WASTE DISPOSAL IN LANDFILL

WASTE – A MOUNTING PROBLEM

The risks of not properly controlling waste disposal are:

1. **Air pollution**
2. **Soil contamination**
3. **Landscape degradation**
4. **Water pollution via leachate**

Our current strategies to managing waste are

1. **Isolation by burying waste** *(also includes containerization and storage)*
2. **Incineration, diluting or spreading the waste**
3. **Recycling paper, glass, metals and some plastics**

In Britain a massive 111 million tons of waste is buried every year (However in 2014 only 23.1% went to landfill). The first solid waste landfill site was established in 1912. So how do landfill's work?

- **Waste is compacted** by heavy machinery
- At the **end of each day a 15cm** thick layer of **soil isolates** the day's waste
- When the landfill is full, the site is sealed by a **layer of soil 50cm thick** and the **surface graded so water runs off.**

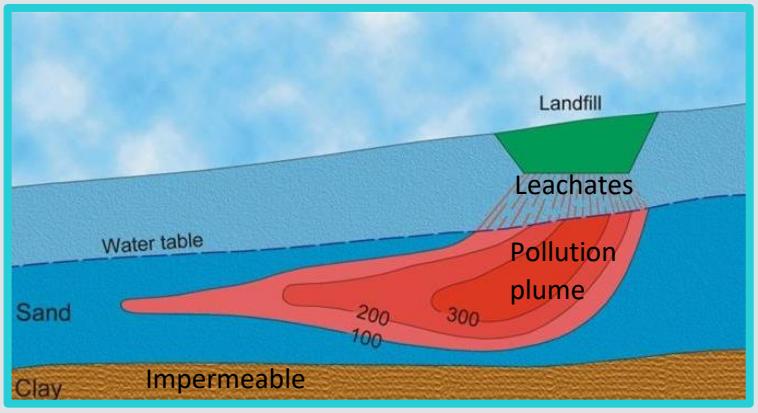
People have the same attitude to landfill sites as they do quarries. No one wants one near their **neighborhood** but we all produce waste which must be deposited somewhere. Often, **disused quarries** and **sand, gravel and brick pits** are used. They are seen as **ready-made holes** in the ground but unfortunately, the geology is rarely ideal for waste disposal. It is best to site a landfill near to an urban area to reduce the cost and fuel associated with waste in transit.

Environmental consequences of landfills:

- During the activity of the landfill site (tipping), the area is **subjected to noise, dust, smells, vermin infestation and wind-blown litter**.

After operations cease:

- **Biodegradation** leads to **settling and subsidence** which may **open cracks and fissures** in the site so rainwater infiltrates waste.
- **Rainwater percolates** through the waste **dissolving soluble chemicals** and **collecting microbial bacteria**. The liquid formed is called **leachate** and the **leachate plume expands laterally** in the direction of groundwater flow.. The exact composition varies and it must be considered toxic unless proven otherwise.
  Leachate can **percolate** downward into the surrounding soils and groundwater leading to **contamination of local aquifers and agricultural** land.
- Additionally, large amounts **of methane** are released due to the large amounts of **anaerobic bacteria** thriving on the waste during **decomposition**. While there is little risk of fires and **explosions due to the anaerobic** environment, the gas must be **vented off** to prevent buildup of dangerous levels. Methane is a **greenhouse gas** but can be collected and sold as fuel.



Problems occur when the **underlying rocks** are **permeable** due to **joints, bedding planes and faults** and the **water table is close to the surface**. Contamination by leachates is likely.

