



Guidelines for Land Treatment Facilities Construction, Operation, and Decommissioning

These guidelines provide basic information to assist in planning for the construction, operation, and decommissioning of a Land Treatment Facility for remediating soil contaminated with petroleum hydrocarbons.

This guide is not intended to be a comprehensive explanation of all regulatory requirements, and does not replace the need for an evaluation of site-specific requirements by qualified staff. If you have a permit for a land treatment facility, your permit may contain conditions that differ from these guidelines; in this case, your permit takes precedence. Please consult the Environmental Programs Branch for further information on regulatory requirements.

Introduction to Land Treatment Facilities

A land treatment facility, or LTF, is a specially constructed facility for treating soil contaminated with petroleum hydrocarbons. The main treatment process that occurs in an LTF is *bioremediation*. Naturally-occurring microbes in soil can, under the right conditions, break down organic contaminants such as petroleum hydrocarbons into non-toxic products. In order for soil microbes to effectively break down hydrocarbons, the soil must have the right balance of moisture, oxygen, nutrients, and pH. Too much moisture will reduce the amount of available oxygen, while too much aeration to introduce oxygen may dry out the soil. Some nutrient mixtures may alter the pH of the soil. LTFs should therefore be designed with these factors in mind to maintain the best possible conditions for bioremediation so that contaminated soil can be remediated quickly.

LTFs can be very beneficial, helping to remove harmful contamination from the environment. However, if operated incorrectly, LTFs may spread contamination to the surrounding area. In order to ensure that LTFs have an overall positive effect, their operation is regulated under the *Contaminated Sites Regulation*.

Permits and Regulation

A **Land Treatment Facility Permit** under the Yukon *Contaminated Sites Regulation* (CSR) is required for all LTFs in the Yukon, and must be obtained before construction of the facility begins. Contact the Environmental Programs Branch for an application form for this permit, or visit our website at http://www.env.gov.yk.ca/air-water-waste/contaminated_sites_regs.php.

In addition to the LTF permit, the operation of an LTF is subject to the requirements of Part 5 of the CSR, as well as all applicable protocols. In particular, Protocol 11 describes requirements for

sampling at an LTF.

The following permits may also be required, depending on the location and operation of the facility:

- A **Development Permit**, from the City of Whitehorse Planning Department (867-668-8335) if the site is within City boundaries. A Zoning Bylaw Amendment may also be required. If the facility is within the boundaries of another municipality, please check with your local municipal office to see if any similar authorizations are required.
- A **Lease** from the Yukon Government Lands Branch (867-667-5215) if the proposed site is on territorial land.
- A **Water License** from the Yukon Government Water Resources Branch (867-667-3171) if the remediation process requires a large volume of water.

If the treatment capacity of the Land Treatment Facility is 3000 m³ or more, the activity will be subject to an assessment under the Yukon Environmental and Socio-economic Assessment Act (YESAA). By default, Environment Yukon will determine the treatment capacity based on a simple volumetric formula (cell length x width x intended pile height [maximum 4.0 metres], added for all cells). In no case shall the treatment capacity exceed the result of this simple volumetric formula.

Alternatively, applicants may choose to calculate operational capacity through provision of a detailed site plan. The site plan must provide detailed information on:

- the length and width of all cells;
- the width of all berms;
- the intended dimensions, slope, and height of all piles or windrows;
- the intended width of the aisles between soil treatment areas and between soil treatment areas and berms;
- the dimensions of any area that will not be used for the treatment of soil; and
- other information as required by Environment Yukon.

If you choose to use the site plan method to calculate your facility's capacity, keep in mind that the operation of your facility must conform to the site plan at all times. Piles must remain within designated footprints. This model is extremely restrictive of facility operations, and should not be used for facilities with frequent turnover of contaminated material.

Even if the treatment capacity is below 3000 m³, a YESAA assessment may still be required due to other aspects of the activity. Please contact your local YESAB Designated Office to determine if your Land Treatment Facility requires assessment; contact information can be found at www.yesab.ca. Please note that no permits may be issued and the facility may not operate until the assessment is complete.

