

# Landfill

## Leachates in Landfills

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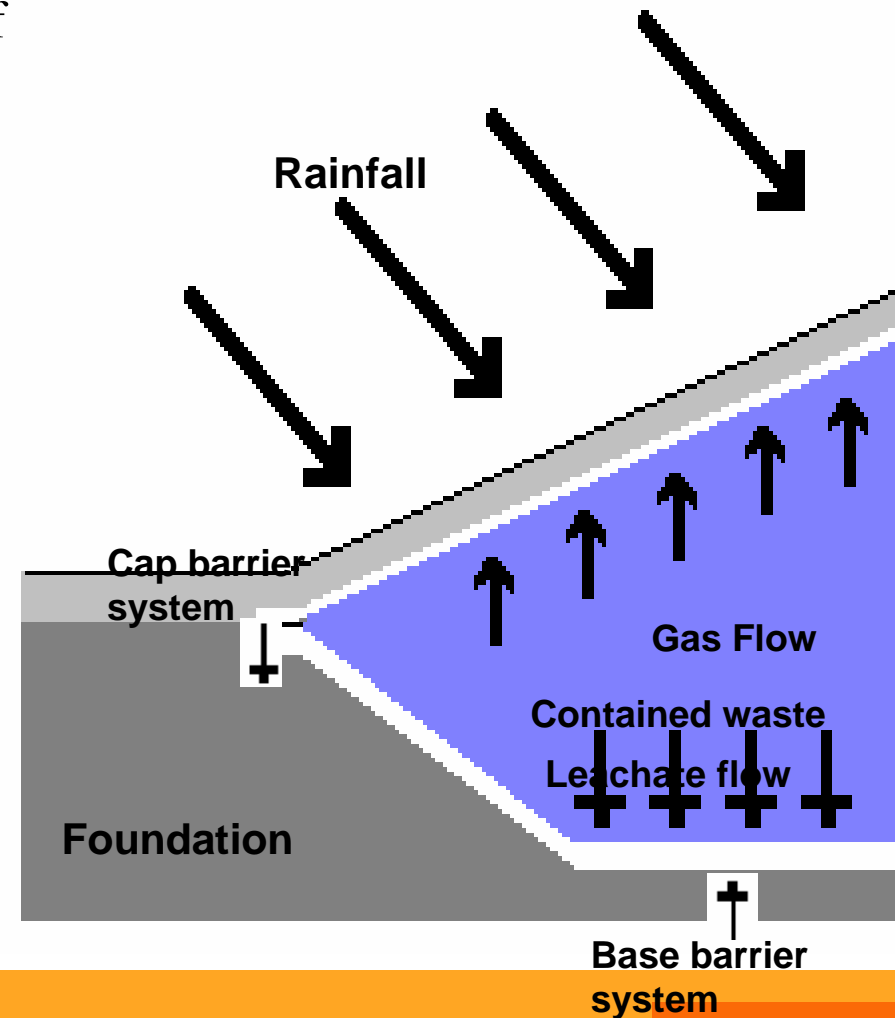


