



# An Introduction to Sanitary Landfills

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# An Introduction to Sanitary Landfills

J. Paul Guyer, P.E., R.A.

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## 1. INTRODUCTION

Options available to eliminate the quantity and specific types of refuse in sanitary landfills include incineration, recycling, composting yard wastes and landfills designed for a specific waste requiring permits (e.g. hazardous waste landfills, asbestos landfills, etc.). So there might be less transport of refuse, placement of landfills close to the center of population would be the most desirable situation for the designer. Adverse public sentiment and the cost and availability of land usually are the deciding factors for locating a landfill, which make transporting the refuse to a more advantageous location the preferred option for many authorities. New technologies that can produce a closed landfill system, a self-contained system resulting in very little impact on the surrounding environment, have resulted in more restrictive legislation and regulations for sanitary landfills. Therefore, site selection and proper landfill design are considered the most important factors in the refuse disposal process.

**1.1 Laws and Regulations.** Representative laws and regulations controlling site selection and design of sanitary landfills include those indicated below. This is not a comprehensive list of federal, state and local laws, ordinances and regulations applicable to the site selection and design of sanitary landfills. Specific projects must be governed by the laws and regulations of the project site.

### 1.1.1 Federal.

**1.1.1.1 40 CFR 240 and 241.** For the design and operation of new landfill sites, 40 CFR 240 and 241 were implemented by the Solid Waste Disposal Act of 1965 as amended by the Resource Recovery Act of 1970. These regulations, which were promulgated by the U.S. Environmental Protection Agency (USEPA), are mandatory and require control of leachate to prevent degradation of surface and groundwater quality.

**1.1.1.2 CFR 40, Part 257.** 40 CFR 257 provides guidance on evaluating existing landfill sites to determine if they are suitable for continued use. In essence, this regulation states that landfills that pollute surface waters or contaminate underground drinking water sources should be considered “open dumps” and therefore must be either upgraded or safely closed.

**1.1.1.3 40 CFR 258.** In September 1991, 40 CFR 258 was promulgated. It provided further location restrictions, operating criteria, design criteria, ground-water monitoring, corrective action requirements, and closure and post-closure care requirements. Specific requirements of 40 CFR 258 are explained in applicable chapters of this manual.

**1.1.1.4 Leachate.** Landfills that release leachate into surface waters or underground drinking water sources can also be subject to the provisions of either the Clean Water Act (CWA) or the Safe Drinking Water Act (SDWA). Contaminants entering the ground-water, which are determined to be priority hazardous pollutants, require remedial action under either SDWA or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), referred to as the “Superfund Law.”

## **1.1.2 State.**

**1.1.2.1** Enforcement of Federal solid waste regulations is now delegated to many states. The law delineating state responsibilities is the Resource Conservation and Recovery Act (RCRA). The mechanism used to discharge this responsibility is the Solid Waste Management Plan, developed by a state and approved by USEPA. An outgrowth of these management plans is definitive state regulations that prescribe design and operating standards for landfills. Most state regulations also require that every landfill operator obtain a permit for each facility, and that a registered professional engineer design the disposal facilities.

**1.1.2.2** A majority of states specifically require groundwater monitoring systems, and many of the remainder have general authority to impose groundwater monitoring on a site-specific basis. Almost all of the states have either requirements in their regulations, or have general authority to impose corrective action. Approximately half of the states require methane gas monitoring and/or surface water monitoring. While most states have general guidelines or requirements for facility closure and post-closure maintenance requirements, these requirements vary widely in stringency.

**1.1.2.3** Most states have issued separate regulations on hazardous waste management. Consequently, whenever a leachate release contains a hazardous substance, corrective action will be required and will be guided primarily by these regulations.

**1.2 Solid Waste Characteristics.** In the past, lawn and garden trimmings have made up approximately 12% of the waste in municipal landfills. Also, many municipalities are no longer disposing of yard or garden wastes in sanitary landfills; instead the waste is land farmed or disposed in non-sanitary landfills, such as approved fill areas. To further reduce the waste streams, many areas now burn wood, recycle metal and other materials, and use dirt, concrete, and brick for erosion control projects.

