

# LANDFILL MANAGEMENT IN ZIMBABWE

Developed by

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# Course Specific Outcomes

- Understand the terminology and concepts of landfill management
- Understand the various types of waste
- Understand and explain the various methods of waste disposal
- Differentiate the types of landfills
- Differentiate the classification of landfills
- Outline the key landfill design parameters
- Explain the site selection considerations for a landfill
- Understand the landfill operations
- Understand landfill human resources requirements
- Understand the importance of landfill closure and post closure monitoring
- Understand landfill economics
- Be proficient in landfill legislation

# TOPICS

1. Waste and Waste Characterization
2. Landfills Classification and Types
3. Landfill Design Parameters
4. Landfill Site Selection
5. Landfill Operation
6. Landfill Closure and Post Closure
7. Landfill Legislation

# WASTE AND WASTE CHARACTERISATION

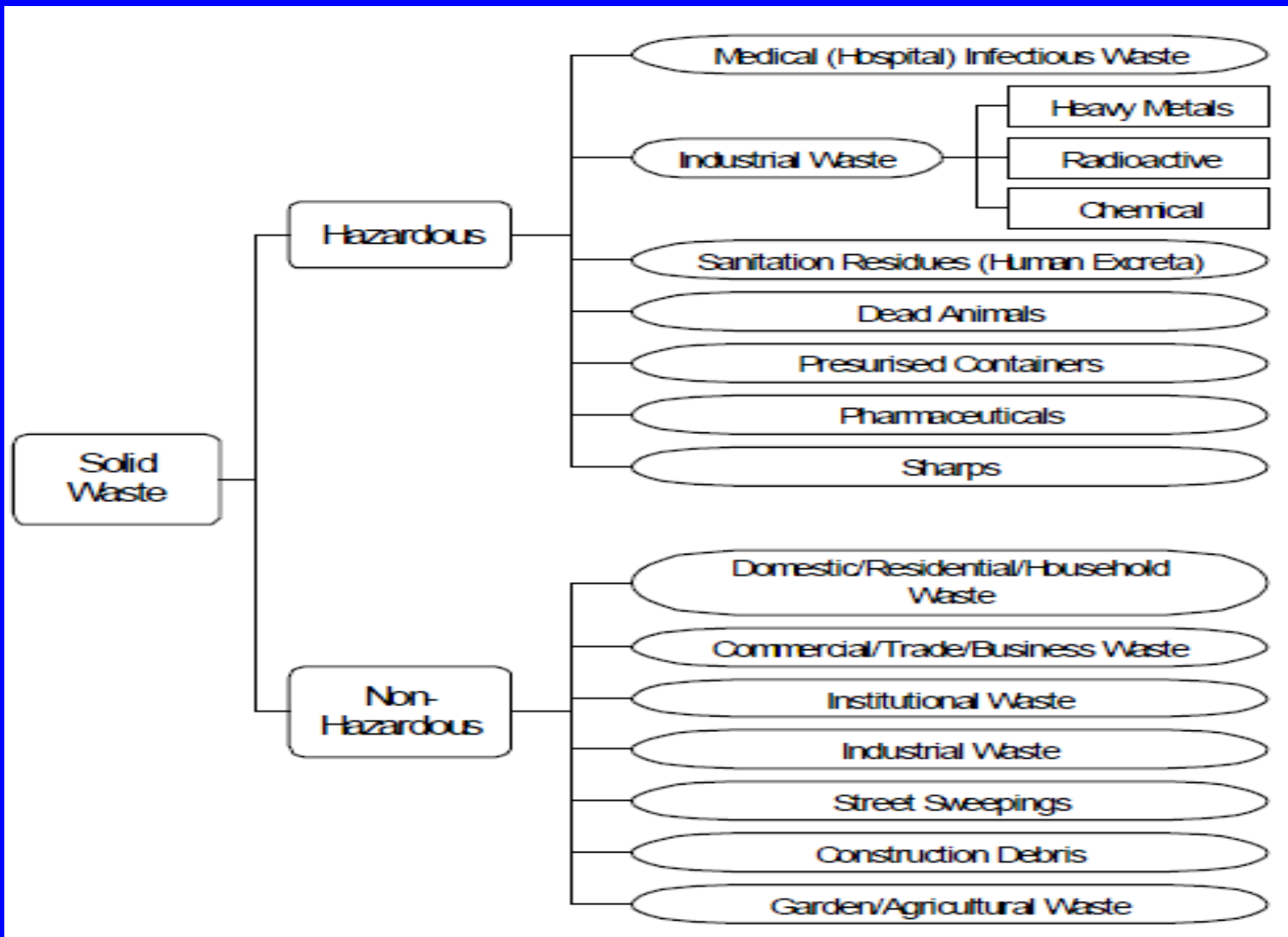
# Topic Outline

- What is waste?
- Waste disposal
- Waste disposal monitoring and control
- Waste disposal at landfills

# Waste disposal and characterization

- Waste is any rubbish people throw away either at home or work
- Zimbabwe produces 150 tons of waste per year<sup>1</sup>
- 70% of it is food waste<sup>1</sup>
- Management of this waste essential hence proposed use and management of landfills

# Waste characterisation<sup>2</sup>



# LANDFILLS AND LANDFILL TYPES



# Topic Outline

1. Definition of a landfill
2. Types and classification of landfills
3. Model landfill
4. Landfill costs
5. Benefits from landfills

# Landfills

- Landfill is an engineered and licensed facility where waste is deposited for permanent storage
- Results in minimal negative environmental impacts due to their design

# What the landfill does

- Can process up to 300 000 tons of waste per annum
- Can generate up to  $2.56 \times 10^8$  MJ of electricity from biogas<sup>3</sup>
- Can generate up to  $7.81 \times 10^8$  MJ of heat<sup>3</sup>
- Minimum operating period of 25 years

