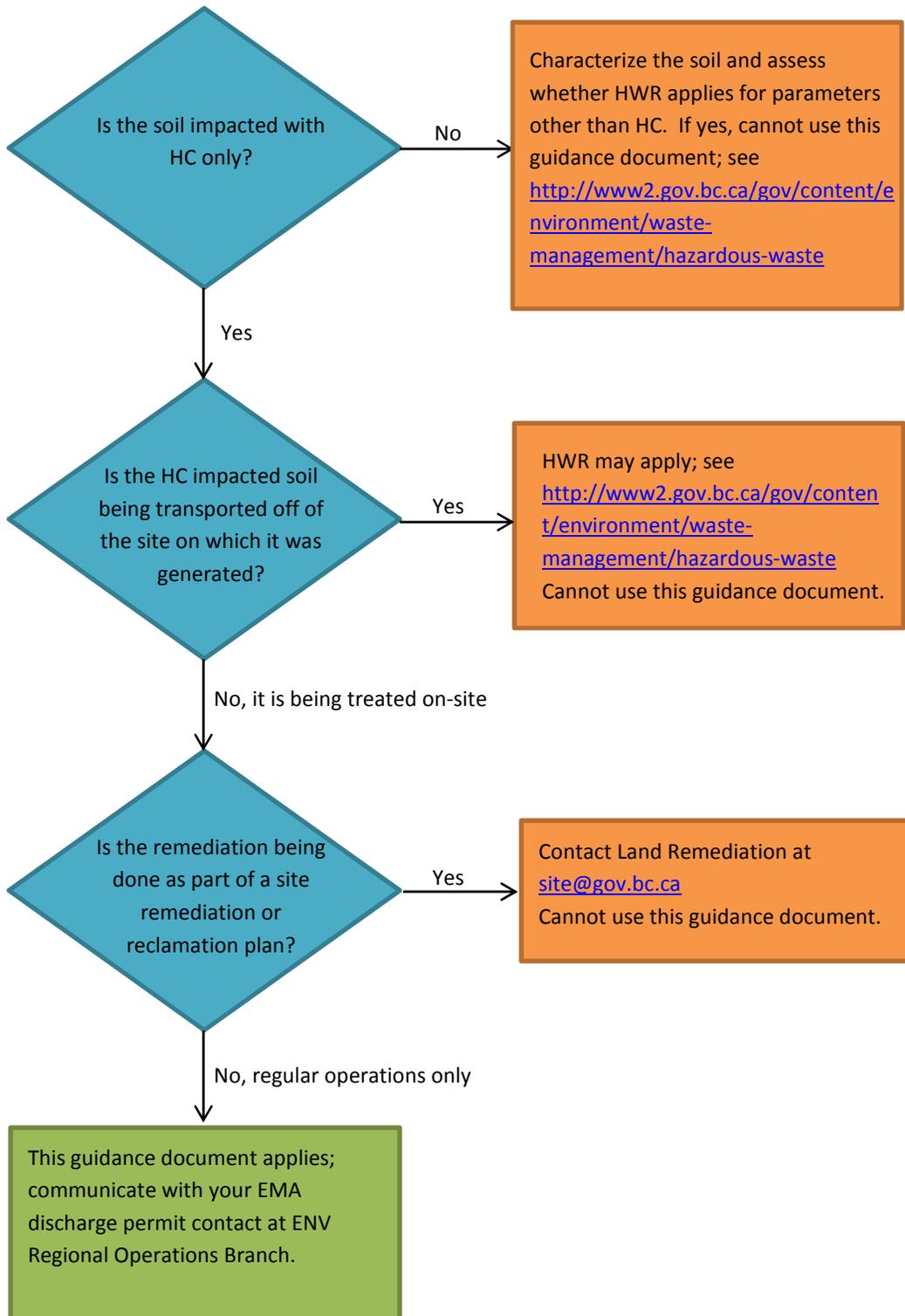
4.5 Mines Act

EMPR, in particular the Chief Inspector's Office regulates the construction, operation and closure of land treatment facilities on mine sites, and the use of contaminated soil for reclamation purposes. A *Mines Act* permit approval is required for these activities. The standards for soil used for reclamation will need to be discussed in the mine reclamation plan.

