Waste Management

إدارة المخلفات

Prepared by

Dr. Karim Emara

Associated Professor of Heat Engines, Combustion, Energy and Environmental Science.

Mechanical Power Engineering Department-

Faculty of Engineering, Mataria- Cairo- Helwan University

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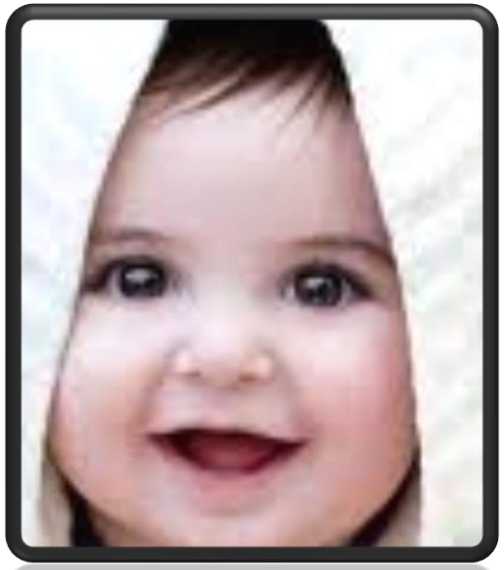
Lecture Strategy

Please



1- Smile

2- Respect the lecture time

3- Make your mobile Silent

CHAPTER (4)

