
بسم الله الرحمن الرحيم
In the Name of Allah
The Beneficent
The Merciful
It's Time To
Think Content!
n
Design of Landfills
and
Integrated
Solid Waste
Management
KEEP
CALM
AND
PROTECT THE
ENVIRONMENT


بسم الله الرحمن الرحيم
In the Name of Allah
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The Merciful
Designed By:
AfzaaL M.
HD Videos & HQ Images Inspiration

Landfill Site Selection, Requirements and Considerations

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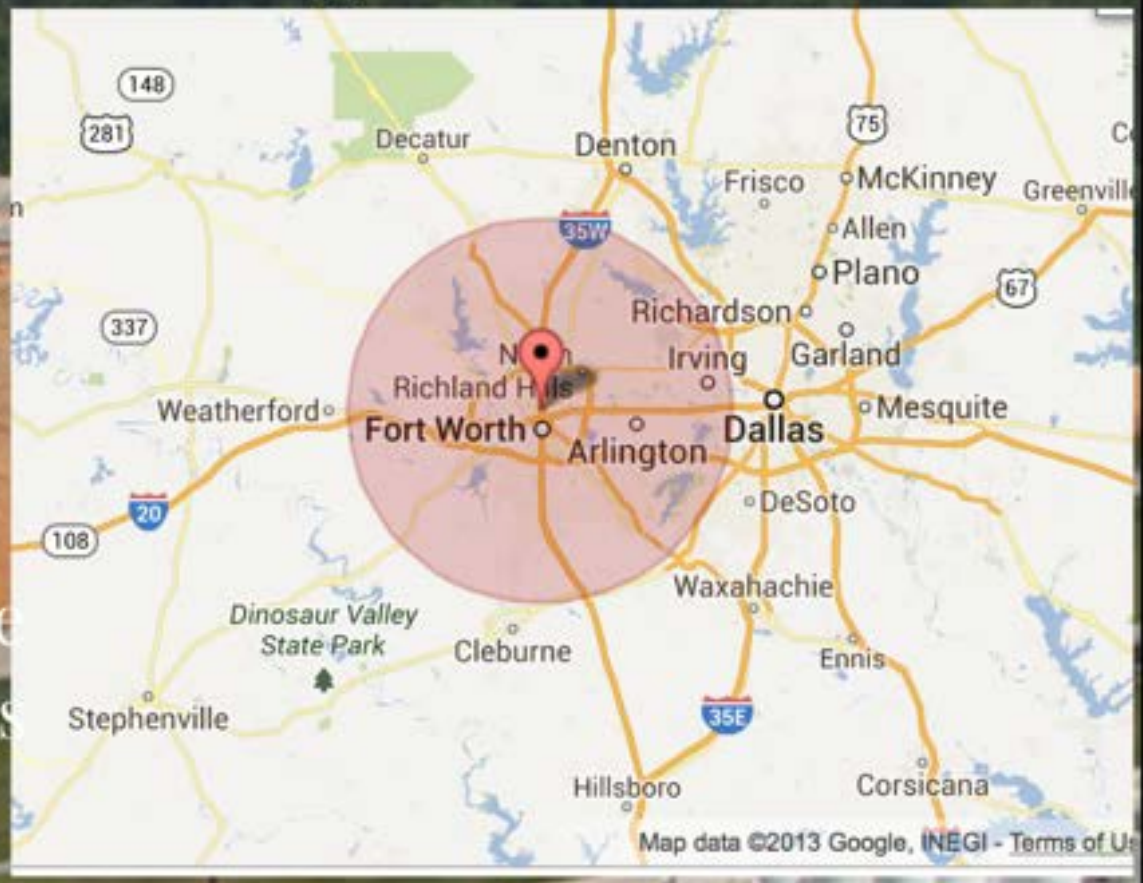
- Introduction
- Data Collection
- Locational Criteria
- Preliminary Assessment Of Public Reactions
- Development Of a List Of Potential Sites
- Final Site Selection
- Preparation Of Feasibility Report

Introduction

- A landfill site has to meet several locational and Geotechnical design criteria and be acceptable to the public.
- A preliminary list of potential sites is developed satisfying the first two criteria.
- For this purpose, usually a circle indicating a "search radius" (the maximum distance the waste generator is willing to haul the waste) is drawn on a road map of the region, keeping the waste generator (a city or industry) at its center.
- The search radius depends on economics of waste hauling.
- Hauling of waste is one of the high-cost items in landfill operation.

Introduction

- Search radius may have to be increased if potential sites cannot be located within the search area.
- If more than one waste generator is involved (e.g., several cities within a county) then a compromise location acceptable to the waste generators is used as the center.
- Since acceptability to the public is crucial to the landfill siting process, the citizens to be affected should be informed regarding the site selection process as early as possible.