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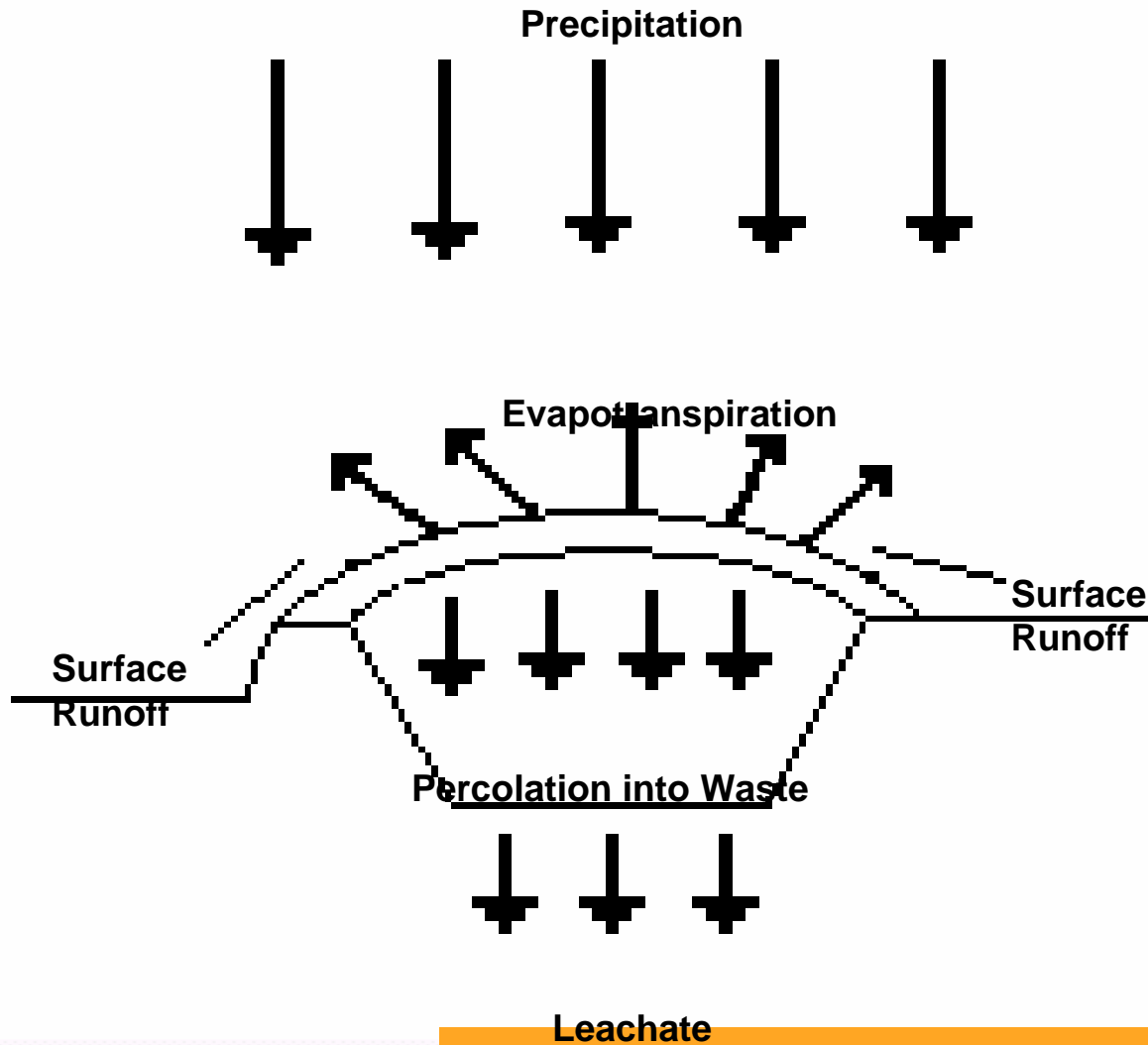
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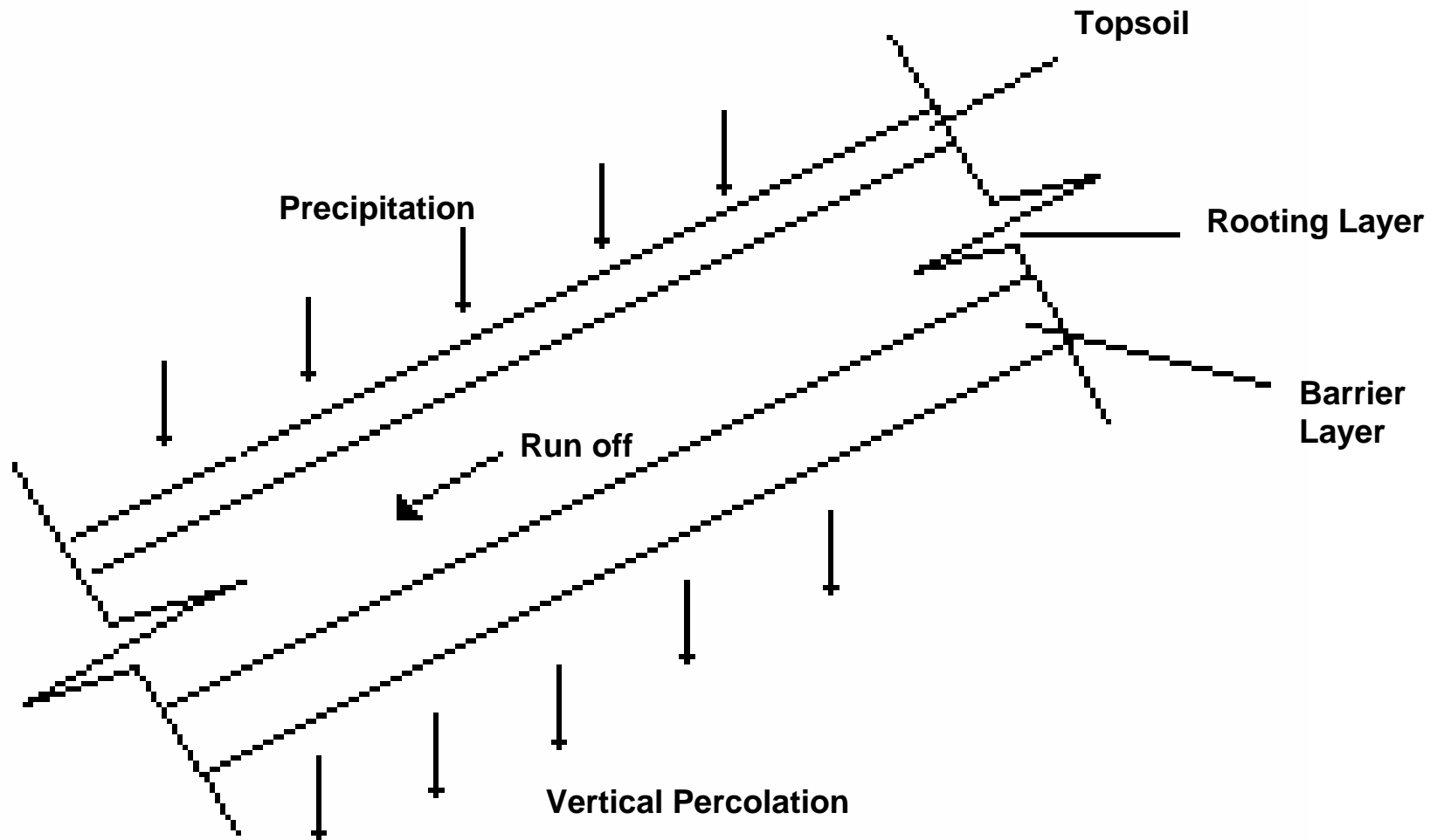
## How do landfills perform?

- Landfills perform by controlling and managing the movements of fluids (i.e. liquids and gasses) around, into and out of the contaminated waste volume.
- Base barrier system functions:
  - (1) To minimise the escape of leachate into the foundation
  - (2) To prevent contamination of groundwater
- Cap barrier system functions:
  - (1) To control moisture filtration into the waste
  - (2) To collect gas flows from the waste
  - (3) To prevent odours, and sources of disease
  - (4) To meet erosion, aesthetic and other functional criteria



# LAND FILL WATER BALANCE





# LEACHATE GENERATION

- ASSESSMENT OF
- QUANTITY &
- QUALITY



## LEACHATE QUANTITY

- PRECIPITATION
- GROUND WATER INFLUX
- WASTE MOISTURE CONTENT
- FINAL COVER DESIGN



# WHY LEACHATE QUALITY ASSESSMENT

- WASTE HAZARD IDENTIFICATION
- CHOOSE LAND FILL DESIGN
- LEACHATE TREATMENT PLANT DESIGN
- FORMULATE GROUND WATER  
MONITORING PARAMETERS AND REGIME



## APPROACHES

- NORMALLY WASTE CHARACTERISATION WILL PRECEDE
- LAB TESTS – BULK TEST, TCLP
- FIELD TESTS – LYSIMETER ETC.
- PREDICTIVE MODELLING