Once an LTF is operational the operator must ensure that **Relocation Permits** are obtained for all incoming contaminated soil and, where required, outgoing treated soil. A Relocation Permit can be obtained by the owner of the contaminated site/soil, the LTF operator, or a consultant working for either party. To obtain a Relocation Permit application, contact the Environmental Programs Branch. The LTF operator must always get approval from the Branch before removing soil from the facility, whether or not it still contains contaminants above the applicable standards.

Types of Land Treatment Facilities

1. Private Land Treatment Facilities

Private LTFs can only accept contaminated material generated by the permittee. The LTF may be designed to accept a small amount of contaminated soil on a single occasion or larger amounts of soil on a more frequent basis.

2. Commercial Land Treatment Facilities

Commercial LTFs can accept contaminated material generated by the public. Once contaminated material is accepted for treatment at a commercial LTF, the permittee inherits all responsibility and liability for the material.

Site Selection

An LTF may be constructed on the site from which the contaminated soils were removed or at a different location. If contaminated soil is to be moved to a different location, a Relocation Permit is required.

The area where the LTF is to be located must be large enough to accommodate the soil spread out into layers less than 0.5 metres in thickness, or placed in spaced rows of piles no higher than 4 metres.

The native soil where the facility is to be built should be sufficiently fine-grained (silt or clay textured) to act as a semi-impermeable barrier to the movement of liquids. If the native soil is too porous, an artificial liner will need to be used.

A land treatment facility **cannot** be constructed on any land where:

- The slope is greater than 6 %;
- The seasonal high water table is less than 3 metres below the surface;
- The Facility would be within 100 metres of a surface water body;
- The land is identified as being within a 25-year floodplain; or
- Residential property lines or buildings are less than 60 metres away.

Construction

An artificial or natural impermeable liner must be installed beneath all cells of an LTF. Artificial liners, such as geomembranes, are specially designed for containment purposes and are constructed from chemically resistant material. Natural liners are constructed through screening, placement and compaction of fine grained soils. Further information regarding construction and installation requirements for both natural and artificial liners is provided in sections 1 and 2 below. .

Facilities may be designed and constructed to accept special waste soil. Soil contaminated with petroleum hydrocarbons is considered special waste if the level of contamination exceeds 30,000 parts per million as measured by assessing either Total Petroleum Hydrocarbons (TPH) or Total Extractable Hydrocarbons (TEH), or if the soil is saturated to the point where free product is visible. Facilities accepting special waste soils must meet more stringent liner specifications.

Each LTF cell must be surrounded by berms of sufficient size to contain the contaminated soil and prevent runoff from entering or escaping from the facility. These berms must be made of low-permeability soil, or if an artificial liner is used, the liner must pass over or through the berms and be

securely anchored to prevent runoff from passing through. If required, diversion berms and/or ditches must also be constructed to keep runoff from entering the facility.

Access ramps must be constructed over the berms to allow equipment to access the treatment cells. It is not acceptable to remove a portion of a berm to allow equipment to pass through.

Fencing or some other method must be used to ensure that the facility is not accessible to the public. Additionally, signs must be posted identifying the site as a land treatment facility and indicating that the facility contains contaminated material.

A land treatment facility must be built according to accepted standards for such facilities, as well as any applicable site-specific requirements. The Environmental Programs Branch recommends that the services of a qualified environmental consultant be engaged to design and oversee the construction of an LTF.

1. Natural Liners

Natural liners must be a minimum of one metre thick throughout each LTF cell. The maximum permeability of natural liners for facilities not accepting special waste soil is 10^{-5} cm/sec. For facilities accepting special waste soil, the permeability of the natural liner must not exceed 10^{-6} cm/sec. Berms surrounding each LTF cell must meet the same permeability specifications as the natural liner.