4.6 EMA Hydrocarbon Impacted Soils Decision Tree

Under the EMA, HWR, CSR, and WDR may all apply to regulating a site with hydrocarbon contaminated soils. The following graphic will help proponents determine how regulation of their site and hydrocarbon impacted soil will occur.

Figure 1 Decision Tree on Legislation Applicable to Hydrocarbon Impacted Soils



4.0 Permitting

The following provides guidance on application for EMA approvals pertaining to hydrocarbon contaminated soil on mine sites. Additional information may be required for MA approvals and mine operators should contact the Chief Inspector's Office for input on how to apply for the MA approval.

Information on the process for applying for a waste discharge permit from the Ministry of Environment and Climate Change Strategy is located at:

<http://www2.gov.bc.ca/gov/content/environment/waste-management/waste-discharge-authorization>

The Information Requirements Table (IRT) component of a waste discharge application must include submission of a Soil Treatment Facility and Operations Plan that incorporates the standards and practices from:

- **Protocol 15** for Contaminated Sites – *Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil (July 17, 2012)*¹
- **Technical Guidance 14** for Contaminated Sites - *Operation of Soil Treatment Facilities for the Bioremediation of Hydrocarbon Contaminated Soil (April 2013)*¹ and
- **Technical Guidance 1** for Contaminated Sites *Site Characterization and Confirmation Testing*¹

The use of Qualified Professionals as outlined in Protocol 15 will be required in the preparation of a Soil Treatment Facility and Operations Plan. Where a mine site has an existing soil treatment facility to be included in a new permit the application should include a gap analysis and an as-built design prepared by a Qualified Professional, and a schedule of improvements that are needed to align the facility or its operation with the above mentioned Protocols and Technical Guidance Documents.

The Soil Treatment Facility and Operations Plan should address, but is not limited to:

- a. the facility design;
- b. siting requirements;
- c. size and maximum storage capacity;
- d. site access and security;
- e. surface water management;
- f. soils handling and management
- g. criteria for the quality of the source soil
- h. criteria for the quality of the soil that can be discharged
- i. remediation techniques;
- j. monitoring and sampling;
- k. record keeping and reporting,;
- l. decommissioning and closure; and
- m. soil disposal locations and criteria.

¹<http://www2.gov.bc.ca/gov/content/environment/air-land-water/site-remediation/guidance-resources>

It is recommended that preparation of the Soil Treatment Facility and Operations Plan also consider the requirements of the *Health, Safety and Reclamation Code for Mines in BC* as this will be a requirement under the MA. For example, soil quality criteria for reclamation and closure will depend on the end land uses approved through the MA permit.

5.0 Operational Considerations

5.1 Notification of On-Site Treatment

The reporting of accidental releases of hydrocarbons to the Provincial Emergency Program under the Spill Reporting Regulation or to ROB under a site-specific permit, as per permit conditions, constitutes providing notification of remediation to ROB. Soils contaminated by hydrocarbons generated from controlled industrial processes (i.e., steam bay sump residuals) do not require notice. The annual quantities of soil deposited in the bioremediation facility and the quantities of soil discharged after successful remediation must be documented and reported in the annual report submission for the waste discharge permit issued by ENV (see Section 8 – Management Plan & Treatment Facility Reporting).

5.2 Potential Contaminants of Environmental Concern

The primary contaminants of concern that require assessment prior to disposal of remediated soil are the petroleum hydrocarbon groups – VPH, LEPH and HEPH. The Industrial Land (IL) numerical standards outlined in the CSR for the petroleum hydrocarbon groups – VPH, LEPH and HEPH are the recommended minimum standards for the discharge of hydrocarbon contaminated soil under an EMA waste discharge permit to a location on a mine site.

It is strongly recommended that a mine manager consider other contaminants of concerns (i.e., metals, BTEX, etc.) as well as the future end land uses and future groundwater uses at the site in order to avoid liabilities under the CSR at the time of mine closure.

5.3 Health and Safety

Soils contaminated by hydrocarbons may be remediated to the CSR Industrial Land criteria for VPH, LEPH and HEPH, but this does not necessarily mean it is no longer a risk to human health; human health protection factors in the CSR should also be considered. The mine manager should consider measures required under the *Health, Safety and Reclamation Code for Mines in BC* to protect human health at the soil treatment facilities and at the disposal locations.