# LEACHATE QUANTITY

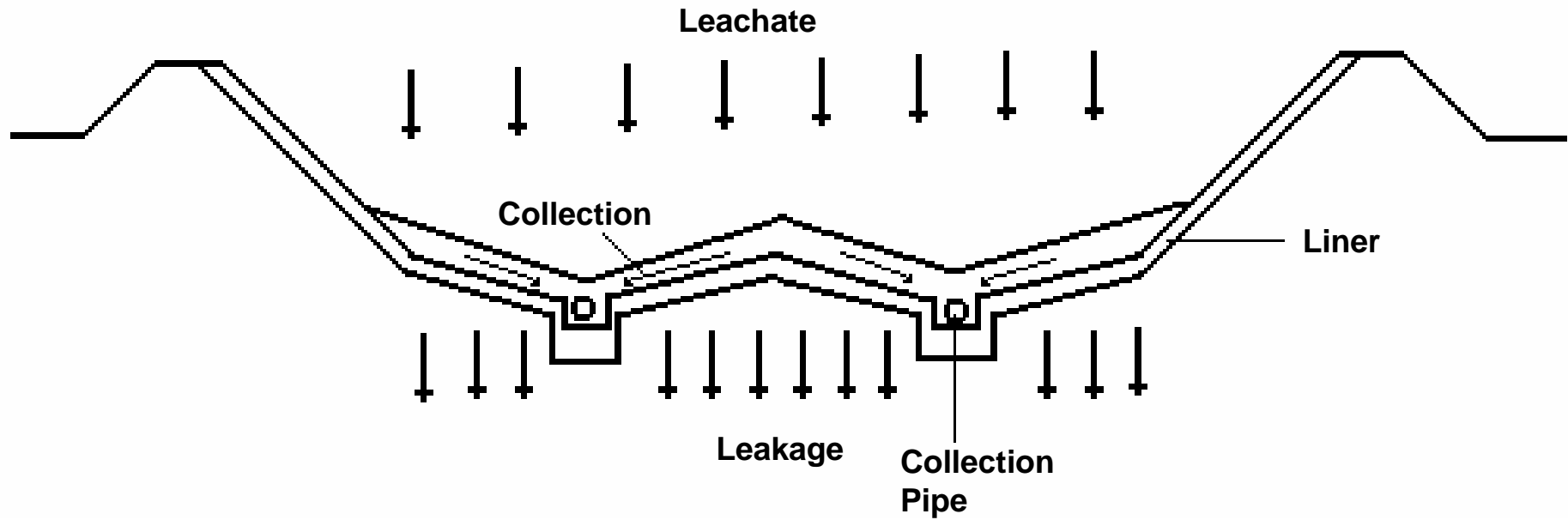
- PRECLOSURE RATE
- POST CLOSURE RATE



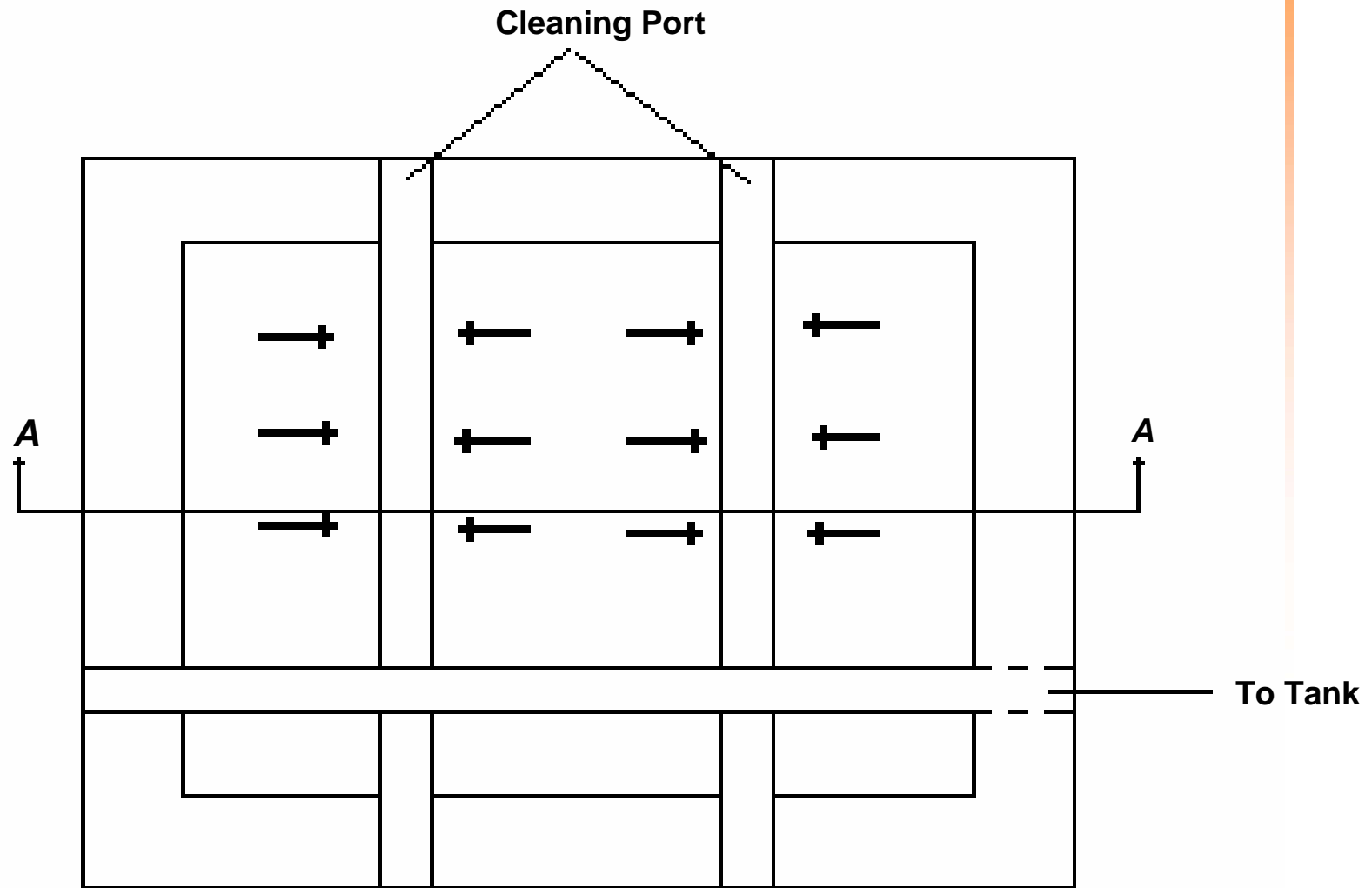
## SOME FACTORS

- COVER OR NOT TO COVER
- HOW LONG BEFORE TREATMENT IS NEEDED? 10, 20, 40 YRS.?
- CLIMATIC CONDITION
- OPERATION OF LANDFILL
- WASTE COMPOSITION
- ELAPSED TIME
- AMBIENT TEMPERATURE
- AVAILABLE MOISTURE , OXYGEN