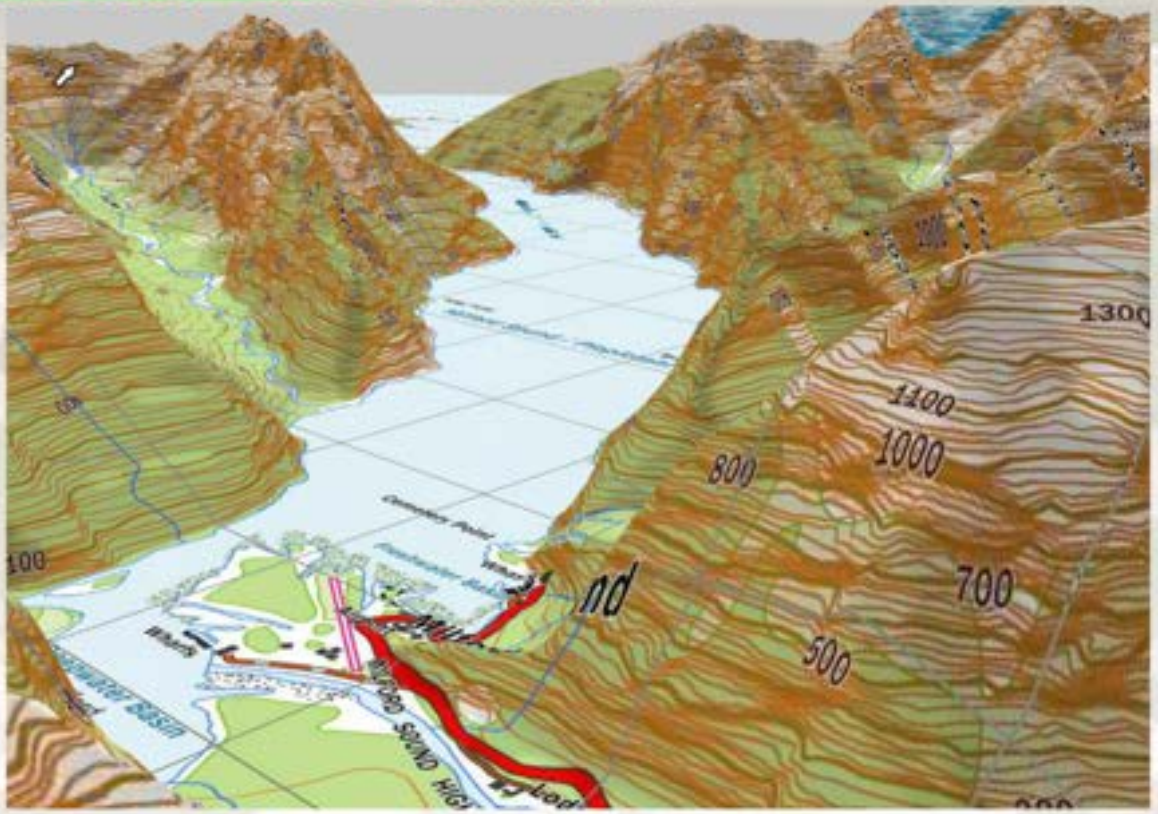
Data Collection

Several maps and other information need to he studied to collect data within the search radius. The following information is needed:

- Topographic map(s)
- Soil map(s)
- Land-use plants)
- Transportation plan(s) and etc.

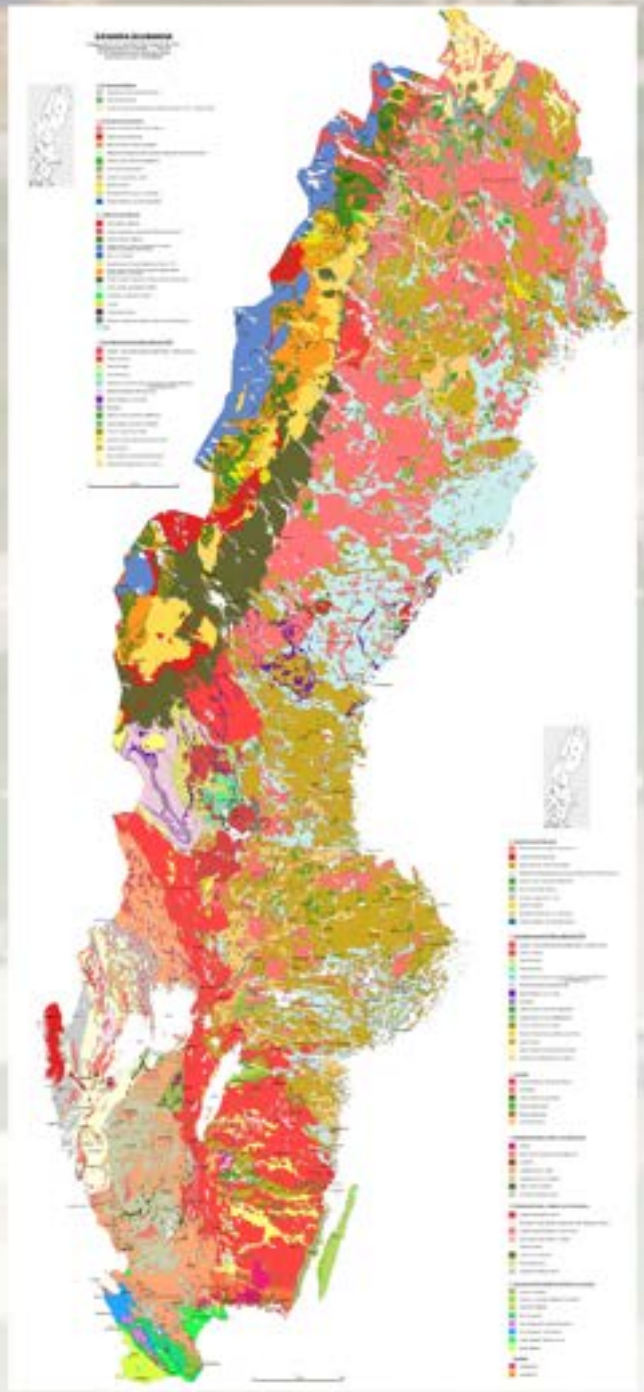
Topographic Maps

- The topography of the area indicates low and high areas, natural surface water drainage pattern, streams, and wetlands.
- A topographic, map will help find sites that are not on natural surface water drains or within a wetland.