In order to assess whether the source material is suitable for use as a natural liner, a variety of tests must be conducted and the results provided to the Environmental Programs Branch as part of the LTF permit application process. The analysis must include:

- Characterization sampling results of the liner and berm source material at a rate of one sample per 500 m³, or at a greater frequency if visual changes in soil type are observed at the source location, for the following parameters: particle size analysis, calculated hydraulic conductivity, moisture density proctor test (minimum 5-point curve) and moisture content; and
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- Laboratory hydraulic conductivity test results of the liner and berm source material at a rate of one sample per 1500 m³, or at a greater frequency if visual changes in soil type are observed at the source location, using a minimum 90% modified proctor density or 95% standard proctor density

The liner and berm source material must be excavated and screened to remove organic debris and all rocks with a diameter of 75 millimetres or greater prior to placement and compaction. The liner and berms must be compacted to a minimum 90% modified proctor density or 95% standard proctor density, or a higher density if required to achieve minimum permeability. The liner and berms must be compacted in lifts with a thickness adequate to achieve the required compaction density. During compaction, the moisture content of the soil must be maintained at 2-5% wetter than the ideal moisture content determined through moisture-density proctor testing.

Within one week of installing and compacting the liner and berms, the following quality control tests must be performed:

- Soil moisture content and density of the liner must be analysed once every 20 metre running length of each cell, or at a minimum of two locations within each cell (whichever is greater);
- Soil moisture content and density of each berm on all four sides of each cell must be analysed once every 20 metre running length; and
- A minimum of one soil moisture content and density analysis must be conducted within each 0.5 metre depth interval at all of the liner and berm testing locations described above.

After the quality control tests are conducted and prior to accepting any material into the LTF, all of the quality control testing locations must be filled and compacted to the required permeability and density.

2. Artificial Liners

All artificial liners used for the construction of an LTF must be resistant to petroleum hydrocarbons. A minimum 30 mil (30 thousandths of an inch) liner thickness is required for facilities that will *not* be accepting special waste soils; a minimum 60 mil liner is required for facilities accepting soils with contaminant concentrations above special waste criteria. An artificial liner that is not UV-resistant must be covered at all times to prevent degradation. The liner must be installed as per the manufacturer's specifications, with a sufficient barrier layer(s) to prevent punctures due to equipment traffic, etc. The liner must be installed by a qualified person according to the manufacturer's specifications and be firmly anchored in the berms on each side of the cell.

Hydrogeological Assessments & Groundwater Monitoring

Operators of some land treatment facilities will be required to conduct regular groundwater monitoring to ensure that contamination is not spreading from the facility to the surrounding environment. When groundwater monitoring is required, a hydrogeological assessment must be conducted by a qualified hydrogeologist to ensure that the groundwater monitoring is accurate and appropriate.

A hydrogeological assessment and groundwater monitoring will be required if the treatment capacity of the LTF is 3000 cubic metres or greater, or if the facility is permitted to accept special waste. The hydrogeological assessment report must be approved by the Branch; additionally, a review of the report by an independent third-party qualified hydrogeologist will be required. The operator will be required to pay a fee to cover the cost of the third-party review.

To be considered acceptable, a hydrogeological assessment of an LTF site must:

- a) determine the direction and rate of groundwater flow;
- b) identify potential receiving environments;
- c) assess travel times for potential contaminant pathways; and
- d) be based on data from a minimum of one well upgradient and two wells downgradient of the facility. Additional wells must be installed if they are found to be necessary to characterize the groundwater flow regime and/or to effectively monitor potential impacts to groundwater quality downgradient of the facility. Please note that larger facilities will most likely require the installation and monitoring of additional wells.

When drilling wells for the hydrogeological assessment, the proponent will be required to drill to a depth that will allow for adequate characterization of the groundwater regime. If groundwater is not encountered at significant depth and, based on the stratigraphy and drilling depth, the hydrogeologist is of the opinion that any transport of contaminants to groundwater would be negligible, the proponent may contact the Environmental Programs Branch to request authorization to cease drilling. In this case, the hydrogeological assessment will not be able to determine the direction of groundwater flow; however, estimated travel time of contaminants to the nearest potential receiving environment should be calculated based on the hydraulic conductivity of the soil observed during the drilling program.

