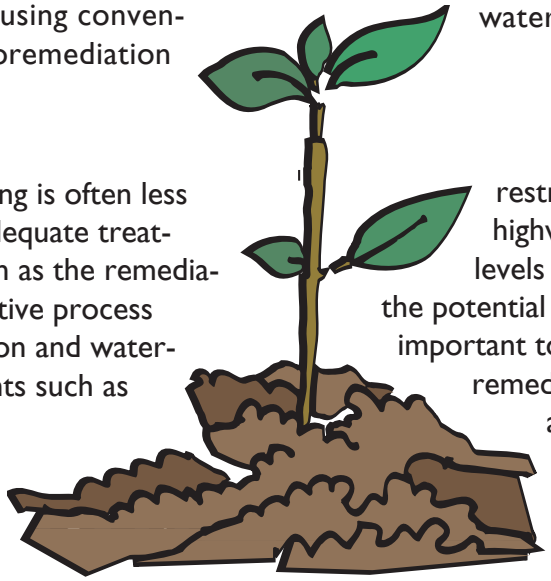
# LAND

# Bioremediation of Excavated Petroleum Contaminated Soil

## Introduction

The DEQ provides this information to facilitate approval of workplans for one-time biotreatment of petroleum contaminated soils using conventional landfarming techniques. Bioremediation will only be approved when appropriate controls are in place to protect the underlying soil, groundwater and ambient air.



## Economics

The cost of hauling and disposing is often less than building and maintaining an adequate treatment cell. If biotreatment is chosen as the remediation alternative, this must be an active process with appropriate and timely aeration and watering as well as additional amendments such as fertilizer or microbes. The default cleanup goal for the soils should be 50 mg/kg TPH. Levels higher than 50 mg/kg may be approved on a case by case basis depending on the proposed use of the soils after remediation, and the presence of adequate controls (for example, a fenced site on property where public access is restricted- an airport or interstate highway median- may have higher levels than 50 mg/kg allowed based on the potential exposures at that site). It is important to evaluate costs for different remedial options. Bioremediation is not a passive treatment and requires capital as well as operational and on-going analytical costs. We encourage careful comparison of biotreatment costs to conventional landfill disposal costs. Disposal in a landfill is often more economical, depending upon the volume of soil and the level of contamination.

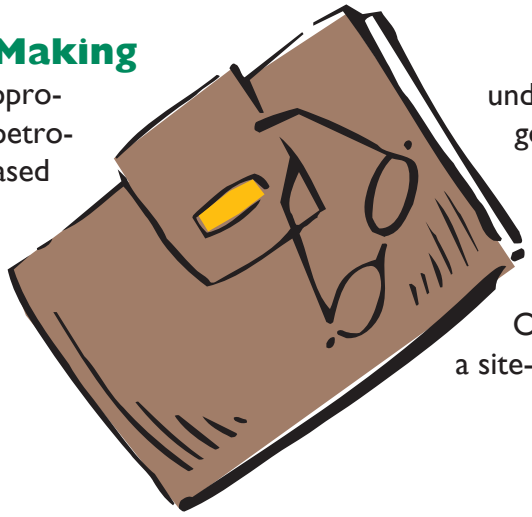
## Consent Order

It is unlawful for any person to cause pollution of the waters of the state or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any air, land or waters of the state. Any such action is a public nuisance. If the DEQ determines there is such pollution, an order can be issued requiring such manner of treatment or disposition of the polluting material as may be necessary to prevent further pollution. For voluntary clean-up activities of petroleum contaminated soils, the DEQ and the remediator can enter into a consent order, which contains the terms of the remediation.

A consent order will require submittal of a workplan for approval by the DEQ. The workplan sets forth design, construction and operational standards. Failure to follow an approved workplan could be a violation of the order and subject to enforcement actions under the Environmental Quality Code. (Specifically: 27A O.S. § 2-6-105(A), 27A O.S. § 2-6-105(B) and 27A O.S. § 2-3-506(B)

## Risk-based Decision Making

Decision-making regarding appropriate methods for dealing with petroleum contaminated soil will be based on protection of human health and the environment, both present and future. The responsible party may choose disposal or biotreatment based on cost considerations, with the understanding that the Department's goal is to achieve protection in both an economical and expedient manner. Reuse of soils remediated to higher levels than those detailed in the Remedial Options Section must be approved on a site-specific basis.



## Temporary Staging

Contaminated soil often is excavated from a site prior to testing. Regardless of where it is staged, the material must be placed on plastic (10-mil or thicker), bermed, and covered with 10- mil or thicker plastic to prevent run-off and vapors from forming. Staging is only temporary until disposal is approved or a workplan for bioremediation is approved by the Department.

## Sampling and Analysis

Petroleum contaminated soil should be adequately characterized. If information is available as to the type of spill then certain testing methods may be more appropriate than others. Gasoline may be characterized with Total Petroleum Hydrocarbon (TPH)/Gasoline Range Organics (GRO) and Benzene, Ethylbenzene, Toluene and Xylenes (BTEX), EPA Method 8020/8015(Modified). If the release is old, or the exact nature of the materials released is unknown, then Volatile Organic Compounds (VOCs) and Semi-volatile Organic Compounds (SVOCs) as well as the hazardous metals may need to be sampled and analyzed. Known diesel contamination may be analyzed with the Diesel Range Organics (DRO) portion of EPA Method 8015(Modified). (NOTE: Generally, composite samples should be collected for every 200 cubic yards of material. If testing is done on soil still in place, discrete samples should be collected every 20 linear feet, or according to approved grid.)