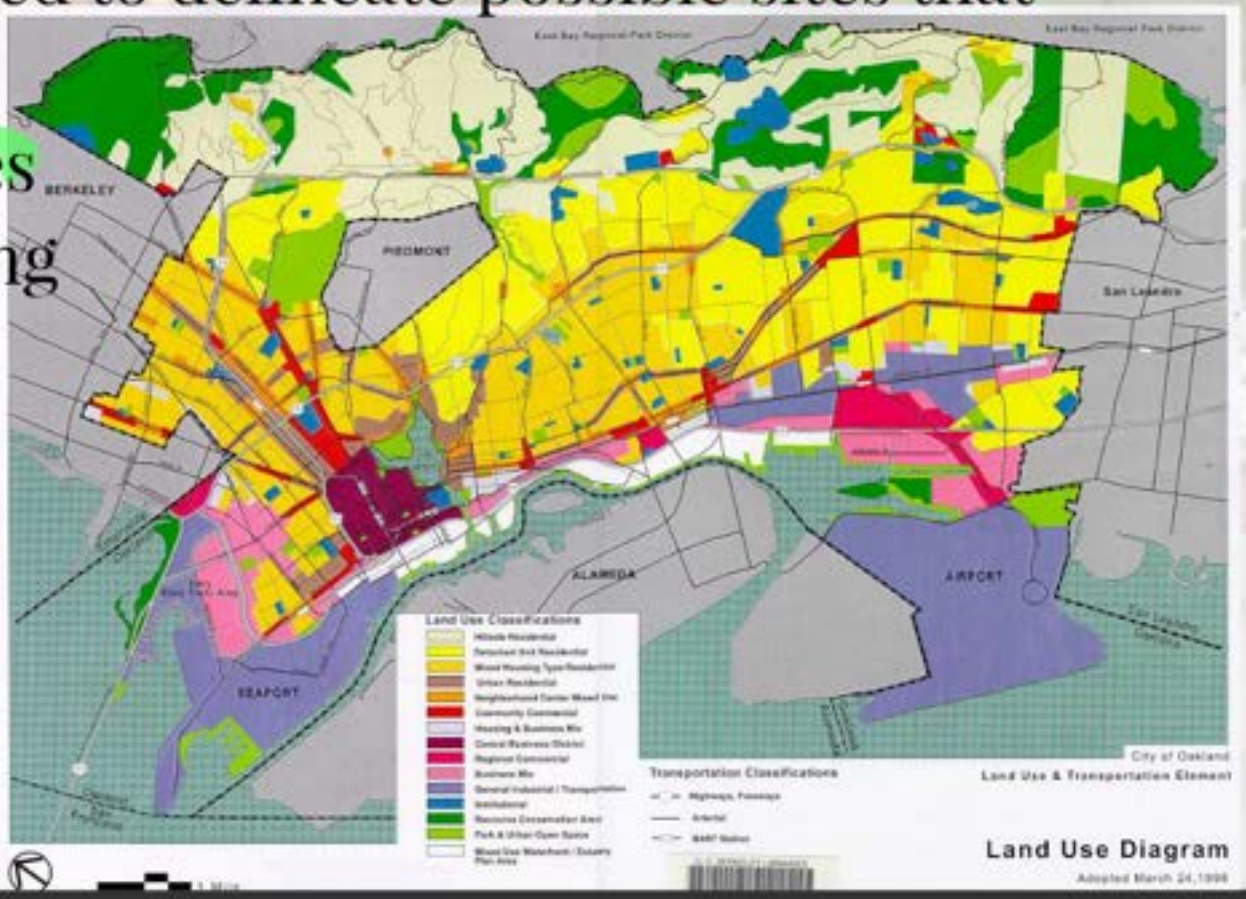
Soil Maps

- These maps, primarily meant for agricultural use, will show the types of soil near the surface.
- Although these maps are partly useful for natural attenuation type of landfill siting, they have very little use for containment-type landfills.



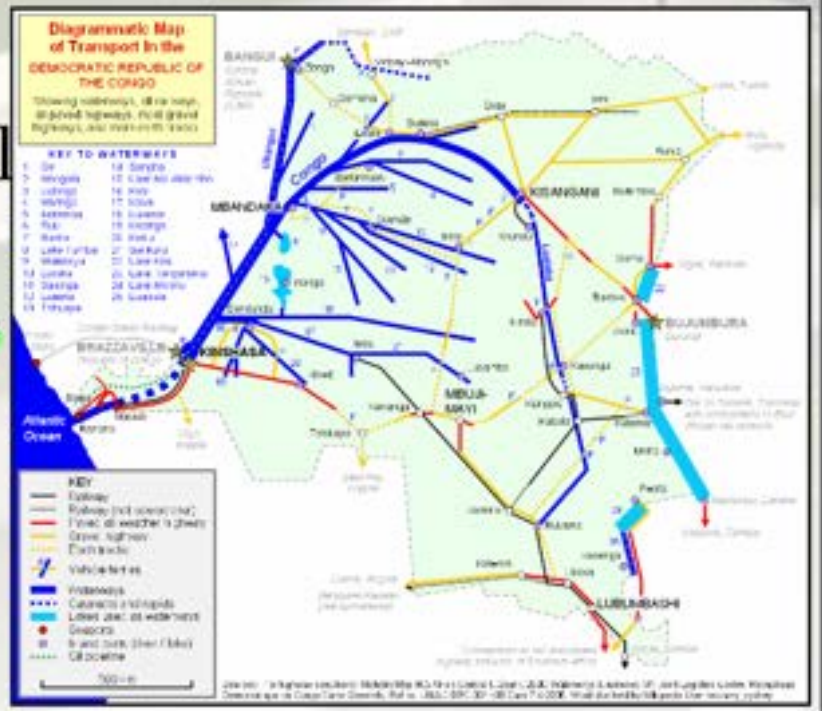
Land-Use Plans

- These plans are useful in delineating areas with definite zoning restrictions.
- There may be restrictions on the use of agricultural land or on the use of forest land for landfill purposes.
- These maps are used to delineate possible sites that are sufficiently away from localities and to satisfy zoning criteria.



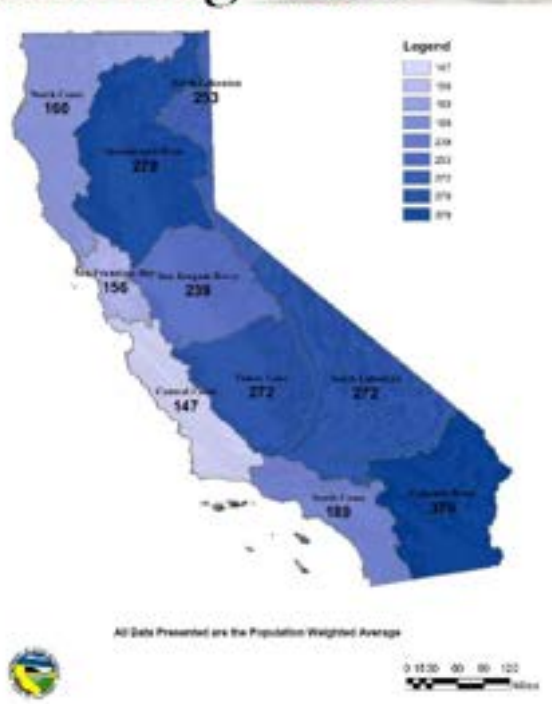
Transportation Maps

- These maps, which indicate roads and railways and locations of airports, are used to determine the transportation needs in developing a site.
- If clay needs to be hauled from a distant source for constructing a liner for a site, then these maps are used to estimate the hauling distance.
- Restriction may exist regarding locating a municipal waste landfill within a certain distance of an airport to minimize "bird hazard" for airplanes.