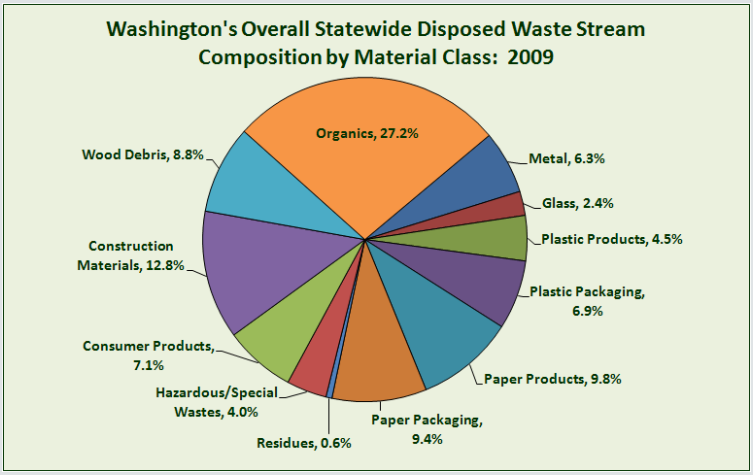
#Leachate = the fluid generated by water dissolving soluble chemicals from landfill waste.

#Landfill = disposal of waste where rubbish is buried in holes within the ground.

Types of waste for landfills or recycling

1. **Biodegradable** waste-food, garden materials, paper
2. **Recyclable** materials-paper, glass, plastic, cans
3. **Inert waste-construction and demolition** materials

Composite waste-clothes, children's toys, Household hazardous waste-paint, batteries, light bulbs, bleach, fertilisers, pesticides and computers.



Types of waste NOT for landfills

1. **Flammable items**
2. **Reactive or explosive substances**
3. **Chemicals that are corrosive or toxic**
4. **Medical waste**
5. **Radioactive waste**
6. **Toxic industrial waste & some batteries**
7. **Tyres**
8. **Mandatory recyclables**
9. **Explosives**
10. **Scrap metal**
11. **Large appliances (e.g. ovens)**

Landfill site construction

- To reduce the cost of operation, **disused quarries or brick pits are used**: readymade holes in the ground.
- An **impermeable base layer** is required to **prevent toxic leachate** percolating out the landfill. Types include clay, geomembrane linings like **HDPE** (**High Density Polyethylene**) and composite.
- When the landfill is abandoned, it is **sealed with an impermeable cap** the same as the base layer used. This is designed to keep rainwater out so **limit the production of leachate**. Furthermore, the impermeable cap **deceases the rate of decomposition** by limiting water and oxygen.
- Surrounding rocks are **grouted** to prevent leachate leakage.
- Leachate may be **drained and collected**.
- Methane gas can be **vented or collected** and transport by pipelines.

Some more measures to protect the environment

- Landfill sites are often covered with a **topsoil layer about 50cm** thick. This will often dry out and is a major source of **wind-blown dust**. **Water sprayers** are used to limit the dust and aid growth of **vegetation**.
- **Unpleasant odours** cause complaints among locals. Landfill operators monitor and log complaints. Spraying the waste with **essential oils** may help musk the smells.
- **Vermin** such as seagulls and rats are controlled by **pest eradicators and birds of prey** such as hawks, owls and falcons.
- Windblown litter may be collected using **litter fences** or mobile collectors on site.

Rock type

- **Fine grained** (<0.0039mm), **impermeable** rocks such as **clays** are best suitable for land fill sites and it is best if they have **thick, uniform, flat lying beds**.
- Porous and permeable rocks such as limestone and sandstone allow flow of leachate so are not suitable unless covered by an impermeable barrier. **Limestone may be dissolved by acidic leachate** leading to the formation of **solution cavities**. These will **destabilize the site.**
- **Crystalline** igneous and metamorphic rocks, when not affected by jointing or fracture, are the most suitable. Weathered rocks decrease stability and also increase permeability and porosity, however, **well cemented** sedimentary rocks can prevent leachates.

Geological structures

- Faults increase the **permeability** of rocks and provide escape routes for leachate as do joints in rocks such as limestone.
- Tilted or folded beds allow **down-dip and lateral movement of leachate**, which can migrate some distance away from the landfill site through permeable beds.
- **Anticlines** may have some **tension joints in their crests**.

Groundwater

- If the **water table is high** in relation to the landfill then there is **less distance from the leachate to travel** to reach underlying groundwater. The level of water may vary in aquifers.

  Control measures to protect groundwater and the environmental engineering practices are very high. Generally activities such as agriculture and urban areas result in more widespread pollution.

Some landfill sites will only take pre-compacted bails of waste so this limits noise around the site.