## Remedial Options

- **No Action -**Soil that tests at 50 mg/kg (ppm) TPH or less with no BTEX generally does not require remediation**.**
- **Disposal in a permitted landfill -**Soil testing under 1000 ppm TPH may be disposed at any landfill permitted to accept such waste. Soils greater than 1000 mg/kg TPH must go to a lined landfill with a leachate collection system**.**
- **Bioremediation -** Contaminated soils may be bioremediated on or off-site provided a consent order is in place and a workplan has been approved by the Department. The end point of bioremediation will depend on the designated future use of the soil.

## Work Plan

Biotreatment proposals must be accompanied by a workplan that includes all of the information on the attached WORKPLAN CHECKLIST. The workplan may be prepared while soil testing is still being carried out, but appropriate analyses must accompany the workplan when it is submitted to the department. The following subjects should be addressed:

### Site History

- Provide a detailed description of the nature and extent of the spill, including knowledge of whether the spill is recent or weathered, has had time to leach or sorb to the soil, and has had time to migrate to groundwater. Groundwater cleanup must be addressed on a site-specific basis and is not the focus of this document. If appropriate, testing for Methyl Tertiary Butyl Ether (MTBE) should also be included. Any other ingredients such as corrosion inhibitors, deicers or additives should be documented. Volumes and types of soil should be documented also.

### Location of proposed treatment area

- A description and map of the proposed biotreatment site are needed. Biotreatment sites should have a general location map, a flood plain map and Quadrangle Topographic map. Map requirements are detailed in OAC part 5 of 252:515-3. Depth to groundwater and public or private water well locations within 1 mile of the site should be documented through existing Oklahoma geologic maps or information developed for this project. No bioremediation projects shall be sited within the 100-year flood plain.
- If the bioremediation will take place on property other than that which the responsible party owns, a statement from the owner of the property, acknowledging that the bioremediation cell will be constructed on the property with the owners consent, should be included with the workplan.

### Design/Construction

- The workplan shall include construction and liner design diagrams. Details about the liner placement, protective layer, and depths of material to be placed in the cell should be shown on the diagrams. Berming materials should be specified and the drawings should include cross sections that show run-off control. Details should also depict drainage within the cell and management of water to prevent runoff and maintain proper moisture levels within the cell.
- The treatment cell should be designed to contain runoff, and prevent overflow from rainwater entering the cell. Determination of the 100-year flood level and boundaries shall be obtained by the applicant and furnished in the workplan for approval of a biotreatment cell. A proposed cell construction map should include: plan view, cross section, construction details, and dimensions. A surface contour map should also be included.
- Bioremediation projects should not be sited within 500 feet of a public or private water supply. Location of such wells or intakes from surface water may be obtained from the Department's Wellhead Protection Planning Group or the Oklahoma Water Resources Board. Bioremediation cells should only be sited where public access can be controlled with fencing, either around the cell or around a larger site perimeter.
- Groundwater protection is an important component to the design of a bioremediation cell. Usually, the liner for the cell should be composed of at least 20-mil thick geomembrane or equivalent liner system. The liner should be free from holes or blisters. Liner material shall be handled in a manner that will prevent damage by such activities as handling, use of equipment, tilling or watering. A sufficient layer of sand or other material should be placed on the liner to protect it during tilling or turning during the life of the project.

## Operations

- Narrative in the workplan should discuss biotreatment methods:
  Number of lifts for placement of material to be bioremediated; Total depth of material; Tilling schedules, including equipment types, depth of disking or ripping, frequency of turning and watering, moisture testing and requirements, as well as the application rate of any proposed amendments such as fertilizer or microbes; The plan should address whether an applicability determination from the Air Quality Division has been considered. This is necessary when volatile emissions could trigger the need for an air permit.
- The plan should discuss the frequency of analytical testing of the soil. A sampling and analysis plan should consider an appropriate number and depth of samples to document that soils have reached the designated end point. Quality Assurance and Quality Control must be appropriate to document precision and accuracy of the analytical data.
- The plan must include final disposition of the soil. The geo-synthetic liner must be removed, and properly disposed, unless the site is to be graded with soil in place. When the liner is removed, testing of the soil underneath may be required if evidence of liner failure is discovered. The site must be appropriately re-vegetated. If the soil is remediated to the default cleanup levels of 50 mg/kg TPH and no detectable BTEX, then the soil may be used for any purposes. In some cases, where the soil is proposed for use on an industrial site, higher levels of TPH may be allowed to be used as fill or as construction base. Approval of such uses will be given on a site-specific basis. In no cases should soil from a bioremediation project be placed where runoff into streams or ditches may occur.

The following checklist may be used to determine if the required elements of the workplan are addressed:

## WORKPLAN CHECKLIST

1._____ Consent Agreement signed by responsible party and DEQ.

2._____ Characterization of soil, including laboratory data, QA/QC Plans.

3. _____ Location of proposed bioremediation site, including flood plain maps.

4. _____ Ownership verification for proposed site.

5. _____ Groundwater maps, depth to groundwater, distance to surface water, floodplain maps.

6. _____ Location of water wells within 500 feet; nearest public water supply wells.

7. _____ Volume of material to be treated.

8. _____ Design plans including liner construction.

9. _____ Control of public access.

10. _____ Air Quality Applicability Determination (if volatiles present) [405-702-4100]

11. _____ Schedule for Operations, including tilling, irrigating, nutrient addition

12. _____ Storm water control – How will storm water be handled? How will cell be dewatered if excess rain occurs?

13. _____ Proposed disposition of soil after remediation.

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