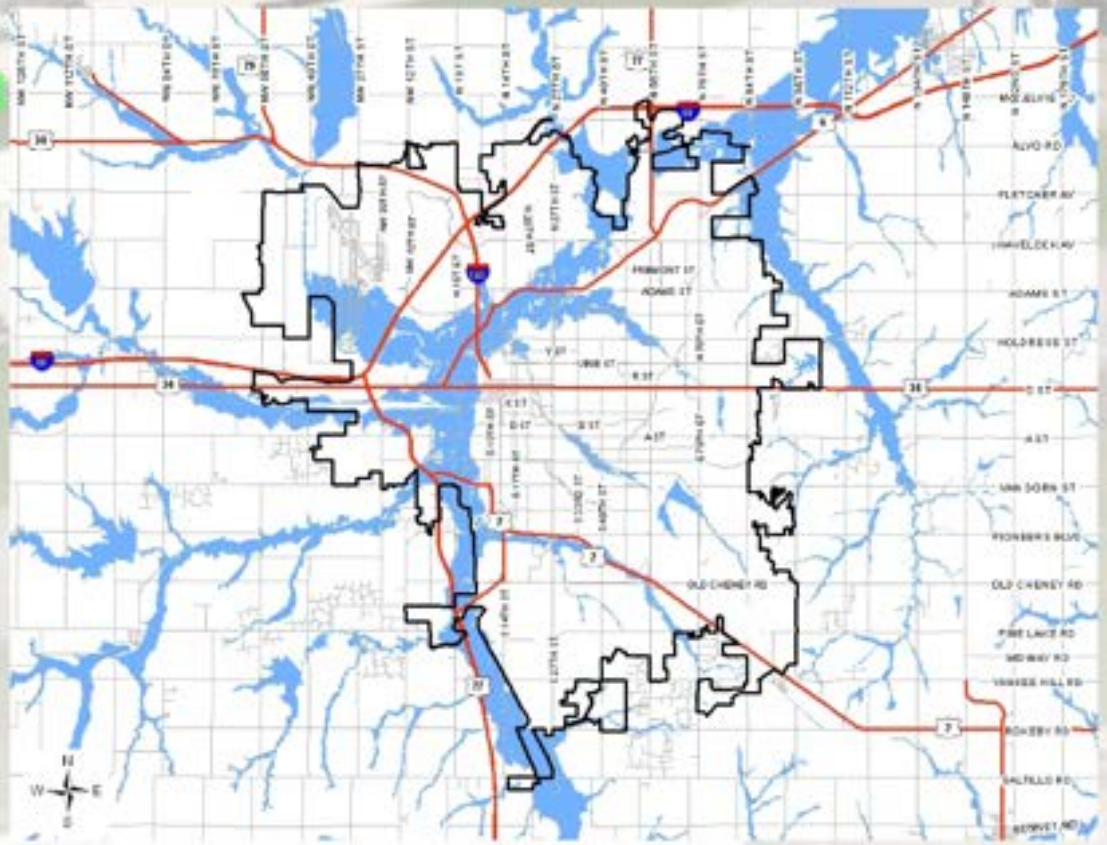
Water-Use Plan

- These maps are usually not readily available.
- However, once potential areas are delineated, the water use in those areas must be investigated.
- A plan indicating the following items should be developed: private and public wells indicating the capacity of each well, major and minor drinking water supply line(s).
- A safe distance (365 m or more) should be maintained from all drinking water sources.



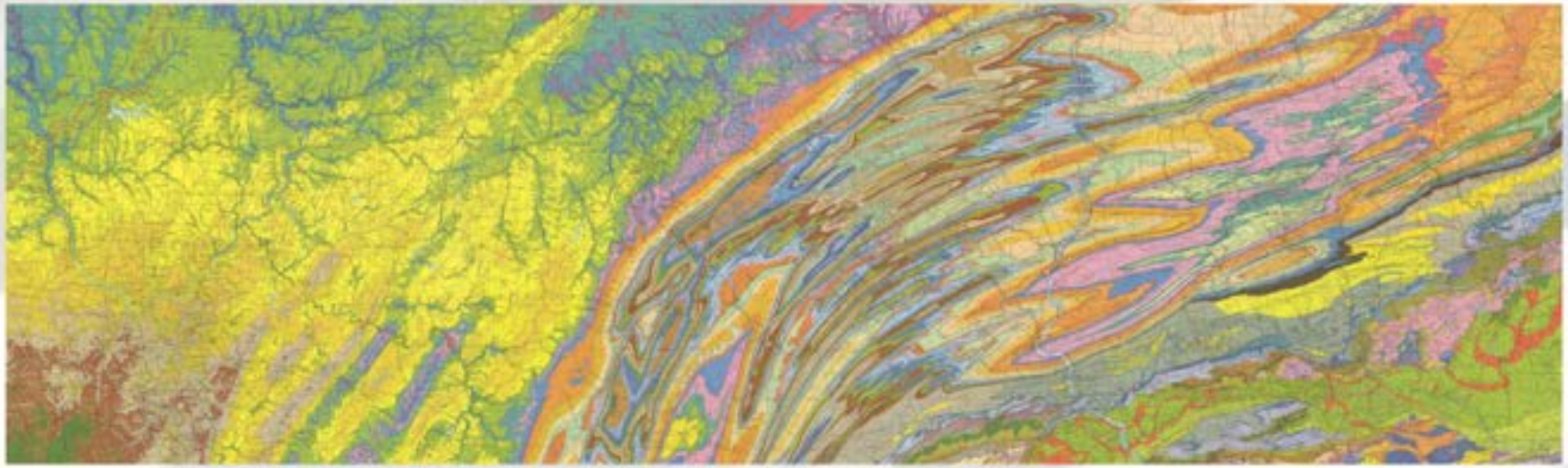
Floodplain Maps

- These maps are used to delineate areas that are within a 100-year floodplain. For hazardous waste landfills a 500-year floodplain may be used. Landfill siting must be avoided within the floodplains of major rivers.



Geologic Maps

- These maps will indicate geologic features and are very important for glaciated regions.
- A general idea about soil type can be developed from a glacial geologic map. They are also very helpful in identifying clay borrow sources.
- In no glaciated regions they may be used to identify predominantly sandy or clayey areas.

