Alaska Department of Environmental Conservation
Spill Prevention and Response Division

June 2009

Environmental Cleanup Methods

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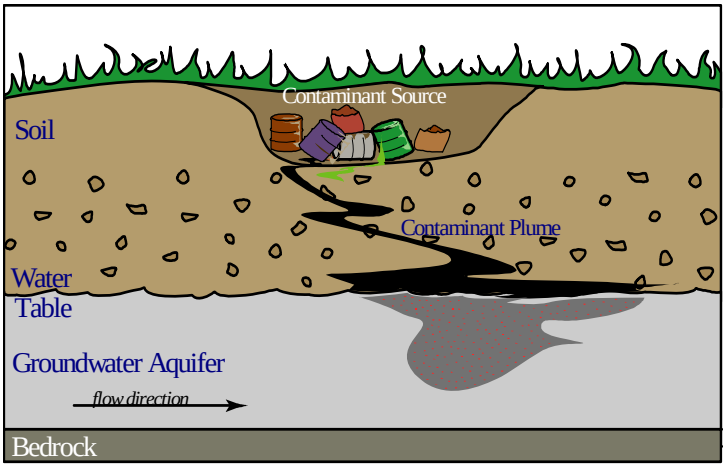


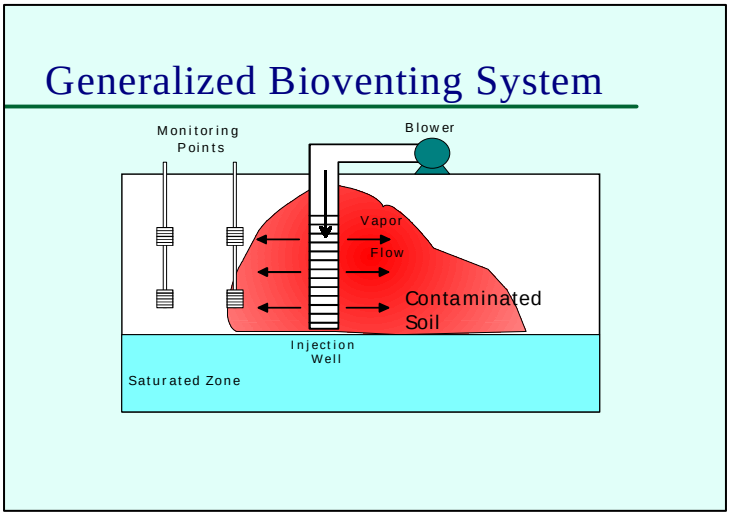
A diagram of below-ground soil and groundwater contamination.

There are many cleanup methods, or "remediation technologies," available to clean up contaminated sites. Some methods (remedies) do not work well in Alaska because they involve using natural heat, moisture, or sunshine, which are not abundant with Alaska's low temperatures and long winter seasons. The type of treatment that will work best can be determined by several factors, including the type of contaminant(s), presence of permafrost, groundwater flow, location of the site, and the interaction of these variables. Some common remediation technologies that work well in Alaska are discussed below. Underlined words are defined in the glossary.

I. Soil Treatments

- ***Bioremediation***

Bioremediation uses microorganisms (such as bacteria) to break down organic contaminants, like petroleum products, in soil or groundwater. Additional microbes, nutrients, moisture, and oxygen may be added to the soil or groundwater to increase the breakdown rate. Oxygen is the additive used most often, since most soils have sufficient numbers of microbes to break down contaminants. When soil is contaminated with oil, the soil is often put with additives into a container called a biocell, which confines the contamination while the microorganisms do their work. This type of treatment is fairly inexpensive and can usually be maintained by the person responsible for the contamination. The disadvantages are: a long length of time required due to Alaska's climate, and the treatment is labor-intensive.