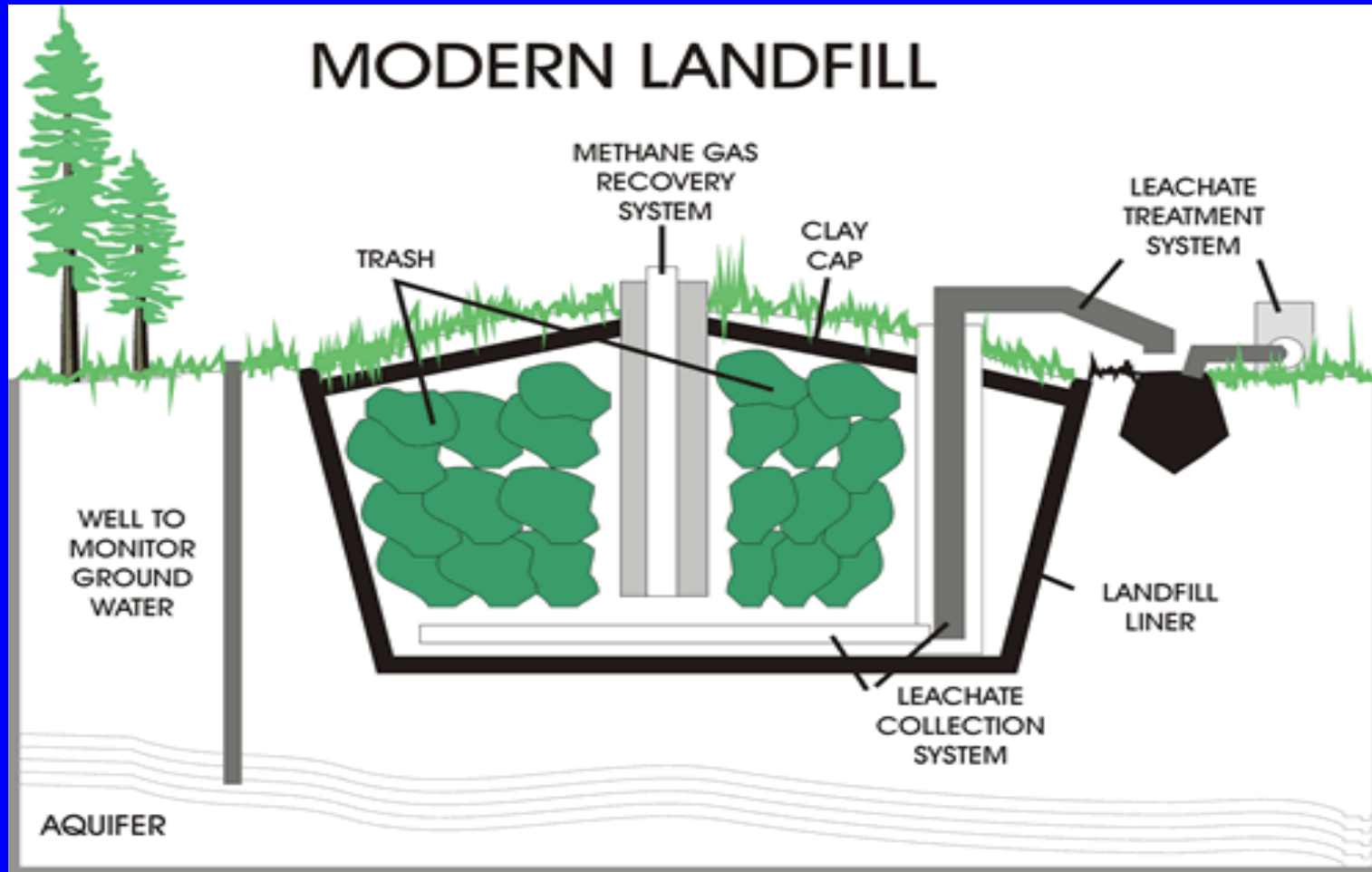
# Landfill types

- The trench method-used in level terrain
- The area method-used on sloped areas
- The valley method-used where there are valleys

# Landfill classification

- Class 1: Hazardous waste
- Class 2: Low level hazardous material
- Class 3: Non-hazardous materials

