

## Operation of Soil Treatment Facilities for the Bioremediation of Hydrocarbon Contaminated Soil

### Introduction

Concentrations of hydrocarbon constituents in excavated soils can be effectively reduced through biodegradation. Bioremediation technology is a controlled process which involves constructing cells, piles or rows of contaminated soils and stimulating microbial activity within the soils through aeration and/or the addition of nutrients and moisture.

Protocol 15, "Soil Treatment Facility Design and Operation for Bioremediation of Hydrocarbon Contaminated Soil" imposes minimum requirements for the design, operation and maintenance of soil treatment facilities. This guidance document augments Protocol 15 by providing recommendations relating to the operation of these facilities and describing when a discharge authorization may be required during their operation.

### Facility operation

Protocol 15 specifies that the management of a soil treatment facility must be carried out so as to ensure the optimal biodegradation of contaminants and to ensure the integrity of the works. Table 1 outlines levels of key environmental parameters recommended to be maintained, to maximize the remediation potential of a soil treatment facility.

In addition to the minimum requirements imposed under Protocol 15, the following

recommendations should also be considered on a case by case basis. Note that they may not be applicable to all areas of the province.

- Turn the soil monthly or install aeration piping to provide adequate aeration.
- Collect soil samples quarterly during the treatment process. Sampling at this frequency is useful in order to inform the adjustment of cell conditions to promote maximum biological activity. Soil samples should be analyzed for appropriate indicator parameters including, but not limited to pH, temperature, moisture, microbial counts, contaminant concentrations, and nutrient levels.
- Consider preparing and implementing a contingency plan for excessive leachate generated in areas with high precipitation. Having holding tanks available onsite is one way such a plan could be put into effect.

### Soil management

#### Independent remediation requirements

Soil, before and after treatment, must be managed appropriately in accordance with the *Environmental Management Act* (the Act) and its regulations. Bioremediation activities trigger the independent remediation notification requirements of the Act. For more information, refer to the Land Remediation Section's key topic, "[Independent Remediation](#)".

### Before placement of soil into facility

Soil quality should be adequately characterized as described in Technical Guidance 1, "[Site Characterization and Confirmation Testing](#)" before placement of soil into a soil treatment facility. Hazardous waste may not be placed in a soil treatment facility unless the facility is registered as required under the [Hazardous Waste Regulation](#).

#### Note

When transferring soil from a dump truck to a soil treatment facility, excess liquid within the soil should be collected and disposed of to minimize leachate generation.

### Final disposition options for treated soil

Following the successful treatment of contaminated soil, there are various options for disposition of the soil. They include, for example, the reuse of treated soil as backfill at the source or treatment site, disposal at an authorized facility or reuse at another location.

A Contaminated Soil Relocation Agreement (CSRA) may be required to move treated soil from a source site to a receiving site. The relocation of soil is regulated to ensure that soil is moved and deposited only at appropriate locations. For more information about CSRAs refer to the Land Remediation Section's key topic, "[Soil Relocation](#)."

Table 2 outlines disposition options for treated soil and explains situations when a CSRA may be required to make use of treated soil. Note that confirmatory samples and results must be documented and are to be used for soil characterization for a CSRA or for compliance monitoring associated with discharge authorization conditions at the receiving or deposit site (e.g., *Mines Act* permit, landfill, etc.).

#### Note

Those wishing to discharge waste to the environment should be aware of the requirements of other agencies such as [local governments](#) which, for example, may have bylaws governing discharges to sewer systems and to the atmosphere. Federal agencies such as [Environment Canada](#) and [Fisheries and Oceans Canada](#) may also need to be contacted in conjunction with discharge requirements under the Federal [Fisheries Act](#).

### Discharge authorizations

While the Act prohibits the discharge of waste from prescribed activities to the environment unless specifically authorized, the release of a substance to the environment which is not defined as a waste is allowed. The Act's Waste Discharge Regulation prescribes industries, trades, businesses, activities and operations which require some form of authorization in order to introduce waste into the environment. Waste discharge authorizations are most frequently issued as permits and approvals.

"Contaminated site contaminant management" is a prescribed activity and is defined under Schedule 1 of the [Waste Discharge Regulation](#). Based on this definition, a discharge of a waste from a soil treatment facility may require authorization. For information on the authorization application process, refer to the ministry's [Waste Discharge Authorizations webpage](#). If you might require a discharge authorization associated with the treatment or management of wastes at a contaminated site, please contact us at [site@gov.bc.ca](mailto:site@gov.bc.ca) for advice.

*For more information, contact the Environmental Management Branch at [site@gov.bc.ca](mailto:site@gov.bc.ca)*

**Table 1: Recommended levels of key environmental parameters**

Parameter	Recommended Operating Level	Additional Information
Microbe populations	Variable	Microbial populations can be raised via blending the soil with cultured micro-organisms or animal manure. Bioaugmentation is not always necessary.
Oxygen	Variable	Added via turning or aeration piping
pH	$6 \leq \text{pH} \leq 8$	pH can be raised by adding lime or lowered by adding elemental sulphur
Soil temperature	10 - 45°C	Soil temperature can be maintained by covering the facility or through warm air injection
Moisture content	40 - 85 % of field capacity 10 - 30 % by weight	Moisture, including recycled leachate may be added through irrigation piping or spraying.
Nutrient levels	carbon:nitrogen:phosphorus ratio 100:10:1	Nutrients may be added via fertilizer

**Table 2: Final disposition options for treated soil**

Treatment Location	Soil Disposition Option	Authorization Requirements
At the source site	Reuse on land where the soil originated	Waste discharge authorization may be required
	Transfer to a facility authorized to accept contaminated soil (For example, to a landfill for either permanent disposal or reuse as landfill cover, or to an industrial site for use in a specific process such as solidification/stabilization with cement or incorporation into asphalt)	No additional authorization required
	Reuse on land at a site, other than where the soil originated, that is not otherwise authorized to accept contaminated soil	A Contaminated Soil Relocation Agreement (CSRA) or waste discharge authorization may be required
Not at the source site	Reuse on land where the soil originated	A CSRA may be required to relocate the soil to a different treatment location and/or to return the treated soil to the source site
	Reuse on land where the soil was treated	A CSRA may be required to relocate the soil to a different treatment location
	Transfer to a facility authorized to accept contaminated soil (see above for examples)	A CSRA may be required to relocate the soil to a different treatment location  No additional authorization required for soil disposal
	Reuse on land at a site (other than the source or treatment site) that is not otherwise authorized to accept contaminated soil	A CSRA may be required to relocate the soil to a different treatment location  Soil disposal may require a waste discharge authorization.