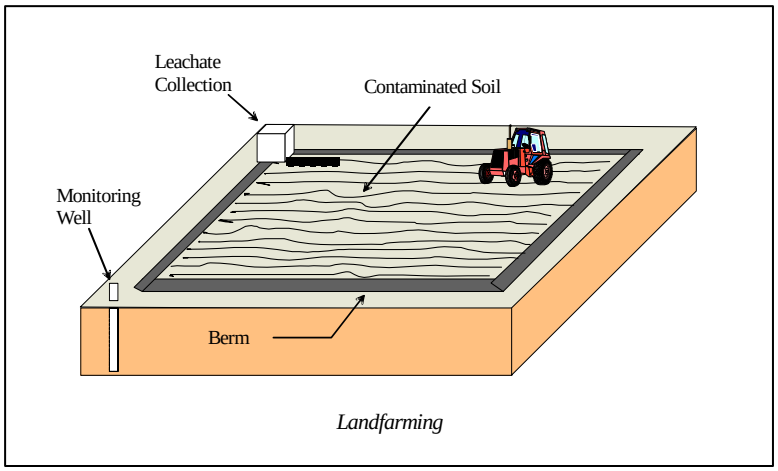
- ***Bioventing***

Bioventing is a type of bioremediation where air is blown into or pulled out of soil. The air supplies oxygen to help bacteria in the soil grow better and allow them to break down the

contaminant. Oil is ultimately turned into carbon dioxide and water.

Bioventing works well with light contaminants which evaporate easily, such as gasoline, and not as well with heavier contaminants like oil.

- ***Landfarming***



Landfarming

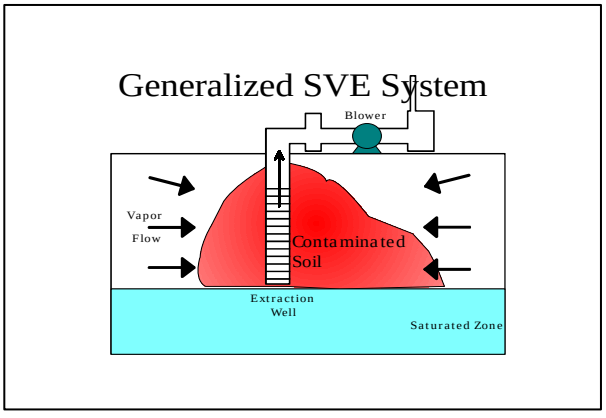
Landfarming involves placing contaminated soil in a biocell. The biocell consists of a liner surrounded by a berm. The soil is placed on the liner, fertilized, and turned periodically to help bacteria break down the contaminant. It works best for oil-type spills. The berm is placed around the area to control water running onto and off of the contaminated soil. Water that seeps through the contaminated soil is collected in a leachate collection system made up of perforated pipe and placed above the liner, to prevent contamination from spreading from the area or to groundwater. One or more monitoring wells are placed around the area to collect samples of groundwater for testing to see if any contamination has escaped.

- ***Landspreading***

Landspreading consists of tilling contaminated soil into the surface layer of a field and letting natural biological action and aeration clean up the contamination. The main difference between landspreading and landfarming is that landfarming is a more active method, because it involves fertilizing and re-tilling the area. In both cases, periodic soil samples are tested to check on how breakdown of the contaminants is progressing.

II. Mechanical/Engineered Methods

- ***Soil Vapor Extraction***



This method involves putting perforated pipes into the contaminated soil and pulling air through the soil and into the pipes. This works well if the contaminant is a volatile compound, like gasoline, which easily turns into a vapor. The air may then be treated before being released. In Alaska, this can work well even in winter. Sometimes it is used on piles of contaminated soil that have been excavated, but it can also work on soil that is still in place. Periodically the soil is sampled to see if it meets the cleanup level.

- ***Soil Washing***

As its name suggests, this method involves removing contamination from soil, gravel, or rocks through washing. Washing can be with water or a solvent that dissolves the contaminant. The contaminated soil

must be moved from its original location to an area where the contaminated wash water can be collected and treated. Soil washing also separates small, more contaminated, soil particles from larger soils and gravel. The disadvantage to this method is that it requires a lot of water, and then the water has to be treated to remove contamination.

- ***Natural Attenuation and Monitoring***

Naturally occurring physical, chemical, and biological processes in soil and water can slowly break down contamination into non-hazardous components and reduce contaminant concentrations to acceptable levels. Natural processes include dilution (dispersed in moving water, for example), volatilization (turned into a vapor), biodegradation (broken down by bacteria in soil or water), and adsorption (attached to soil or vegetation). Natural attenuation can be used for both soil and water. It may be allowed in lieu of cleanup if there is little chance that the contamination will pose a threat to people, plants or animals and when other treatment is impractical or impossible. When this solution is allowed, the contaminated soil or water must be monitored to show that the contaminant level has decreased and a health or environmental problem does not exist. Generally, monitoring must be carried on for a longer time in Alaska, because natural attenuation can take much longer due to cold temperatures and short daylight in the winters.