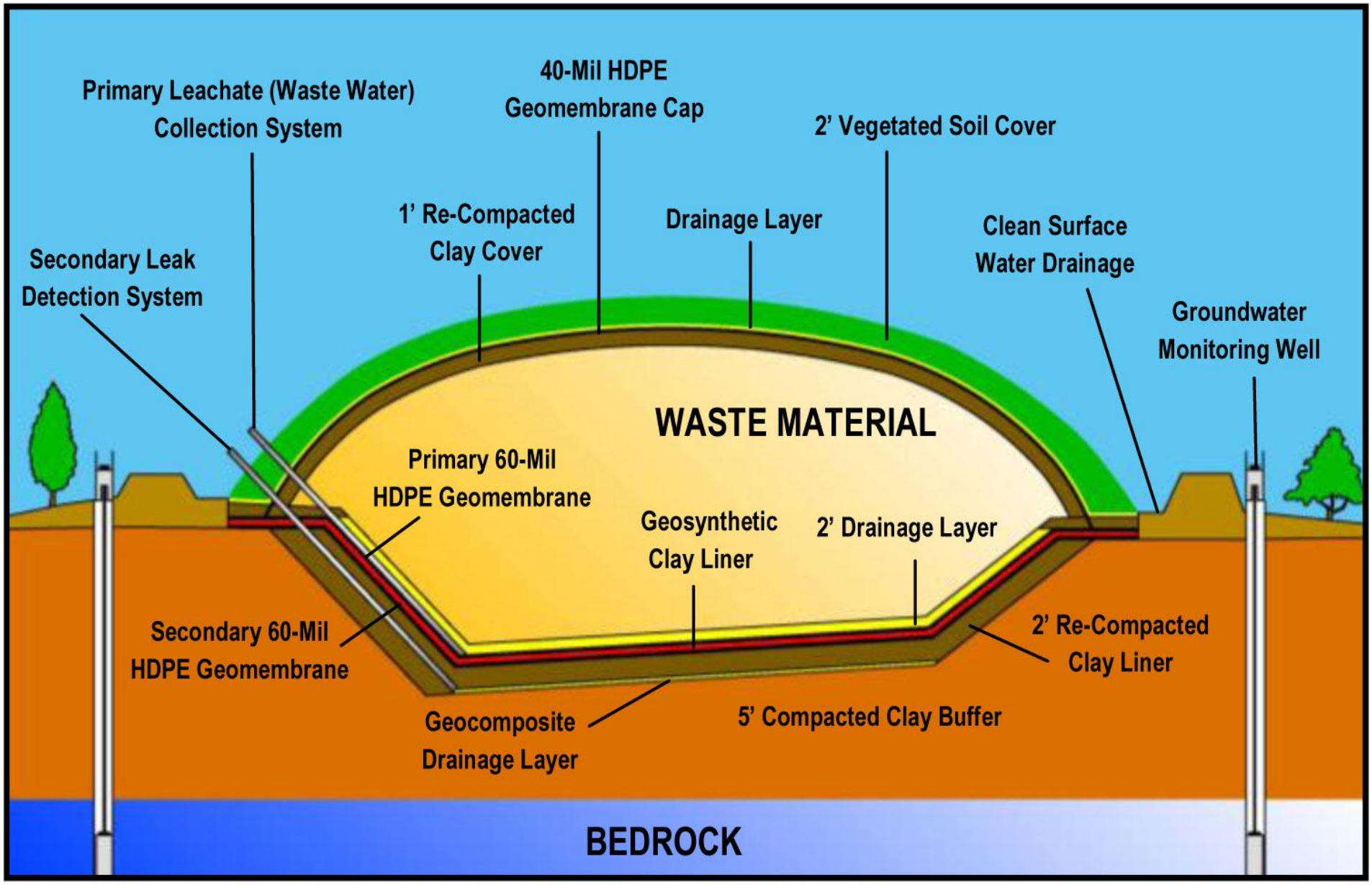
Landfill Design

What is a Municipal Solid Waste Landfill?

Definition

A municipal solid waste landfill (MSWLF) is a discrete area of land or excavation that receives household waste. A MSWLF may also receive other types of nonhazardous wastes, such as commercial solid waste, nonhazardous sludge, conditionally exempt small quantity generator waste, and industrial nonhazardous solid waste.

Landfill design



Landfill design

From Dump to Sanitary Landfill

Definitions (from World bank technical paper no.426.)

- Dump = uncontrolled dump causing hazards to human and environment
- Controlled Landfill = dump with covering of waste
- Engineered Landfill = controlled landfill + engineered measures to limit impact
- Sanitary Landfill = engineered landfill + landfill gas extraction + groundwater monitoring + highly trained staff + water treatment facility + ...