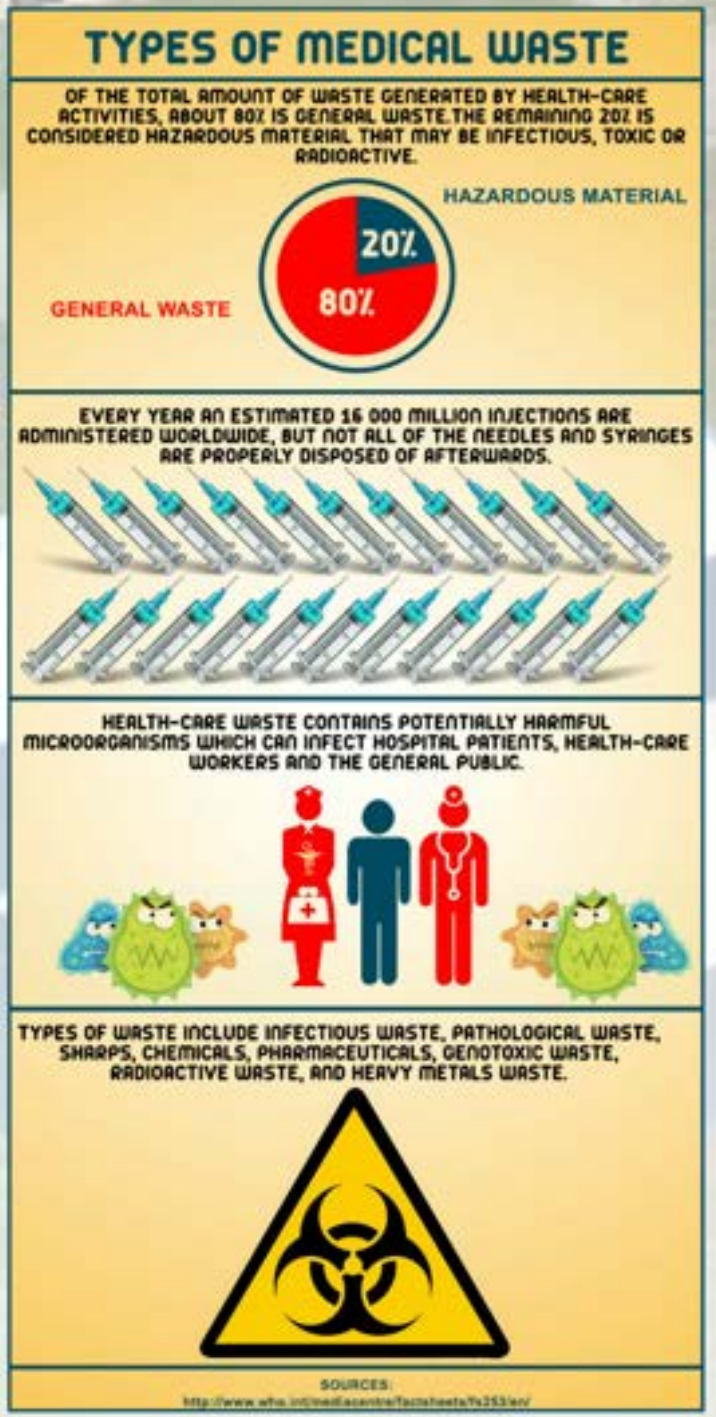


Aerial Photographs

- Aerial photographs may not exist for the entire search area. Once a list of potential sites is developed, aerial photographs or preferably a photogrametric survey of each of the potential sites may prove to be extremely helpful.
- Surface features such as small lakes, intermittent stream beds, and current land use, which may not have been identified in earlier map searches, can be easily identified using aerial photographs.

Waste Type

- The first thing to identify is whether the waste is hazardous or nonhazardous.
- If the waste is nonhazardous, then the designer should know whether it is municipal or industrial waste.
- Municipal wastes are highly mixed types of wastes whereas industrial wastes ate usually either monotypic or a mixture of two or three different waste streams with identifiable characteristics.

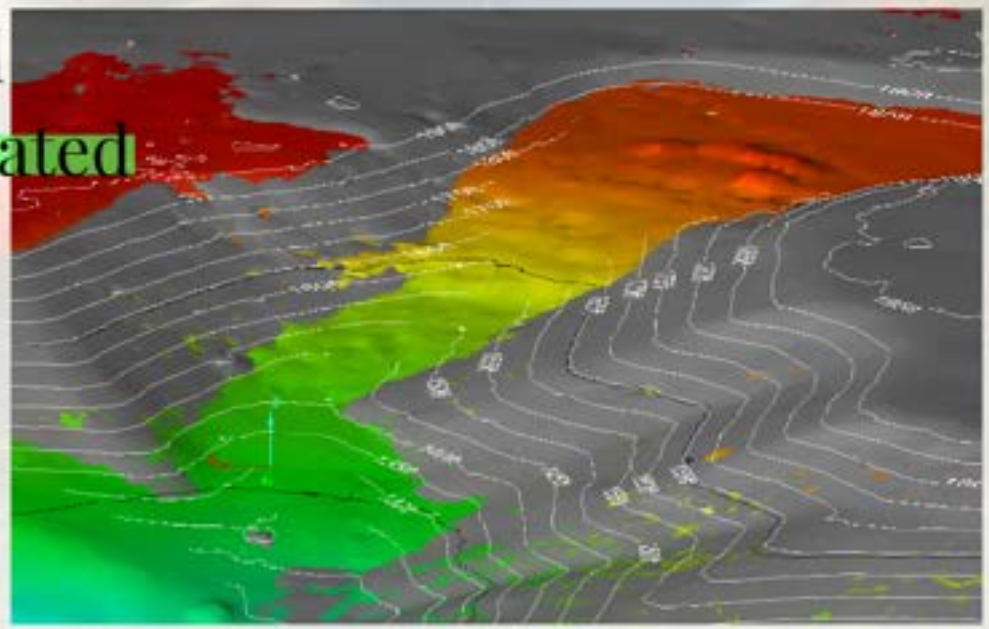


Waste Volume

- The volume of industrial waste (hazardous or nonhazardous) can be easily estimated by studying the previous disposal records.
- Although municipal waste generation rates vary widely, 0.9–1.8 kg (2–4 lb) per person per day is a reasonable estimate; 650–815 kg/m3 (40–50 lb/ft3) is a reasonable range of bulk unit weight for municipal garbage.
- An estimation of population during active life of the landfill should be done; the estimated population in each year is then multiplied by the waste generation rate to obtain the waste volume in each year.

Landfill Volume

- Landfill volume is estimated by adding the daily, intermediate (if used) and final cover volume to the waste volume.
- Daily cover is mandatory for most municipal garbage landfills. If soil is used as daily cover, then a waste to daily cover ratio of 4:1 to 5:1 by volume is a reasonable estimate.
- The intermediate and final cover volume can be estimated from the thicknesses of these covers.



Availability of Landfill Equipment

- Although this item is not involved in developing the landfill plan, these data should be gathered at the planning stage.
- Special hauling trucks are sometimes required for hauling sludges, especially if they have a high liquid content.

Recycling and Incineration Options

- A study regarding possible recycling or incineration of all or part of the waste should be undertaken.
- Recycling of a waste, if technology is available, is sometimes mandated by regulatory authorities.
- Recycling and incineration, although technically feasible in some cases, may not be an economically acceptable option.

Existing Disposal Option

- The available landfill volume within a reasonable haul distance should be studied.
- The cost of disposing of waste in existing landfill could be less than developing and operating a new landfill.
- There are certain hidden costs of operating a landfill (e.g., monitoring of groundwater wells, payment for bond purchase if required by regulation) that are sometimes overlooked.
- A list of landfills around the proposed site will also be helpful in emergency situations (e.g., the landfill could not be built by the target date due to litigation).

Funding

- The cost of developing a landfill is quite high. Funds for the initial investigation, preparation of the report, landfill construction, and so on must be obtained for planning purposes.
- A proper estimate for each stage of the proposal preparation and the flow of necessary funds must be studied.

Locational Criteria

- Usually a landfill cannot be sited within a certain distance of the following: lakes, ponds, rivers, wetlands, floodplain, highway, critical habitat areas, water supply well, active fault areas, and airports.
- In addition, landfill siting is not allowed in areas in which a potential for contamination of groundwater or surface water bodies exists. Landfill siting should be avoided in unstable areas and seismic impact zones.