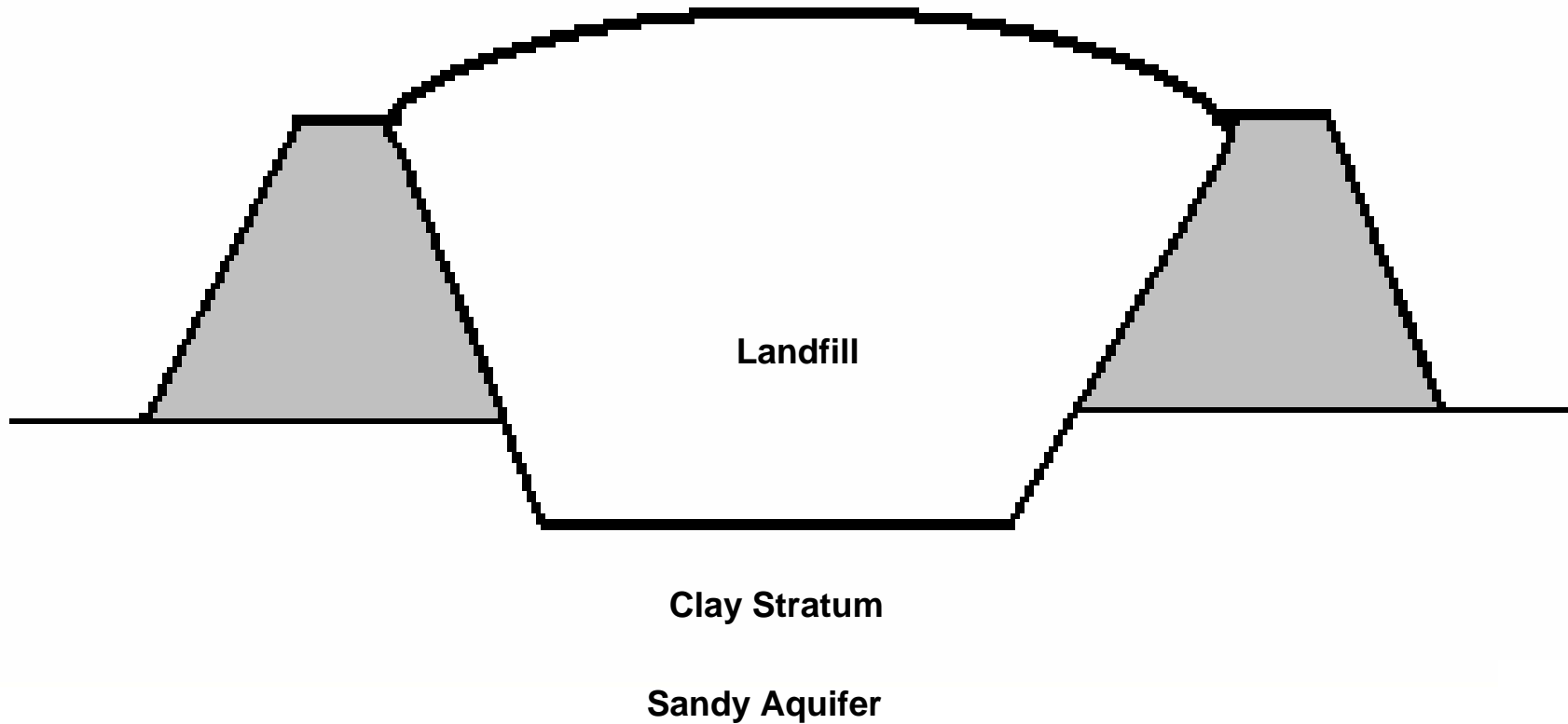


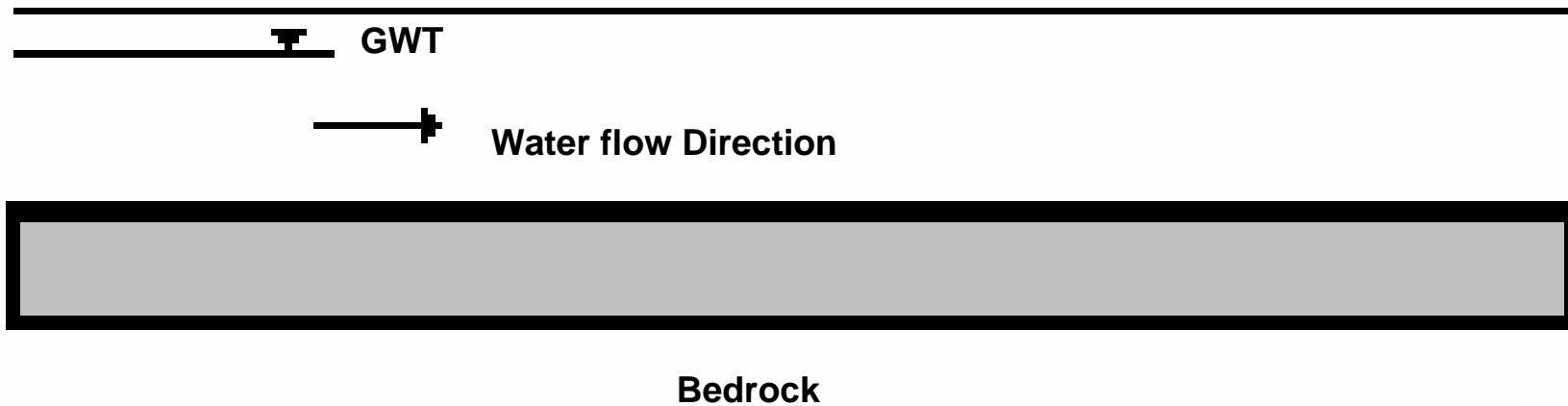


# PLAN VIEW

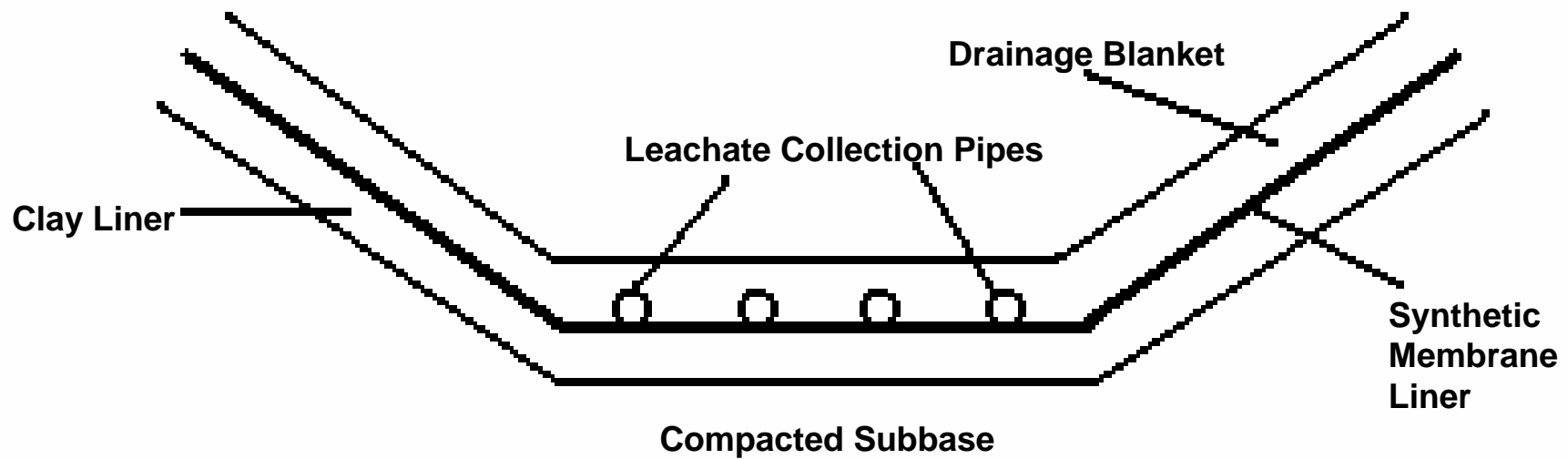


# NAL





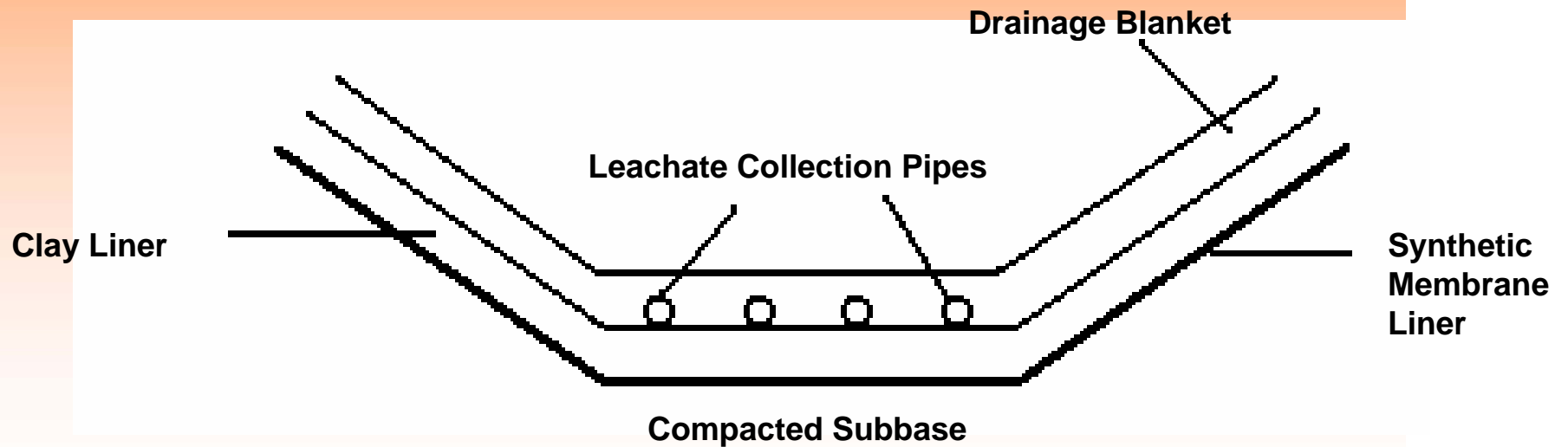
# LEACHATE COLLECTION



**Double lined landfill with a single collection system: scheme 1**



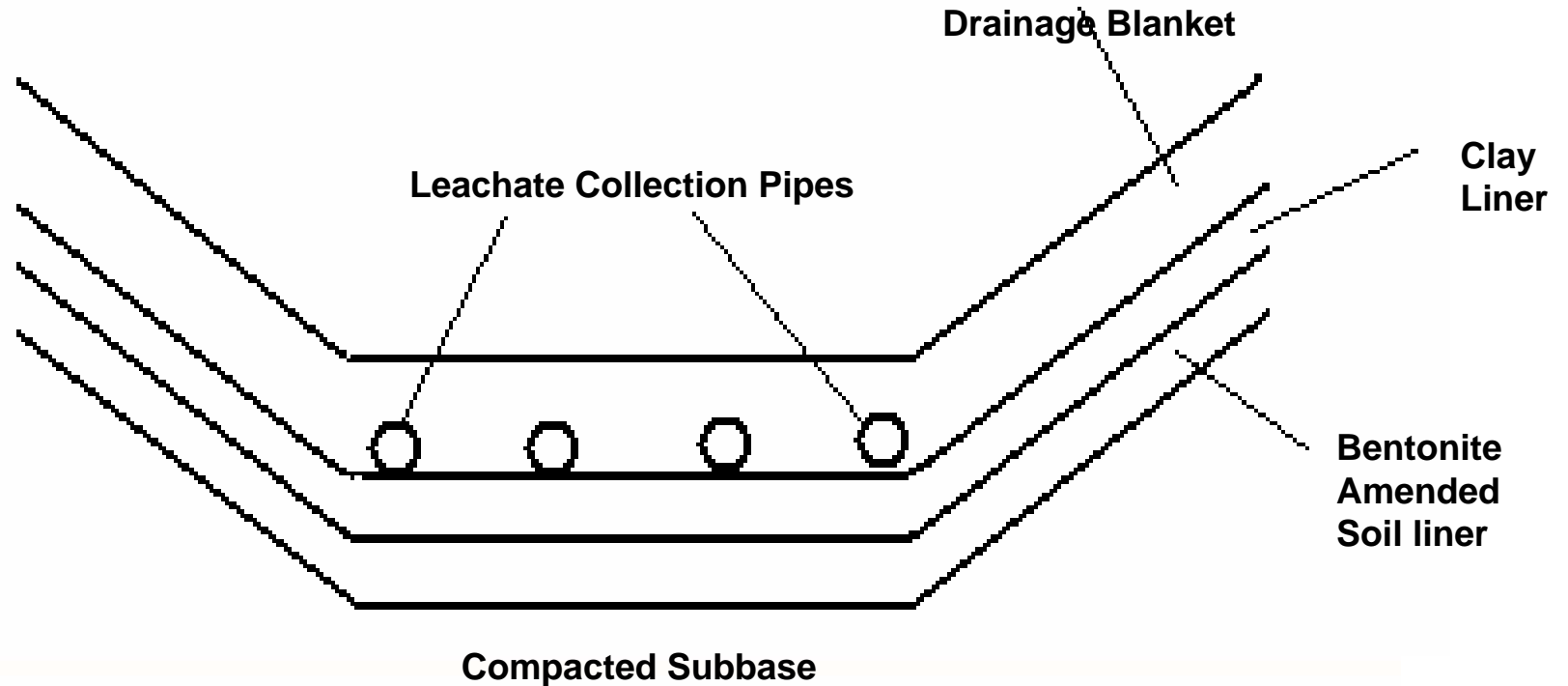
# LEACHATE COLLECTION



**Double lined landfill with a single collection system: scheme 2**



# LEACHATE COLLECTION

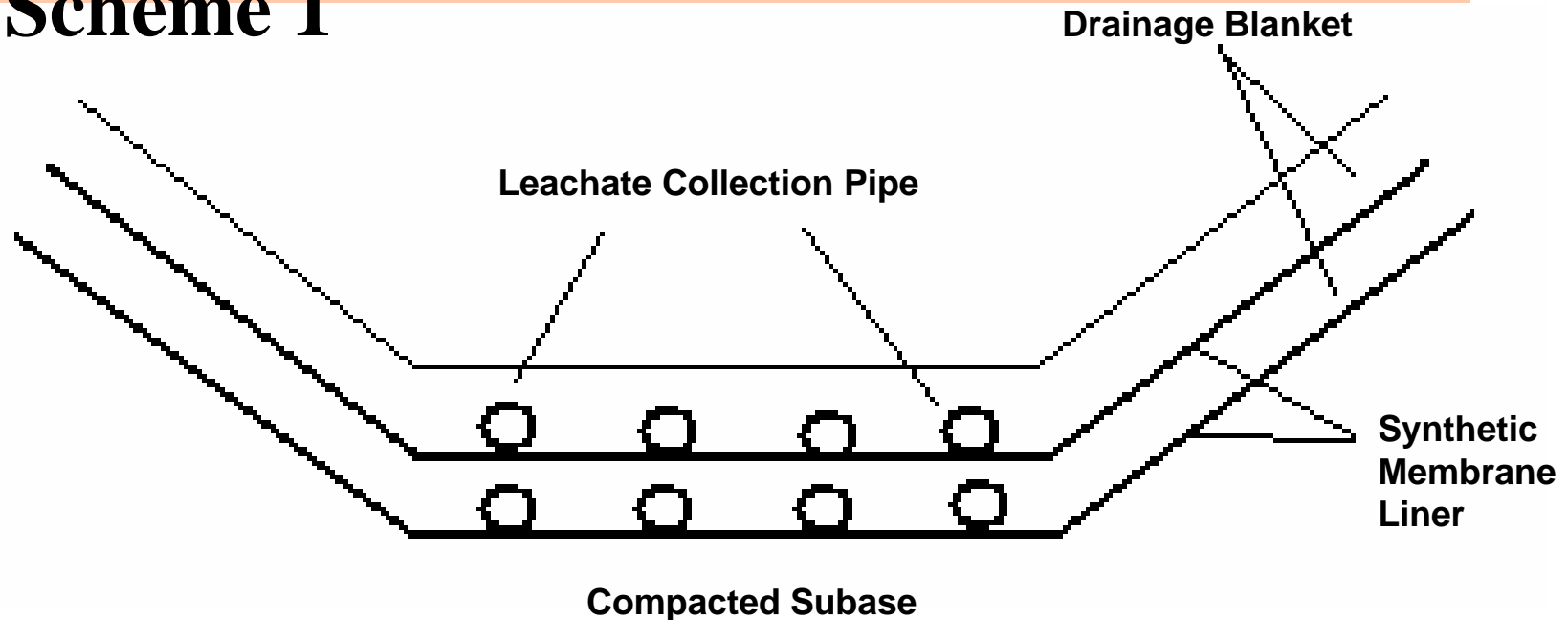


**Double lined landfill with a single collection system: scheme 3**



# LEACHATE COLLECTION

## Scheme 1

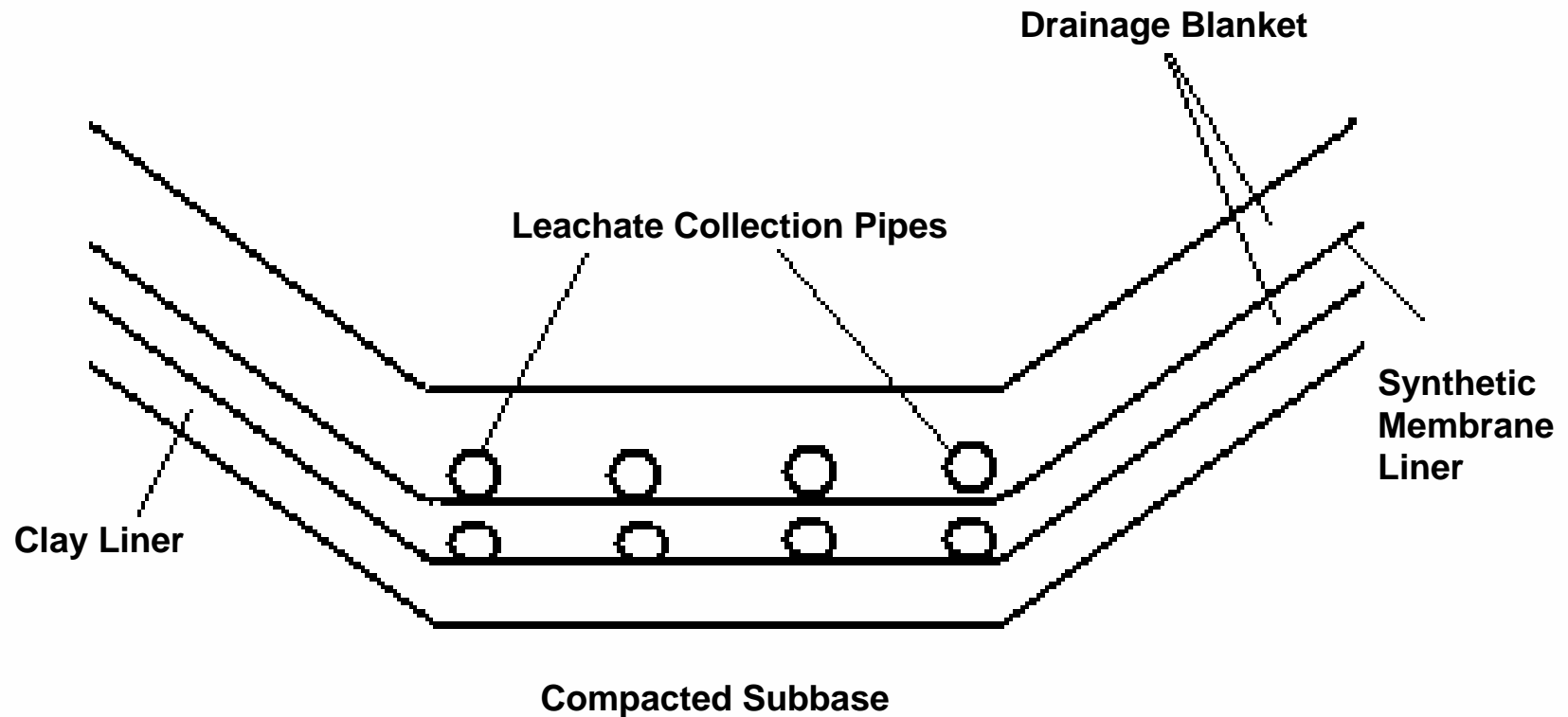


**Multiple lined landfill with two collection systems**



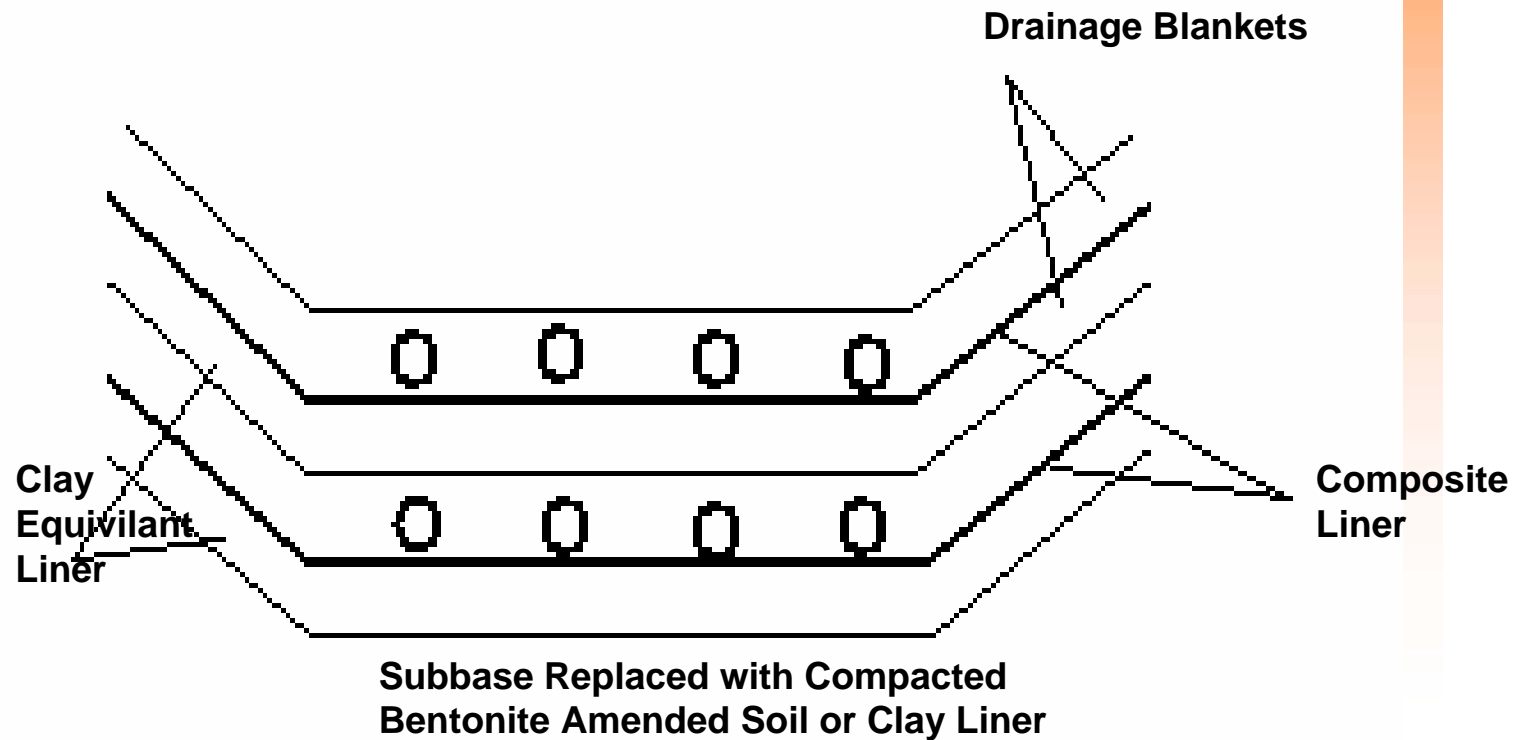
# LEACHATE COLLECTION

## Scheme 2

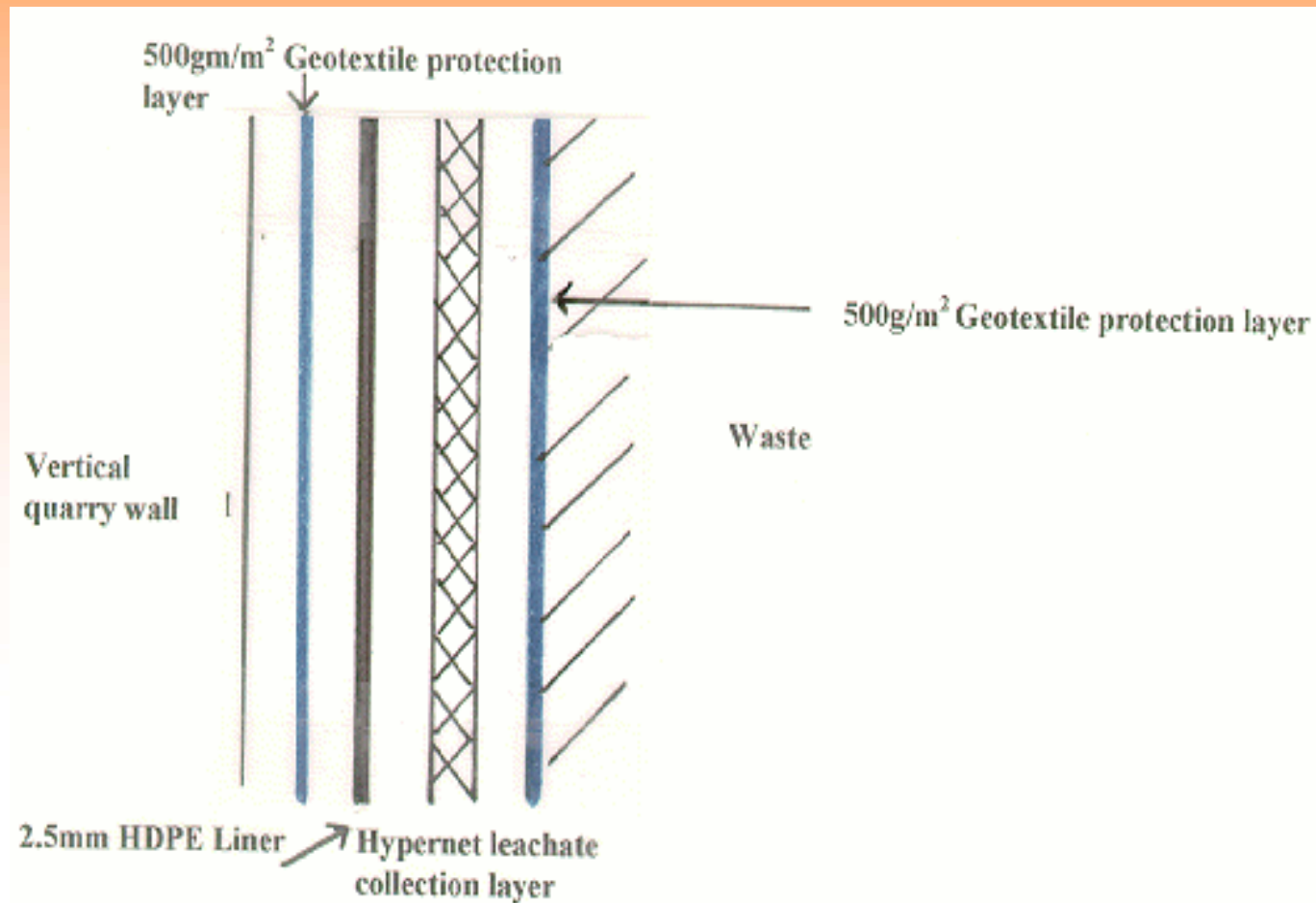