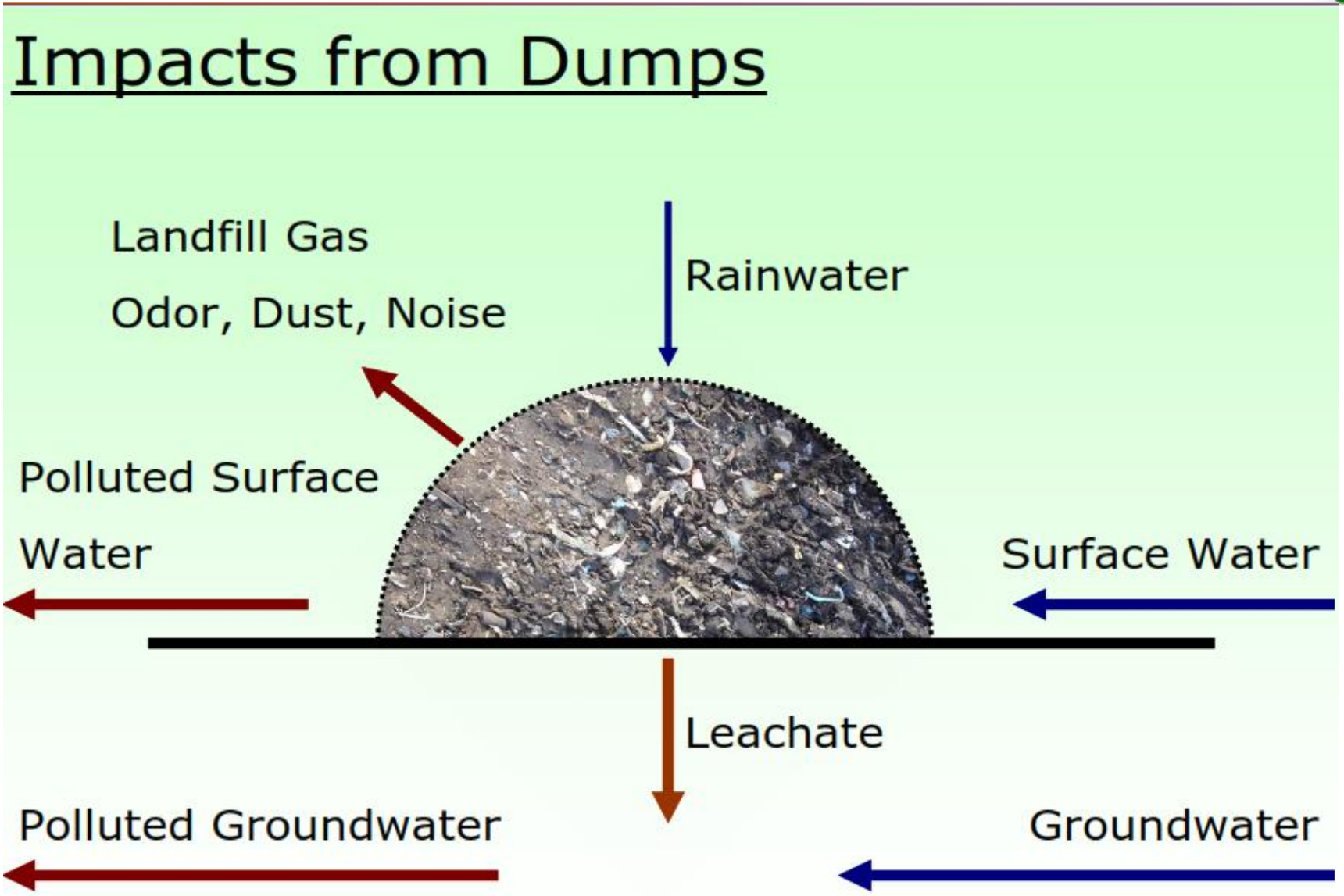
Landfill design

Impacts from Dumps

A dump will impact ist surrounding environment by:

- Its presence (area need, visual impact, social and economical impact)
- Transport of waste (noise and air)
- Waste attracts animals (vermins, insects)
- Waste emits landfill gas (odor, fires, global warming)
- Waste emits dust and other materials (plastic)
- Waste emits pollutant water impacting soil, surface water and groundwater (drinking water problems, food)