Lake or Pond

- No landfill should be constructed within 300 m (1000 ft) of any navigable lake, pond, or flowage. This distance may be reduced for a containment-type landfill.
- However, because of concerns regarding runoff of waste contact water, a surface water monitoring program should be established if a landfill is sited less than 300 m from a lake, pond, or flowage.

River

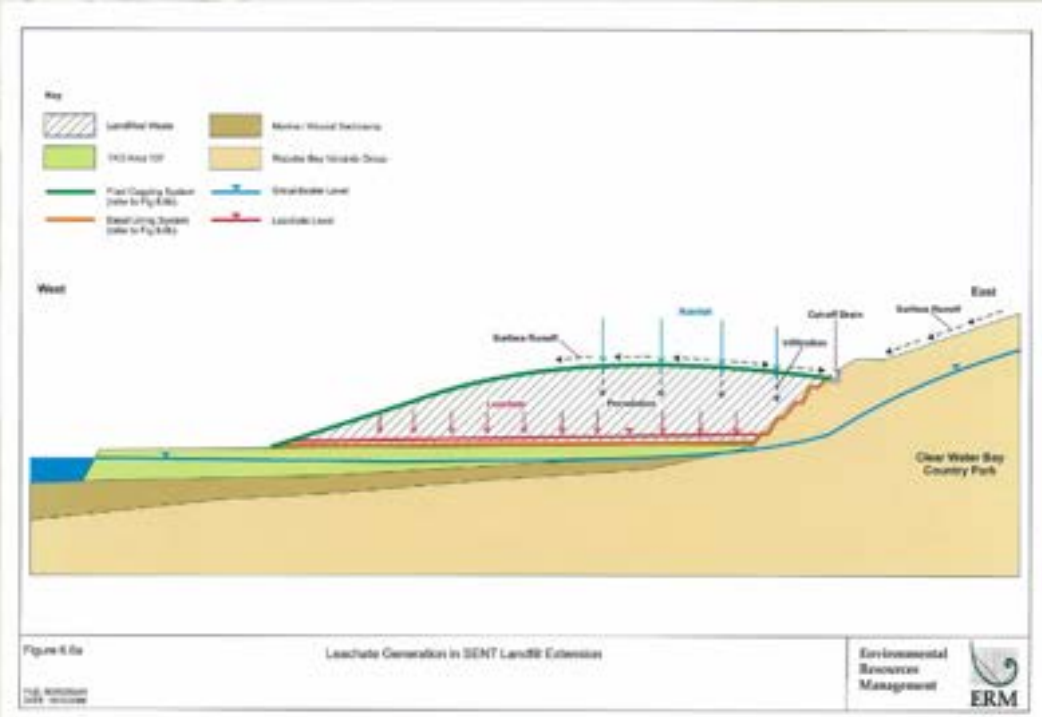
- No landfill should be constructed within 90 m (300 ft) of a navigable river or stream. The distance may be reduced in some instances for no meandering rivers, but a minimum of 30 m (100 ft) should be maintained in all cases.

Floodplain

- No landfill should be constructed within a 100-year floodplain. Regulations may require a more restrictive floodplain (e.g., 500-year floodplain) siting criteria.
- However, landfills must not be built within the floodplains of major rivers.

Highway

- No landfill should be constructed within 300 m (1000 ft) of the right of way of any state or federal highway.
- This restriction is mainly for aesthetic reasons.
- A landfill may be built within the restricted distance if trees or berms are used to screen the landfill site.



Public Parks

- No landfill should be constructed within 300 m (1000 ft) of a public park.
- A high fence around the landfill and a secured gate should be constructed to restrict easy entry of unauthorized persons in the landfill.

Critical Habitat Area

- No landfill should be constructed within critical habitat areas. A critical habitat area is defined as the area in which one or more endangered species live.
- Siting a landfill within critical habitat areas is not suggested.

Wetlands

- No landfill should be constructed within wetlands. It is often difficult to define a wetland area.
- Maps may be available for some wetlands, but in many cases such maps are absent or are incorrect.
- Disturbance of wetlands should be avoided. However, there are situations where impact to wetlands is unavoidable.

Unstable Areas

Landfills should not be constructed over unstable areas. An area can be unstable due to natural conditions or human activities.

Naturally occurring unstable areas include regions with :

- Low bearing capacity soil
- Expansive soil
- Karst terrain
- An area underlain by a thick soft clay

Areas considered unstable because of human activities include areas where :

- Groundwater withdrawal is high
- Near a cut or fill
- Areas where significant quantities of gas have been extracted

Significant total or differential settlement can damage the integrity of the liner and the leachate collection system.

Airports

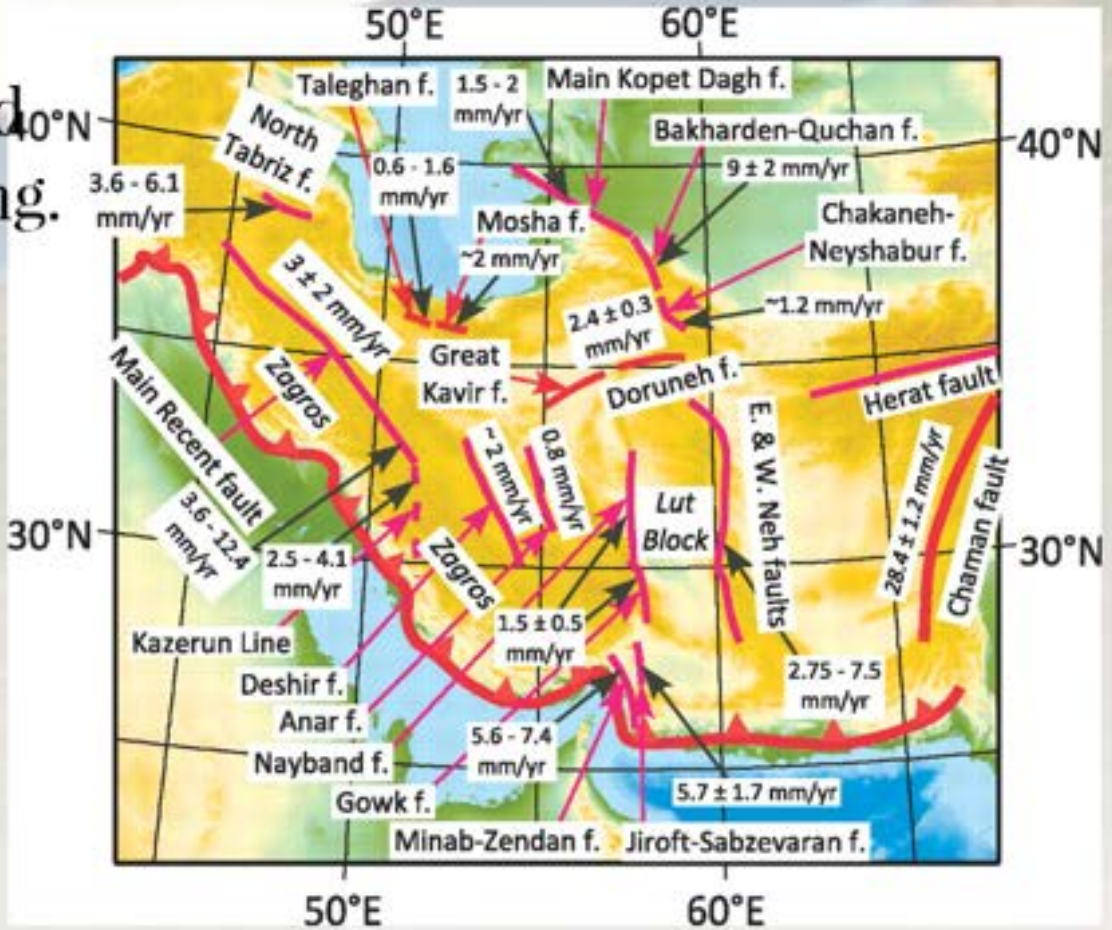
- No landfill should be constructed within 3048 m (10,000 ft) of any airport.
- This restriction is imposed to reduce bird hazard. Birds are attracted to landfills where food is available (in general, municipal landfills fall in this category).