**Multiple lined landfill with two collection systems**

# LEACHATE COLLECTION



# LEACHATE COLLECTION



**Waste**

**150mm Protection layer  
(20-150mm gravel)**

**140 g/m<sup>2</sup> geotextile**

**150mm Drainage layer  
for leachate collection  
(-20mm gravel)**

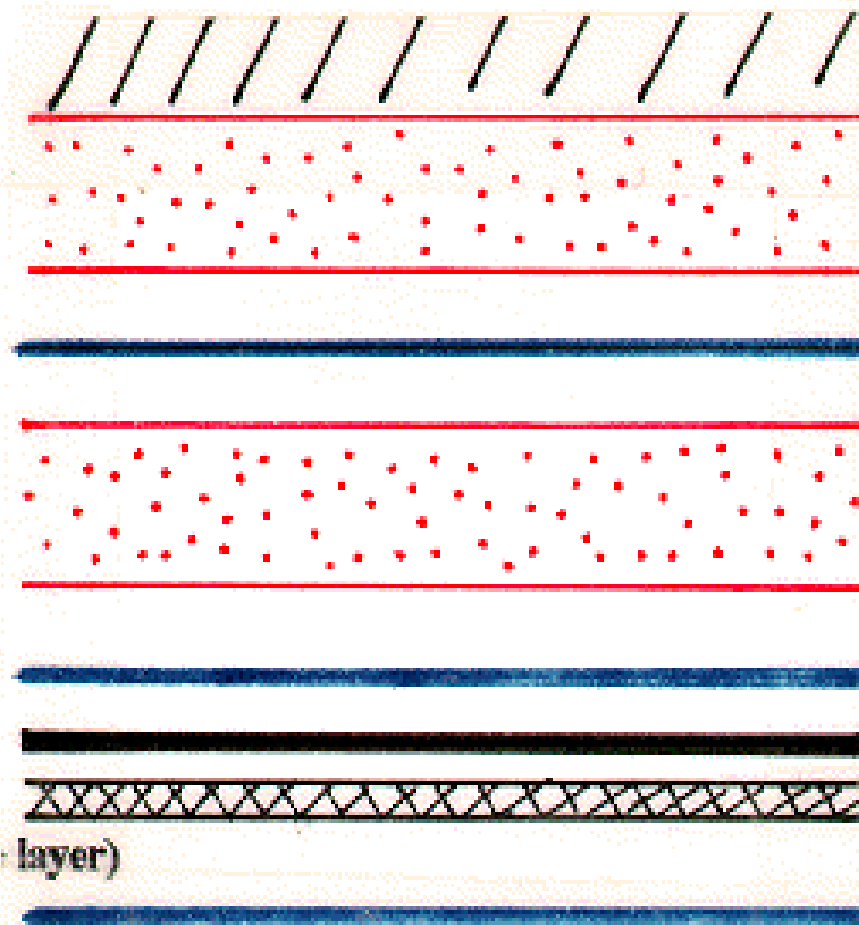
**310g/m<sup>2</sup> Geotextile**

**2.5mm HDPE Liner**

**Hypernet**

**(ground water drainage layer)**

**140g/m<sup>2</sup> Geotextile**



**Compacted Shale Subbase**



## LEACHATE COLLECTION DESIGN

- APPRECIATE FAILURE CAUSES - CLOGGING, CRUSHING, FAULTY DESIGN
- LEACHATE TRENCH & PIPE
- LEACHATE LINE CLEAN OUT PORT
- LEACHATE COLLECTION PUMP & LIFT STATION
- LEACHATE HOLDING TANK
- LEACHATE REMOVAL



# STORM WATER MANAGEMENT

- STORM WATER DITCHES
- CULVERTS & MANHOLES