## **1.3 Alternate Disposal Methods.**

**1.3.1 Alternatives.** The options generally available are contractual arrangements, sanitary landfills, and incineration, but new methods may be introduced as they become economically viable. The preferred method of solid waste disposal is to participate in a regional solid waste management system, if feasible. In the absence of a regional system, contractual arrangements for hauling and/or disposal with a public agency or a commercial entity may be practical. When contractual arrangements are impractical and where conditions are suitable, alternative methods to sanitary landfills may include incineration with energy recovery, recycling of suitable materials, and composting organic matter.

### **1.3.2 Comparison of Alternatives.**

**1.3.2.1** Sanitary landfilling is generally preferred over other alternatives, because there is less handling and processing of materials. However, a landfill may not be the most economical or environmentally preferred method. The rapid filling of available sites, and outdated containment systems of existing landfills have forced authorities to consider alternative disposal methods. A combination of the options listed above may be the best solution, but may depend on several factors at the installation, including: the type of refuse, availability of land for site selection, incinerator accessibility, economic feasibility for recycling usable materials, suitable locations for large quantity composting, and possible contractual arrangements that would combine several of these methods.

**1.3.2.2** The main advantage of a sanitary landfill is that handling and processing of refuse is kept to a minimum. Handling is limited to the pickup and transport of the waste, the spreading of refuse, and covering with a suitable cover material. Composting requires more handling before it is stored to decompose, and may only be suitable for disposing of organic matter such as yard waste. Therefore, composting may not be a viable alternative for a majority of the situations. Recycling requires that only specific materials be processed, and requires more handling than most other methods, but can reduce solid wastes in a landfill by as much as 30%. After the material is collected, it may go through various changes and processes, at a substantial expenditure of energy, before it results in a reusable form. Recyclable materials include paper, plastics, glass, metals, batteries, and automobile tires. Incineration with energy recovery has been used for some time, but has come under increased scrutiny because of new laws and regulations aimed at reducing air pollution and the resulting products of incineration may be even more dangerous than originally thought. Clean air laws, and negative public sentiment may require additional expense and waste treatment that can make incineration the least favored alternative. Ash residue and bulky refuse which are not burned during incineration will still require disposal. The main advantage of incineration is the capability to reduce landfill use by 70-80%.

**1.3.2.3** The critical factors which must be considered include: the possibility of surface and groundwater contamination, explosions from gases generated by waste decomposition, airborne ash from incineration, odors from the composting process, and the lack of suitable sites with the capacity for long term use are critical factors which must be considered. Design authorities must make decisions which are critical to the areas surrounding the proposed sanitary landfill. Selecting a method for proper and complete disposal can be a very intricate process.

## 1.4 Solid Waste Stabilization in a Sanitary Landfill.

**1.4.1 Alternatives.** While past designs required that landfills receive extended maintenance after closure, increasingly stringent regulations and the shrinking availability of suitable sites for landfills may force the designer to consider some of the technologies that can speed up solid waste stabilization. Stabilization of deposited refuse, mainly through decomposition, can reduce surface subsidence. Landfill designs offer

**1.4.2 Dry Landfills.** In hopes of reducing leachate production, the landfill system. Unfortunately, this “dry” system. Archaeological evidence which was preserved from the rotting influences of decomposition could possibly require more decomposition of the solid waste.

### 1.4.3 Wet landfills.

**1.4.3.1 Biodegradation.** Closed systems, or landfills that use leachate recirculation, are a favored option when considering solid waste stabilization as a priority for the landfill. Since most biodegradation results from complex interactions of microbial bacteria, these “wet landfills” may also require the addition of air along with the recirculation of leachate. Lined landfills that have been properly designed and constructed provide leachate containment with a low risk of leakage.

**1.4.3.2 Gas Generation.** Methane gas generation is considered to be a problem at some landfills. Therefore, the production of methane and other gases should be considered in the design. The economics of extracting methane gas as an energy source makes accelerated methane gas production a benefit of wet landfill designs. This may require that containing and recovering the

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