Water Supply Well

- No landfill should be constructed within 365 m (1200 ft) of any water supply well.

Active Fault Areas

- Landfills should not be sited within 60 m (200 ft) of an active fault. Active fault areas are subject to earthquakes, which may cause landslides or soil liquefaction.
- Known faults are already mapped and available from the agency involved in earthquake monitoring. For suspected areas, a fault characterization is done.



Seismic Impact Zone

- A landfill should not be sited in a seismic impact zone; an area having a 10% or greater probability that the maximum horizontal acceleration caused by an earthquake at the site will exceed 0.lg in 250 years.

Preliminary Assessment Of Public Reactions

- The public should be informed regarding the possibility of siting of a landfill in their area as soon as a list of potential sites is developed.
- The public is less suspicious and more open to discussion if they are informed by the owner rather than getting the news from other sources.

Preliminary Assessment Of Public Reactions

- Public education regarding the dangers and benefits of a landfill should be undertaken.
- A preliminary assessment of public opinion regarding all the sites in the list is essential.

Preliminary Assessment Of Public Reactions

- The "not in my back yard" (NIMBY) sentiment is high initially, however, with proper discussion it can be overcome in some cases.
- Early assessment regarding how strong the NIMBY sentiment is can significantly reduce the time and money spent on obtaining the final permit for a landfill site.
- Noise, dust, odor, increases in traffic volume, and reduction in property value concern the area residents more than the fear of groundwater contamination.
- To identify the major concerns of the public affected by the siting of a landfill, the owner may conduct interviews with representatives of major community groups such as civic groups, religious organizations, and business associations.

Preliminary Assessment Of Public Reactions

- Methods for notifying the public.

In many cases, existing landfills are expanded. To avoid public opposition to such expansions, it is essential to maintain good public relations both with the immediate neighbors and with the community in which the landfill is located.

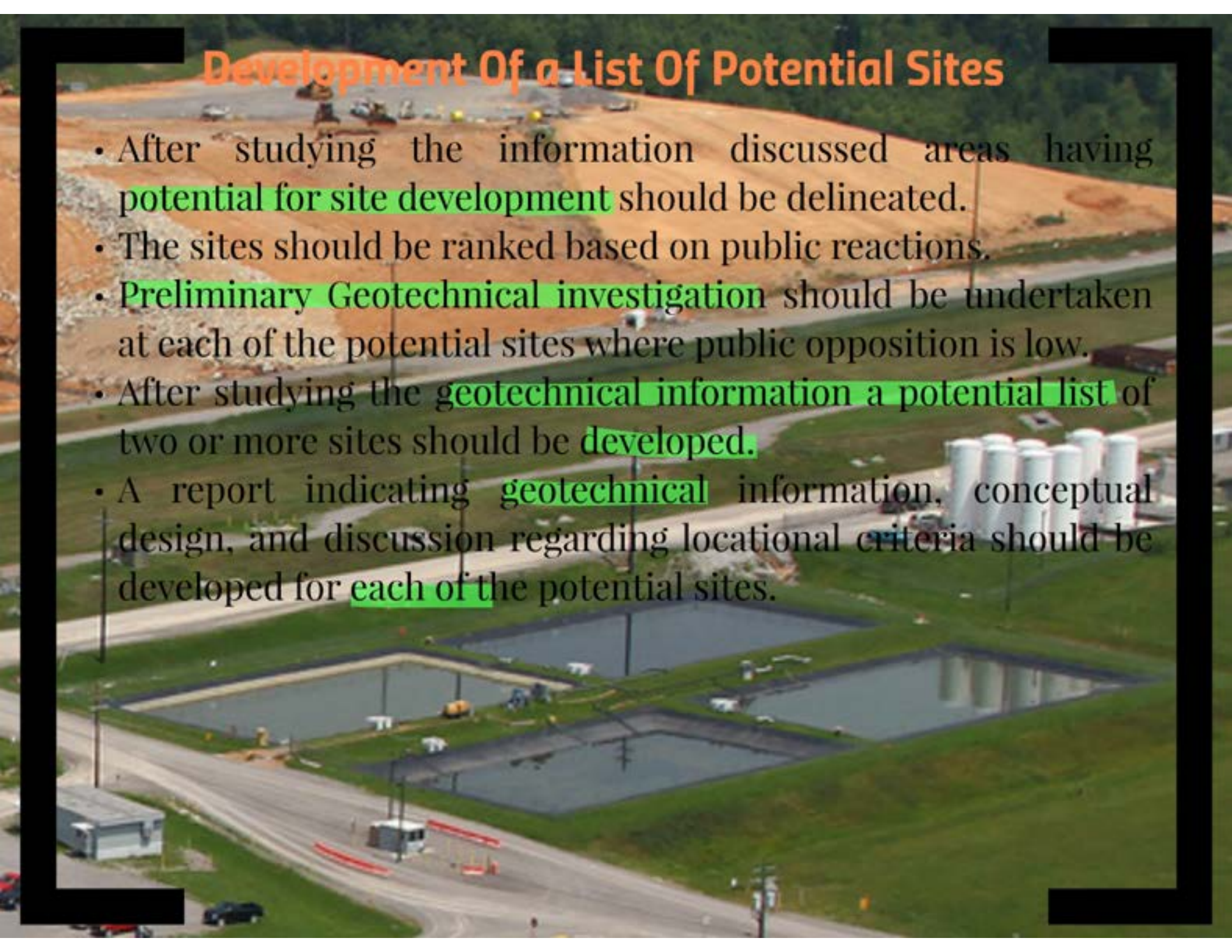
- A community can be informed about the landfill by:

1. Conducting a tour of the landfill
2. Easily accessible documents summarizing the activities in the landfill
3. Short informational news articles published in local newspapers or magazines published by civic or environmental groups.