Health, Safety and Reclamation Code for Mines in BC:

<http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia>

5.4 Wildlife Protection

With respect to managing due diligence under the *Wildlife Act*, the mine manager should consider the risk of exposure of contaminated soils to wildlife and the risk of accidental poisoning. Mitigation measures such as exclusion fencing should be considered where the risk is significant.

This reference from the BC Oil & Gas Commission provides some guidance on protecting wildlife from coming into contact with potentially harmful substances:

<https://www.bcogc.ca/content/sa-2012-01-preventative-measures-protect-birds-and-wildlife>

6.0 Soil Handling & Treatment

6.1 End Uses of Soil

Bioremediated soil quality may be enhanced compared to other soil material available on a mine site for reclamation purposes because soil microbes, organic material, nutrients, oxygen and water are incorporated into the soil during the remediation process. Further, soil resources for reclamation are often at a deficit on mine sites. Consideration should be given to using this treated soil for reclamation purposes, rather than burying or landfilling the materials.

The Parkland (PL) numerical standards provided in the CSR for the petroleum hydrocarbon groups – VPH, LEPH and HEPH is the recommended minimum standard for remediated soil used in reclamation; however, the standards for soil used for reclamation will need to be discussed and approved in the mine’s reclamation plan by the EMPR.

Acceptable end uses / disposal options for bioremediated soil on a mine site, all of which may require EMA and MA approvals prior to initiation, may include:

- Reclamation growth medium
- Buried in a waste rock dump
- Cover materials for landfills
- Construction material for select applications

Soil can be removed from a soil treatment facility once the concentrations of hydrocarbons are below the required limits. Treated soil can be moved from a soil treatment facility to a suitable

location on the mine site where continued remediation can be managed through land farming practices (i.e. bio- or phytoremediation) should there be a need to further reduce the concentration of hydrocarbons.

6.2 Soil Dilution

Diluting contaminated soil with clean soil or blending different source soils can reduce the concentrations of individual contaminants within the resultant mixture. However, this does not reduce the contaminant mass overall. Dilution can reduce the rate of contaminant release into the environment, but may not reduce short- and long-term toxicological effects from the blended contaminants. Blending different sources of contaminated soil can result in changes to the toxicological character of a contaminant, and raises the potential of multiple loading effects, bioaccumulation, chemical accumulation, and chemical species interactivity.

Practices for removing contaminated soil at spill sites should be rigorous enough to prevent incorporating clean soil with contaminated soil. The size and type of equipment used for these purposes needs to be carefully considered in order to minimize inadvertent dilution. Practices within the bioremediation facility should avoid blending different source soils together.

If hydrocarbon concentrations in soil excavated due to a spill are measured below threshold levels, the contaminated soil must either be disposed of in the mine's engineered landfill or actively treated in a soil treatment facility for at least two growing seasons before it can be moved to another location on the mine site.

7.0 Innovation & Experimental Trials

Experimentation and innovation in the on-site treatment of soils contaminated by hydrocarbons is encouraged by both ENV and EMPR. Innovative ways may be found to help enhance remediation and lower treatment costs. Innovation could be in identifying different treatment or bioremediation technologies, alternatives for organic matter and nutrient sources, recycling and use of leachate and/or treated water and other resources found locally on the mine footprint (such as wood waste, soil, etc). Approvals for conducting trials and for use of site resources (such as soil and wood) or importation of resources (such as organic matter residuals, wood, soil, etc) for treatment purposes may be required under EMA and/or MA.

Small-scale experimental trials for the bioremediation of other types of non-hazardous impacted soil may be considered by ENV where the technology is supported by the scientific literature and the quantity and contaminant to be tested does not pose undue risks to the environment. Trials must be presented to ENV in a request for an amendment to an existing permit or as part of the scope of a new

permit application. Protocols for managing experimental trials must be incorporated into the mine's Soil Treatment Facility and Operations Plan.

8.0 Management Plan & Treatment Facility Reporting

A Soil Treatment Facility and Operations Plan must be submitted with the application or within a time frame specified in an EMA permit. The Plan must outline the siting, design and operation requirements of each mine's soil treatment facility as specified by appropriate Qualified Professionals.

An annual report must be submitted to ENV which summarizes the volume of soil treated, concentrations of VPH, LEPH and HEPH, metals, BTEX, and any other site-specific potential contaminants of concern, and maps of the disposal sites as well as the locations of any landfarms. Additional report submissions may be required by EMPR.