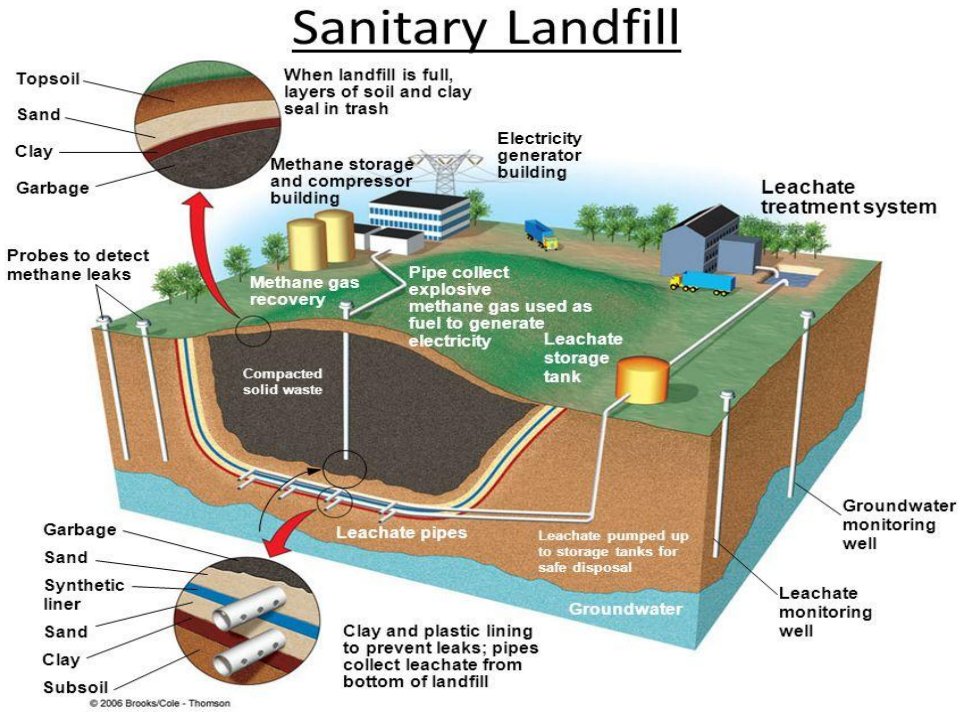
Landfill design



Landfill design

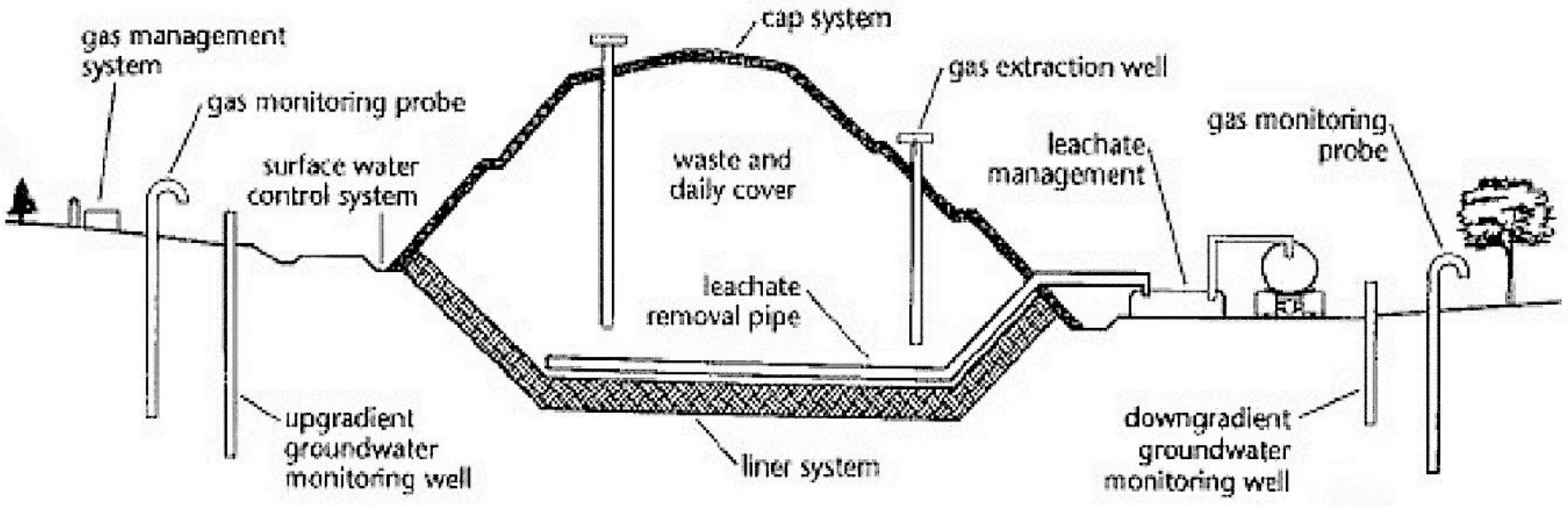
Open dumps were often clay and gravel pits or other low-value land filled with what ever waste that might appear, including industrial and hazardous waste: the waste was dumped from the truck where possible. As long as the dumps were small and local waste disposal sites, the impacts and problems were often only local and tolerable, maybe except with respect to smells, rodents and local fires.

The sanitary landfill offered a more orderly appearance by limiting access to the site (fences), organizing the disposal activities and often covering of the waste with soil. Where land was plentiful, the sanitary landfill could be trenches dug into the ground.



Landfill design

The controlled landfill offered controls on leachate and gas by introducing liners, collection systems and treatment facilities for leachate and gas.