- ***Incineration***

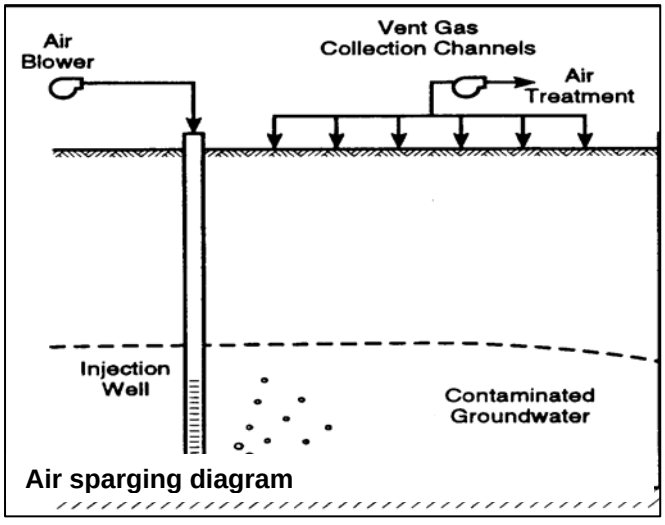
Soil contaminated with hazardous substances that can be burned at moderately low temperatures and result in safe byproducts are good candidates for incineration. Chemicals that need a much higher temperature or do not form safe byproducts can still be incinerated, but the job must be done at a special incinerator with good air quality control devices. If a large amount of soil must be treated, a mobile incinerator can be brought to a site. In-state soil burners are able to handle oil-type spills. Soil contaminated with hazardous wastes, like PCBs or solvents, must be shipped out of state because they require special types of EPA-approved incinerators that are not available in Alaska.

III. Groundwater Treatment

- ***Natural attenuation*** (see section II) and ***bioremediation*** (see section I) are the most commonly used treatment methods for groundwater in Alaska.

- ***Air Sparging***

Air sparging is a method in which air is forced downward into a contaminated aquifer. Air bubbles move horizontally and vertically through the soil, creating an underground stripper that removes contaminants by volatilization. These air bubbles carry the contaminants to a vapor extraction system. Air sparging wells can also be used to create a barrier preventing contaminated groundwater from leaving a site.



Air sparging diagram

- ***Pump and Treat***

This method involves pumping contaminated water out of the ground, running it through a filter or other treatment system to remove the contamination, and returning the water to the ground. It is effective for any contaminant for which there is a good filter

method, such as dissolved oil. It often takes many years to successfully remove the contamination. This method is not often used in Alaska but is common in the Lower 48.

IV. Removal of Contaminated Soil, Water or Debris

Sometimes contaminated material may have to be removed and shipped to an off-site waste treatment and disposal facility. This can happen when the contaminant cannot be removed easily by any of the methods discussed above, or when the responsible person wants to clean up and close the site quickly.

For More Information

Alaska Department of Environmental Conservation
Contaminated Sites Program
Main Offices:
Anchorage: (907) 269-7503 Juneau: (907) 465-5390
Kenai: (907) 262-5210 Fairbanks: (907) 451-2153

Homepage:
www.dec.state.ak.us/spar/csp

Reference list

U.S. Army Corps of Engineers Toxic and Hazardous Materials Agency, *Installation Restoration and Hazardous Waste Control Technologies*, 1992.

DOD Environmental Technology Transfer Committee, *Remediation Technologies Screening Matrix and Reference Guide*, Document number EPA/542/B-94/013, October 1994.

Glossary

Aquifer: a subsurface area composed of saturated ground containing sufficient groundwater that the water can be pumped out.

Bacteria: single cell organisms. In remediation activities, bacteria can break down chemicals.

Ex situ: remediation that is performed on soil or water after it has been removed from its original location.

In situ: remediation that is performed without removing the soil or water from its original location.

Leachate: water and sludge that has passed through contaminated soils. Leachate can be compared to making coffee, the water flows down through the coffee grinds.

Microorganisms: tiny living things including bacteria.

Organic contaminant: A contaminant partly made of carbon and hydrogen, for example, oil.

Responsible Person: The owner, operator, or person otherwise legally responsible for cleaning up a contaminated site.

Volatile compound: a compound that evaporates easily.

This fact sheet is one of a series of free publications prepared by DEC to help people understand contaminated site cleanup issues. The others can be found at **www.dec.state.ak.us/spar/faq.htm#csp**