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## Managing Waste

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### Landfills

After source reduction, recycling, and composting, a large portion of municipal solid waste (MSW) still goes to landfills. While disposal of waste to landfills has decreased, it remains the primary disposal option for MSW.

A municipal solid waste landfill is where household waste is deposited and buried. Properly managed landfills are an environmentally safe means of disposal, and are closely monitored for their environmental impact by the U.S. EPA, as well as state and local authorities.

The number of landfills in the U.S. has steadily declined over the past two decades, but has remained relatively constant since 2002. The average size of landfills, however, has increased. While landfill capacity is largely sufficient, it may be limited in some communities.



### Landfill Standards

Modern landfills are well-engineered facilities that are located, designed, operated, and monitored to ensure compliance with federal regulations, and to protect the environment from contaminants which may be present in the solid waste stream.

Municipal solid waste landfills are regulated under Subtitle D of the Resource Conservation and Recovery Act passed by Congress in 1976. In 1991, the U.S. EPA published a supplemental set of Landfill Rules which now serve as the basis for state regulatory and permitting requirement.

Standards for municipal solid waste landfills include restrictions on location, requirements for liners, collection and removal systems for leachate, operating best practices, groundwater monitoring, and closure requirements. New landfills may also collect potentially harmful landfill gas emissions, such as methane, and convert them into energy.

Because today's landfills need to operate with unquestioned safety and efficiency, it often can take five or more years from the time a site is selected until design, permit application, and public hearings are completed and the facility is built.

### How a Landfill Works

A typical landfill is divided into a series of sections called "cells." Solid waste is placed in what is called a "working face," which is a portion of a landfill cell that is currently available to accept material. Limited sites in a landfill are exposed at any given time to minimize exposure to environmental elements like wind and rain. Because a landfill is filled so systematically, landfill operators may be able to pinpoint where a specific load of garbage was deposited days, weeks, or even months afterward.

At the conclusion of each day's activity in a cell, a "daily cover" is spread across the compacted waste to minimize odor, prevent windblown litter, and deter insects and vermin. The daily cover may include a layer of dirt, clay, foam, tarps, sand, or sometimes finely crushed glass. The landfill operator moves from working face to working face, and from cell to cell as the landfill gradually reaches its capacity over a period of years, or even decades.

### Environmental Safeguards

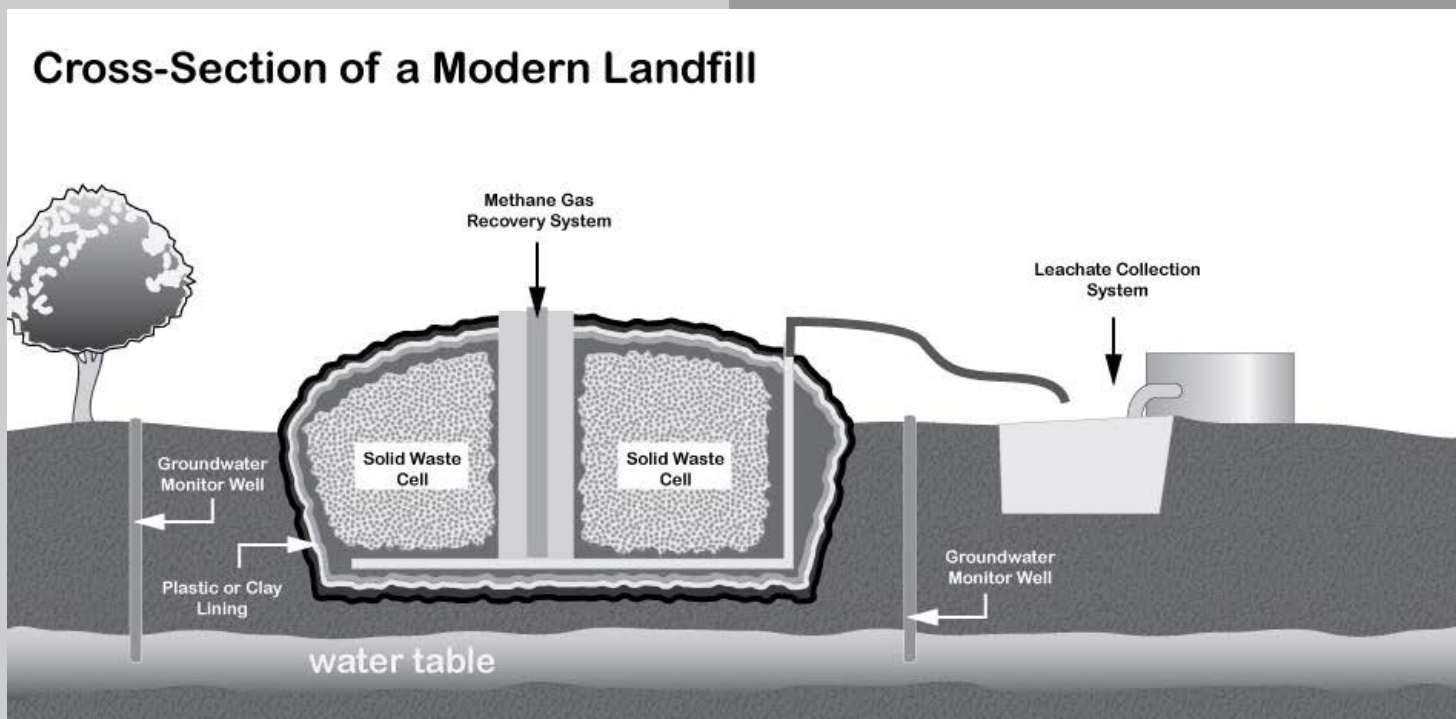
Modern landfills are constructed with a number of safeguards, including clay or plastic lining to contain leachate. Rain, snow, and liquids created by the compaction and decomposition of solid waste, which can seep through a landfill cell, is called "leachate." Leachate is a potential pollutant of surface waters (lakes, rivers, streams, or oceans) or groundwater, which is the source of most drinking water.