Various bioreactor landfill technologies were suggested and, in some cases, introduced to enhance degradation and shorten the time for stabilization of the waste

Landfill design

The location of the landfill site should be determined by following 4 steps as follows:

Step 1: Collect maps and exclude sites having any of the following exclusion criteria:

- Located in floods area
- The site is a collection point for rainwater
- Located in areas with a groundwater level close to the subsurface (≤1 m)
- The surrounding areas are planned as residential areas.
- The location is less than 500 m from the nearest residential area
- Located within an area where explosives are used or military activities Located in a landslide area
- Located in less than 1.5 km from the nearest airport

Landfill design

Step 2: Identify a list of potential sites taking into account the following:

- Limited use of groundwater for drinking or agriculture due to its high salinity. Sites away from populated areas more than 1.5 km
- Area availability compared to the quantity of waste that will be disposed over the lifetime of the landfill and the size of these wastes and the extent of the site's accommodation of the volume of waste in terms of depth and height of waste.
- Geological factors such as high soil permeability or low soil bearing capacity, which reduces waste height.
- Groundwater aquifer direction of flow determine the probability of contaminants moving to nearby and descending receptors such as wells and springs. The potential health impact of pollutants is reduced if the flow of groundwater exposed to the pollutants is away from the receiving locations.

Landfill design

Step 3: Review and evaluate the proposed sites

A field survey of all potential sites is carried out and evaluated according to Table 5. Rating system based on grading (1, 2, 3) according to the nature of the site most suitable for each criterion, the appropriate sites will take the highest score (3) and the non-appropriate one will take a low score (1). The site with the accumulative highest grade is selected.

Landfill design

S	Evaluation Criteria	Site 1	Site 2	Site 3
1	Land ownership. Where ownership papers and the allocation decision are confirmed. Any obstacles in site, including the presence of private properties or houses or any other military or civilian entity.			
2	Site distance to the waste generating area and the impacts of the site on the collection and transport operations (need extra resources as transfer stations)			
3	Site distance to the main roads.			
4	Existing surface waters next to the site (rivers, streams, lakes).			
5	The ability of the site to hold rain water or Flood			
6	Groundwater level			
7	The existence of groundwater wells for drinking or agriculture.			
8	Flood path crossing the site			

Landfill design

9	Level of ground sealing materials required			
10	Availability of cover material from low permeability soil.			
11	Land use around the site. The boundaries of the site, the uses of neighboring lands, residents in the vicinity of the site and main potential problems of project construction			
12	The existence of power lines near the site, air hanged or underground			
13	There is a prospect for nearby archaeology or an archaeological area			
14	Traffic on roads leading to the site the main and sub roads surrounding the site, the effect of constructing and operating the site on these roads, need of access road			
15	Area available, capacity and lifetime			
16	Distance between the location and the nearest agricultural or residential activity around the site			
17	Cast of landfill construction (estimate)			
	Total Site Rating			

Landfill design

Step 4: The lifetime of the landfill can be estimated in planning phase using the following formula:

$$LS = (A \times D \times 2 \times 0.9) / \{(Wgr \times P \times 365 \times dv) / p\}$$

Where:

LS= life time in years

A= Site Area (m^2)

D= depth of landfill

Wgr= Waste Generation Rate (kg/person/day)

P= population served by the landfill

Dv= diversion rate from landfill due to treatment and recycling activities

p= density of collected waste (kg/m^3)

Landfill design

1. Criteria for Landfill design

Landfills should be designed according to the following criteria:

- **The site is divided into cells. Each cell will have a lifetime of minimum 5 years.**
- **Access roads to the cells and access ramps with suitable inclination for waste trucks.**
- **The main services are provided to employees including administrative offices and toilets**
- **A wire mesh fence around the site to prevent illegal access to the site**
- **Weigh bridge, capacity not less than 70 tons and length not less than 15 m equipped with solar cells shall be provided for operation 24 hours a day.**
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Landfill design

- **In the case of shallow groundwater minimum distance of I meter between the higher (seasonal) groundwater level and the bottom sealing of the landfill is maintained.**
- **The design elements of the landfill are:**

1) Dimension, depth and inclinations

2) Lining system.

3) Leachate collection and treatment system

4) Gas collection and treatment system

5) Surface water management


Thank
you