- STORM WATER BASINS
- SEDIMENTATION TANK



# DRAINAGE FOR LEACHATE



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# LEACHATE PONDS



## Leachate Drainage Layer

- Must have adequate capacity to handle the maximum flow produced during landfill operations.
- Can use granular materials, with hydraulic conductivity  $1 \times 10^{-3}$  m/sec, or a geocomposite drain.
- Design of drainage layer needs to consider clogging when –
  - (1) **High pH liquids**
  - (2) **More than 2,500 g/ml of TDS or BOD**
- Network of perforated collection pipes (usually HDPE) carry leachate out of drainage layer.
- Do not place geotextile filter directly around pipes (clogging)



## Geocomposite Drainage Layers

- Geonet drainage layer between two layers of non-woven geotextile filters.
- Design is based around equivalency with granular drainage layer, with lab testing to ensure adequate flow rates under weight of waste.
- Lab testing needs to simulate the intrusion of the geotextile filter into the geonet core, and the compressive creep of the geonet.



## Geonets

- Bi-planar geonets commonly used in small landfills.
- Tri-planar geonets withstand a greater compressive stress (important for large depths of waste).
- Transmissivity under 1000 kPa can be half the transmissivity under 100 kPa.
- Use relatively high factor of safety (build up from partial factors)



## Geotextile Filters

- Pore opening size needs to be small enough to prevent fine particles entering the geonet drainage core, whilst large enough to allow adequate flow under compressive stress and potential clogging.
- Use a relatively high factor of safety (build up from partial factors).



## Leachate Collection and Removal

- System comprises leachate filter and drainage layer, perforated collection pipes, sumps, riser pipes, pumps and leachate storage ponds or tanks.
- Sub-base must be sloping (minimum 2%).
- Pipes should be spaced and sized for the required flow and must be strong enough for the weight of the overburden of waste (design examples given in Qian et al, 2002).
- Unusually large rainstorm events can sometimes be difficult to cope with.



## Geotextile Durability

- ASTM test for long term immersion in leachate under elevated temperature.
- Tests carried out with Hong Kong leachate indicated that HDPE and polypropylene geotextiles had a good long term resistance to our leachate, but polyester geotextiles had a lower resistance.