Groundwater elevation and water quality must be monitored regularly in accordance with the land treatment facility permit. Samples must be analyzed for petroleum hydrocarbons and any other potential contaminants of concern.

Detection of hydrocarbons may indicate a breach in the liner system designed to contain contaminants within the LTF. If hydrocarbons are detected in any monitoring well at the facility during any sampling event, the LTF permit holder must develop an adaptive management plan to address the contamination in accordance with *Protocol No. 13: Adaptive Management*. The adaptive management plan must be prepared by a qualified professional and submitted to an environmental protection analyst for approval in accordance with Protocol 13.

Incoming Material

All contaminated material entering an LTF must be tested to determine the level and type of contamination. Two requirements are particularly important to keep in mind:

- Unless authorized by the permit, an LTF cannot treat soil contaminated with anything other than petroleum hydrocarbons. Contaminated material resulting from a spill of waste engine oil, or originating from a location where metal ores are handled, may contain heavy metal contamination in excess of the standards in the contaminated sites regulation, and this material must be tested for metals before treatment can begin.
- Unless authorized by the permit, an LTF cannot accept material that is so heavily contaminated as to be considered **special waste**. Soil contaminated with petroleum hydrocarbons is considered special waste if the level of contamination exceeds 30,000 parts per million as measured by assessing either Total Petroleum Hydrocarbons (TPH) or Total Extractable Hydrocarbons (TEH), or if the soil is saturated to the point where free product is visible. 30,000 ppm is the level at which free product is expected to form in average soils, but free product formation may occur at lower concentrations. Other criteria may also apply for specific compounds; consult the Environmental Programs Branch for further information. Special waste material needs to be handled more carefully to avoid spreading contamination, and may require more vigorous treatment to allow the contamination to be remediated in a timely manner.

General Operation Requirements

Land treatment facilities must be operated correctly to ensure that contaminated material is remediated quickly and effectively without allowing contamination to spread to the surrounding environment. Some of the standard operating conditions that should be considered when planning and running an LTF are outlined below.

- The operational season of an LTF should be limited to the portion of the year when the soil is not frozen or covered with snow, approximately April through October. No contaminated material should be applied at any time when the soil is saturated with water, frozen, or covered with ice or snow.
- If soil is placed in the facility to a depth of greater than 15 cm, the soil should be tilled or turned at least twice yearly. Tilling aerates the soil, which provides microbes with the oxygen they need to break down petroleum hydrocarbons. Tilling more frequently will allow the soil to remediate more quickly, and the Environmental Program Branch recommends that soil be tilled at least once per month.
- In order to ensure that the microbes in the soil can process hydrocarbons efficiently, the pH of the soil should be maintained between 6.5 and 8.5.

- The addition of fertilizer may be beneficial, or even necessary to ensure that the soil is remediated in a timely manner. Treatability studies can help to determine if fertilizer or other amendments would be helpful. Some commercial laboratories offer these tests.
- Care should be taken to ensure that the soil in an LTF does not become saturated with water. Water saturation will slow or halt the remediation process by reducing the amount of oxygen available to microbes in the soil. Large land treatment facilities and those that do not undergo frequent tilling are particularly vulnerable to saturation. Depending on local climactic conditions, it may be beneficial to incorporate a sump into the design of the facility to collect runoff water in one location. This also allows collected water to be easily sprayed back onto the top of the soil piles, maintaining an even level of moisture that may encourage remediation.
- Materials from different locations or containing different levels of contamination must be kept separate within the facility unless otherwise authorized by a permit.
- A land treatment facility that is treating water as well as soil must have appropriate tanks of sufficient volume on site in which to store the contaminated water.

Monitoring and Record Keeping

Land treatment facilities must be inspected every two weeks during the operational season and maintained in good working order. If any irregularities are detected, they must be addressed immediately, and the Environmental Programs Branch must be notified.