A protective liner is used to prevent filtration of liquid from the landfill. Liners may be made of compacted clay or impermeable materials

such as plastic, or both. When clay is used, the layer may be as much as ten feet thick. This site preparation is done so that any liquid entering the landfill can be controlled and treated externally, or retained inside the landfill, rather than being permitted to pass through.

Beyond protective liners, modern landfills include multiple safeguards to contain leachate and other waste and waste byproducts and isolate them from surrounding water and soil. To prevent leachate contamination, a network of drains is installed at the bottom of the landfill to collect the liquid that has percolated through the solid waste. Leachate is then pumped to waste water recovery points for treatment.

Groundwater monitoring wells are also installed around the perimeter of the landfill to ensure that surrounding groundwater is not contaminated with leachate. Should a liner system fail by breaking or deteriorating, leak detectors installed under the liners signal the presence of leachate, allowing corrective action to prevent any movement of leachate from the landfill toward nearby ground or surface waters.



## Landfills and Gas Emissions

Gases emanating from the landfill are also monitored and controlled. As the organic portion of waste (e.g., food and yard wastes) decomposes, large amounts of methane, a greenhouse gas, and carbon dioxide are produced. Under the Resource Conservation and Recovery Act and the Clean Air Act, landfill operators are required to monitor gas both on the surface and around the boundaries of landfills.

As cells to the landfill are sealed off, venting systems are installed to prevent methane from diffusing into the ground, and to collect any gas released and burn it off. The gas can also be collected and used to generate electricity for use on site or to sell for residential or business use.

## Closing a Landfill

When a landfill has reached its capacity, it is required to close consistent with U.S. EPA "final cap" environmental requirements. A final layer of plastic, clay and top soil cap the landfill. It is then re-landscaped according to closure plans drawn up in accordance with the community. This process is planned many years in advance. To be granted a license to operate, a landfill operator must have a complete plan for the site's eventual closure. The operator is also required to set aside necessary financial resources for all closure, post-closure, and corrective activity which may be needed over the lifetime of the landfill.

Once a landfill is capped and closed, operators are obligated to monitor the site for gas and leachate for at least 30 years, and may be involved in ongoing efforts to reclaim the land for other uses. Landfills can end up as open space for communities to use as parks, or other recreational facilities. Building any permanent structure on landfills is less common because, as solid waste decomposes in the landfill, the entire landscape can settle. A structure on the site could break the "cap," allowing water to percolate through the garbage and potentially allow the release of methane gas.