Preliminary Assessment Of Public Reactions

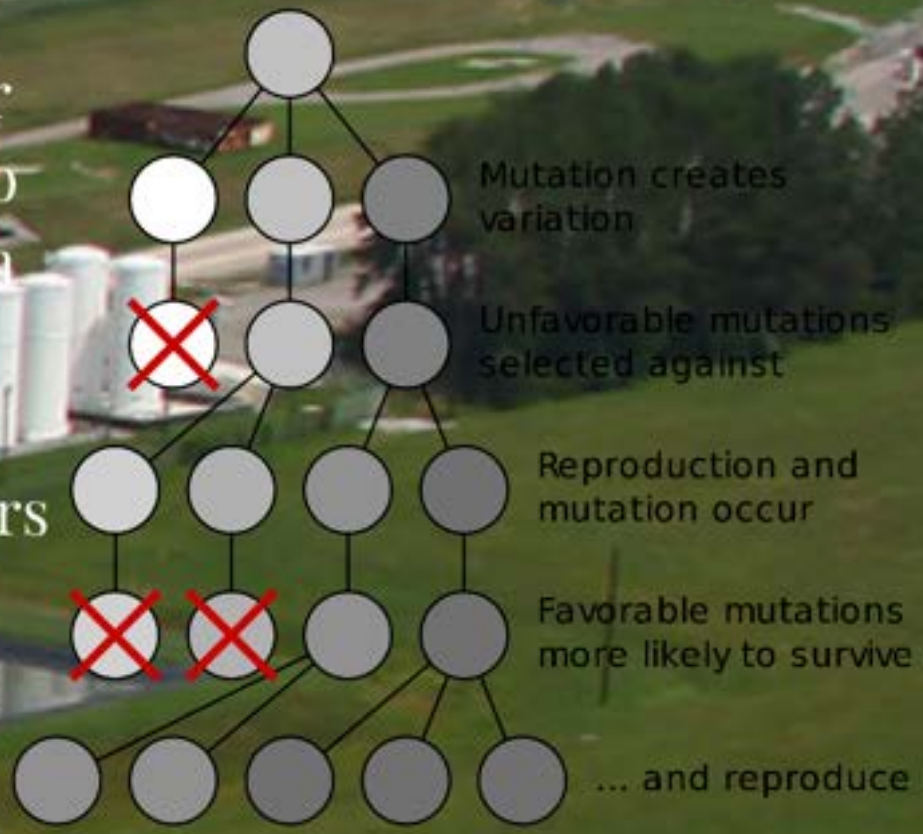
Development Of a List Of Potential Sites

- After studying the information discussed areas having potential for site development should be delineated.
- The sites should be ranked based on public reactions.
- Preliminary Geotechnical investigation should be undertaken at each of the potential sites where public opposition is low.
- After studying the geotechnical information a potential list of two or more sites should be developed.
- A report indicating geotechnical information, conceptual design, and discussion regarding locational criteria should be developed for each of the potential sites.



Final Site Selection

- Based on the discussion of the reports mentioned before one or two sites are selected finally.
- A detailed investigation for each of these sites needs to be undertaken to develop a feasibility report.
- Two major items of this report with which engineers get involved are on-site geotechnical investigation and borrow source investigation. These two items are discussed below.



On-Site Geotechnical Investigation

- Subsoil Investigation
  - Continuous soil samples
  - Mechanical properties (strength and consolidation characteristics)
  - Consolidation characteristics of highly organic (e.g., peat) clay layer(s)
  - Strength characteristics of suspected collapsible soil
  - Permeability of the soil layers (both laboratory permeability of undisturbed soil samples and field permeability)
- Seismic Hazard Investigation

Borrow Source Investigation

- Clay
  - Grain size distribution curves
  - Atterberg limits
  - Permeability test
  - Compaction test
- Sand
  - Permeability
  - Relative Density
- Silty Soil
  - Freeze-thaw
  - Permeability
- Topsoil
  - pH
  - Nutritional testing (for agriculture)
- Leachate Collection Pipes and Synthetic Membrane for Liner

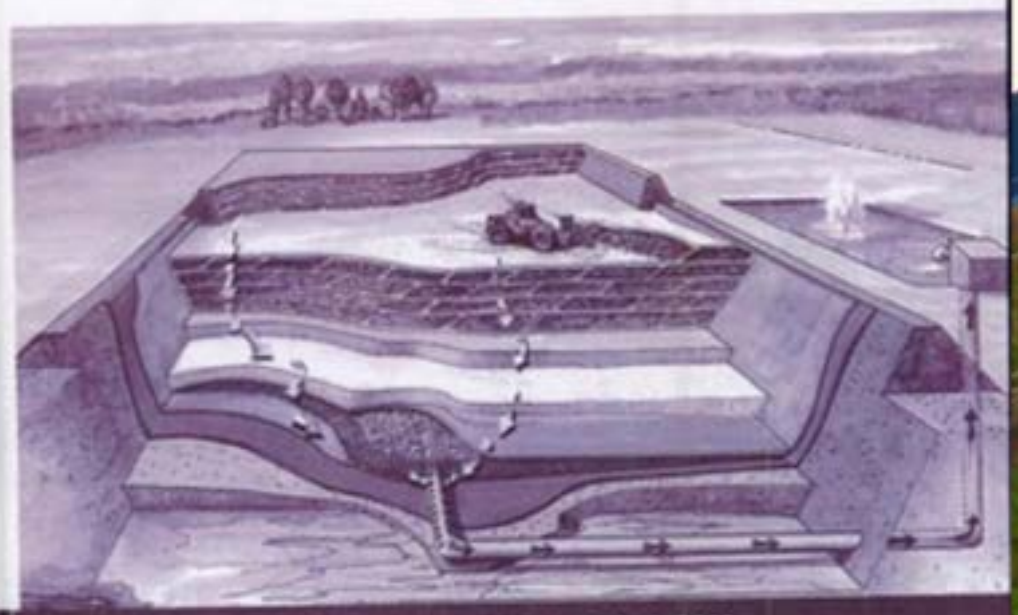
Preparation Of Feasibility Report

The purpose of a feasibility report is to determine whether a particular site has the potential for use as a landfill for the disposal of a particular waste type.

- Geotechnical Information
- Hydrogeology
- Environmental Impact
- Conceptual Design

THIRD EDITION

Design of Landfills and Integrated Solid Waste Management



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