A regular monitoring program should be implemented for all soil being treated in order to monitor the progress of remediation. Whenever contaminated soil is tested, care must be taken to ensure that samples are representative of the soil being characterized by combining several grab samples from throughout the volume of soil to be represented. All sample collection must comply with *Protocol 11: Sampling Procedures for Land Treatment Facilities*.

LTF operators must submit an annual report to the Environmental Programs Branch by March 31 of each year which provides information about the operation of the facility during the previous calendar year. Each facility's permit includes a detailed list of the specific information to be included in the annual report, but this list generally includes the following:

- the origin of all contaminated material being treated, the volume of material accepted from each source, and the total volume being treated;
- a figure showing the layout of the facility and the location of each stockpile of contaminated material;
- laboratory analytical results for materials added or removed from the facility in that year (unless previously submitted in support of a permit or removal request), as well as results of any other sampling conducted;
- data from groundwater monitoring, if applicable;
- the volume of soil removed from the facility and the locations of the receiving sites;
- operational details, such as how the contaminated material was tilled or turned and whether nutrients were added to help remediation; and
- a sampling and analysis plan for the following year.

Treated Material

Once contaminated soil is remediated, it should be tested in accordance with *Protocol 11: Sampling Procedures for Land Treatment Facilities* in order to verify that the appropriate standards for contaminant concentrations in the *Contaminated Sites Regulation* have been met. The operator may then apply to the Environmental Programs Branch for permission to remove the material. Removal will be approved if the contaminant levels in the soil are below the standards that apply at the proposed receiving site.

Treated soil must only be re-used for the land uses for which it has been remediated, or for which the remediation criteria are less stringent. For example, contaminated soil remediated to the Commercial Land Use standard could not be used at Residential or Parkland sites, which have more stringent criteria. However, soil remediated to the Residential Land Use standard could be used at a Commercial or Industrial site as these land uses have less stringent criteria.

If the treated material exceeds any of the standards in the *Contaminated Sites Regulation*, a Relocation Permit will be required to move the material from the LTF to an off-site receiving location. If all contaminant levels are below the most stringent standards, or if the material will not leave the property, no Relocation Permit will be required, but the Environmental Programs Branch must still authorize the removal of the material from the facility.

Decommissioning

When a land treatment facility is no longer needed, it should be decommissioned. Abandoning an LTF without proper decommissioning is not acceptable. Depending on the intended future use of the site, decommissioning may involve removing the treated soil, removing the artificial liner (if present), levelling the berms, and revegetating the area.

A closure plan must be submitted to and approved by the Environmental Programs Branch before work begins to decommission the facility. This plan must include a schedule for decommissioning, the results of sampling demonstrating the contaminant levels in all soil being treated in the LTF, details of the proposed disposition of remaining soil, a description of the intended future use of the site, and a description of how the site will be restored or prepared for its future uses.

Additional Resources

For more information on legislative requirements for the operation of land treatment facilities, please consult the following documents.

1. The *Environment Act*, the *Contaminated Sites Regulation*, the *Special Waste Regulations*, and associated fact sheets published by the Government of Yukon, Environmental Programs Branch. Visit <http://environmentyukon.gov.yk.ca/contaminatedsites> or contact the Environmental Programs Branch for more information.
2. *Protocol #11: Sampling Procedures for Land Treatment Facilities*, published by the Government of Yukon, Environmental Programs Branch. Visit <http://environmentyukon.gov.yk.ca/contaminatedsites> or contact the Environmental Programs Branch for more information.

3. *Protocol #13: Adaptive Management*, published by the Government of Yukon, Environmental Programs Branch. Visit <http://environmentyukon.gov.yk.ca/contaminatedsites> or contact the Environmental Programs Branch for more information.

Disclaimer

These guidelines are not intended to serve as comprehensive design and operational specifications for land treatment facilities. Such specifications are dependent on the unique characteristics of the site and the contaminated material to be treated, and should be developed by a qualified professional in consultation with the Environmental Programs Branch. Conformance with these guidelines does not guarantee compliance with relevant statutes and regulations.

A number of other in-situ and ex-situ treatment and destruction technologies exist that have been shown to be effective in dealing with contaminated soil and special waste. These guidelines should not be viewed as indicating a preference towards land treatment over these other technologies.

For more information on Land Treatment Facilities and the Contaminated Sites Regulation, please contact:

Environmental Programs Branch
Environment Yukon
Box 2703 (V-8)
Whitehorse, Yukon Y1A 2C6

Phone: (867) 667-5683
Toll-free: 1-800-661-0408 ext. 5683
Fax: (867) 393-6205
Email: envprot@gov.yk.ca

Website: <http://environmentyukon.gov.yk.ca/contaminatedsites>

Checklist A: Siting a Land Treatment Facility

The following is a list of factors that should be investigated and assessed when selecting a site for the storage and treatment of contaminated soils. Additional factors not listed here may also require investigation and assessment.

- The jurisdictional authority for the land where the site is to be located and permitting/approval requirements for developing on that land;
- Topographical features;
- Adjacent land features, uses, and structures;
- Surficial geology, soil characteristics and presence of permafrost;
- Heritage resources in the area;
- Wildlife and aquatic life;
- Existing and proposed land uses at the site (agricultural, park, residential, commercial, or industrial);
- Location and details of existing structures at the site;
- Type and frequency of public use in and near the area;
- Need for buffer zone to act as a visual/noise barrier;
- Potential for public interest or concerns in the facility and actions to identify and address public concerns;
- The hydrology at the site, including presence and location of water bodies, watercourses (freshet and year-round flows), drainage patterns and the groundwater regime;
- Water uses at the site; and
- Water uses adjacent to the site.

Checklist B: The Design of a Land Treatment Facility

Considerations for the design of a land treatment facility should include, but not be limited to the following:

- Site preparation requirements (the facility must either include an impermeable liner or be constructed over low-permeability soil);
- Design features that will prevent damage to the liner and berms, such as an extra layer of bedding sand over an artificial liner;
- Quality assurance and quality control measures to be implemented in the design and construction of the facility;
- Site maps and drawings that show the location of all facilities to be constructed, topography of the land, important structures and features, water bodies, drainage patterns, sampling and monitoring points, disposal locations, and any other feature which may be relevant;
- A natural or engineered berm of sufficiently low permeability to prevent leachate migration and adequate impoundment capacity to contain the leachate;
- Ditches, if required, to ensure that runoff cannot enter the land treatment facility;
- Restricted access to the site through fencing or other suitable means, and signs posted warning of the potential hazard; and
- Any other special environmental protection measures that may be necessary.

Checklist C: The Operation of a Land Treatment Facility

Considerations for operating a land treatment facility should include, but not be limited to the following:

- Criteria for accepting or rejecting wastes for treatment;
- Procedures for transporting contaminated soils;
- Plans for stockpiling contaminated soils and how the stockpiles will be maintained to prevent dust problems and mixing of material from different sources;
- Maximum depth to which the soil will be piled in the land treatment facility;
- Frequency and method of soil tillage;
- Type and application rate of any land treatment amendments which may be required, such as water, air, lime, nutrients or inoculants¹;
- A means of collecting and holding contaminated run-off water and leachate;
- A means of controlling dust from and runoff infiltration into the land treatment facility;
- Leak detection systems and groundwater monitoring;
- Triggers (such as elevated contaminant levels in groundwater samples) that will indicate that the facility is not performing as expected, and contingencies to be implemented when triggers are activated;
- Life of the facility and schedule of operation;
- Air emission considerations;
- Monitoring and sampling plans;
- Where, how, and when remediated soils will be disposed, including a confirmatory testing program and ensuring compliance with *Contaminated Sites Regulation* requirements; and
- A health and safety plan which addresses both site workers and, where applicable, nearby residents.

¹ Federal legislation, the New Substances Notification Regulations Amendment for Biotechnology Products, specifies information to be submitted if a substance intended for import or manufacture is not on the Domestic Substances List and meets notification criteria. For further information, contact the New Substances Notification Line at (888) 693-0473 (toll free in Canada) or at (819) 994-4737 (outside Canada).