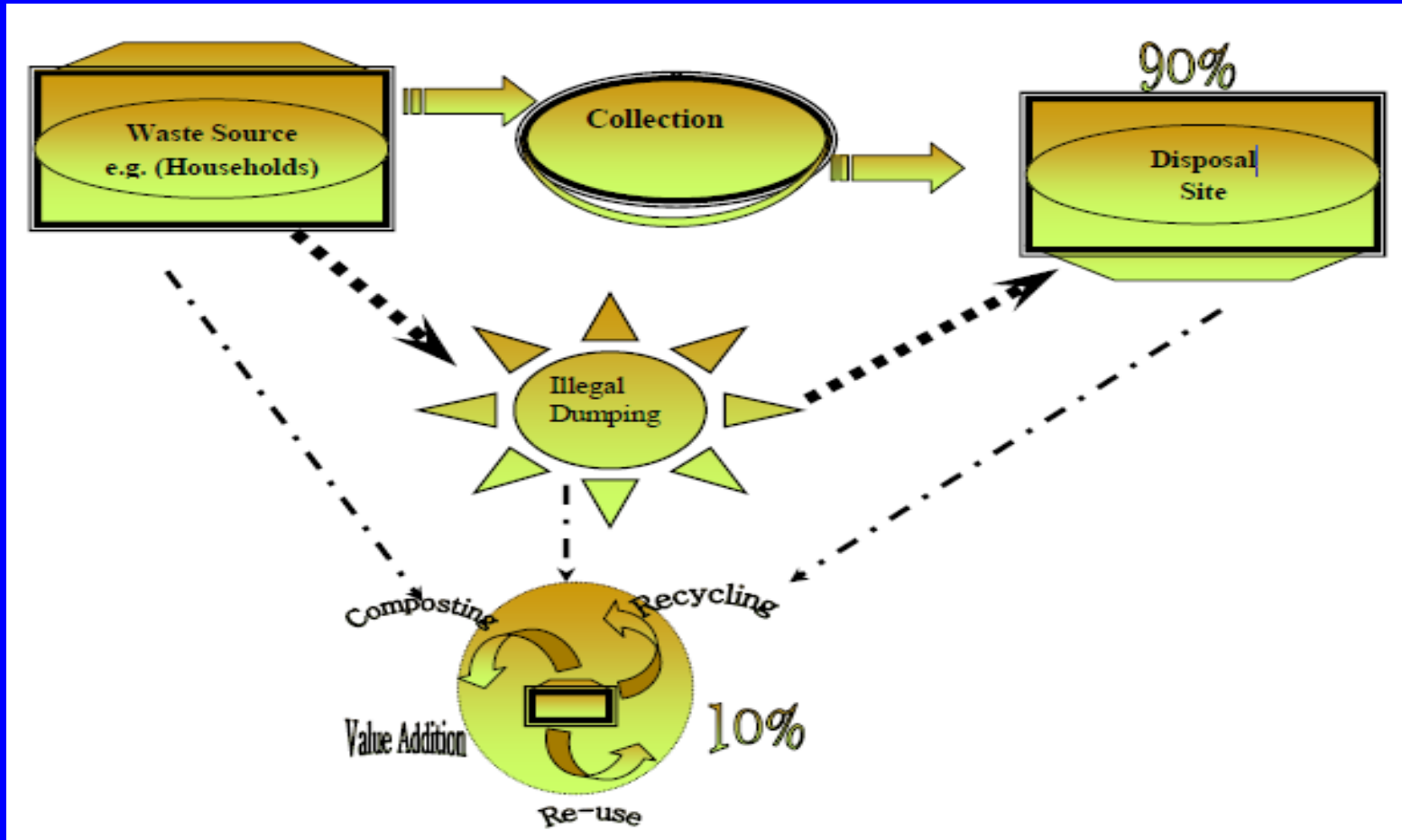
# Model engineered landfill<sup>4</sup>



# Landfill liner cross section<sup>5,6</sup>

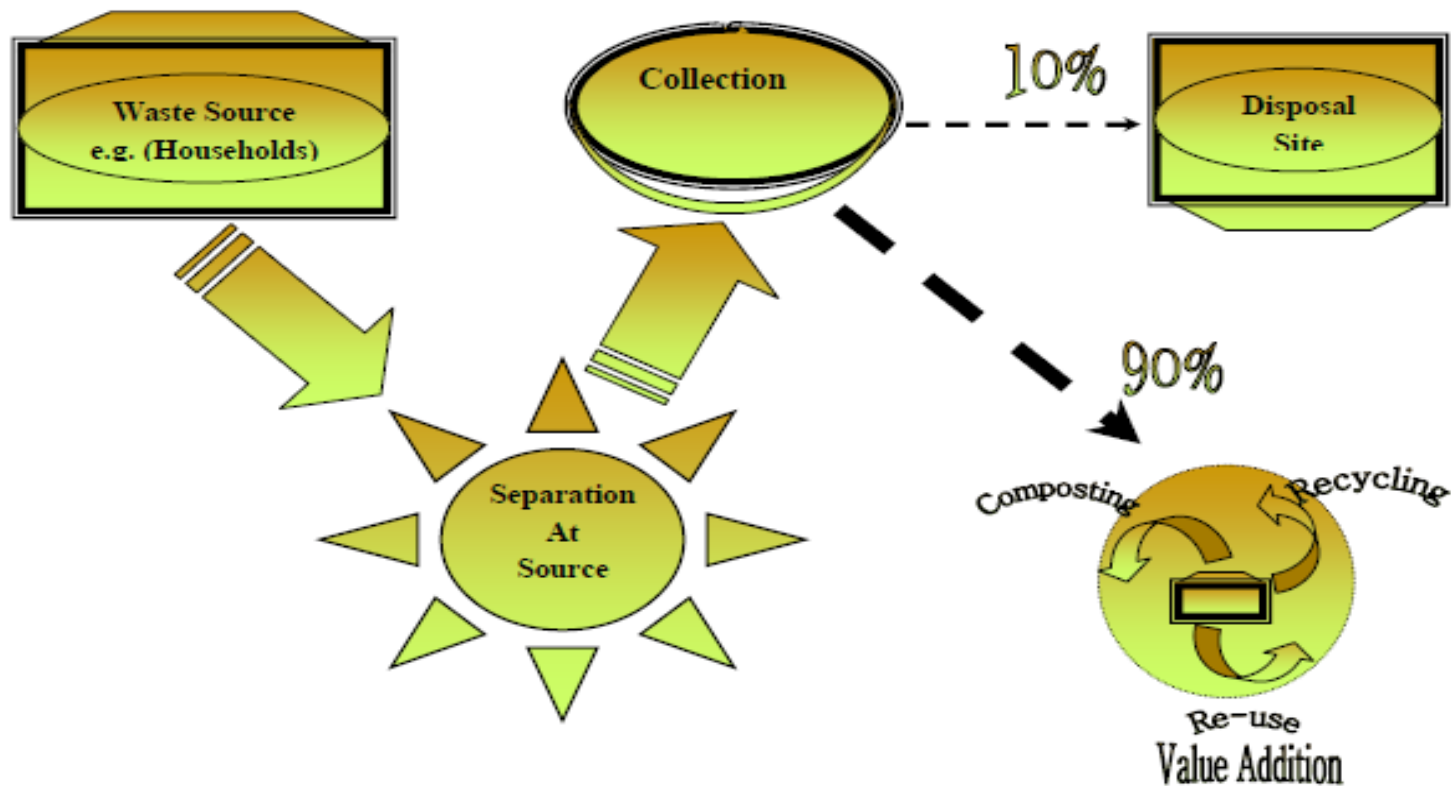


# Current waste disposal at landfills in Zimbabwe<sup>2</sup>





# Ideal waste disposal at landfills in Zimbabwe<sup>2</sup>



# Landfill costs

- Pre-development
- Construction
- Operations
- Closure
- Post closure
- Human resources payment
- Equipment

# Landfill benefits

- Compost and to be used as bio-fertilizers and soil conditioners
- Electricity generation from methane
- Heat generation for use in boilers
- Minimal impacts to the environment
- Employment generation

# LANDFILL DESIGN PARAMETERS

# Topic Outline

1. Importance of design considerations
2. Bottom liner
3. Leachate collection
4. Leachate treatment
5. Landfill gas collection
6. Final cover layer
7. Groundwater monitoring system
8. Energy production
9. Landfill site selection

# Landfill System Design Considerations

Landfill Design Factor	Material Used
Bottom liner	Geosynthetic clay liner Geomembrane Geonet Geotextile
Leachate collection	Gravel drainage bed HDPE pipes
Leachate treatment	Aeration ponds Release in receiving body of water
Landfill gas collection	Vertical wells
Landfill gas treatment	Flare
Final cover layer	Sand Geomembrane Organic soil
Groundwater monitoring	Boreholes sunk around the landfill
Energy production	Natural gas electrical power station Natural gas industrial boiler

# Landfill Auxiliary Equipment

Equipment	Use
Pumps	Leachate collection Collection and disposal of leachate sludge
Compressors	Landfill gas collection
Dehydrators and pipeline	Treatment and transport of landfill gas
Weighbridge	Quantifying incoming waste and waste types
Bowser	Water sprinkling during waste spreading
Forklift	Waste lifting and spreading
Compactor	Waste compacting
Front end loader	Waste moving

# Other Design Parameters

- Compaction then daily cell cover- 15cm of soil
- Final landfill cell cover-60cm of soil
- Slope of the landfill cell- 2: 1 i.e. 30° angle
- Leachate generation between 30-300 L/day
- Geology of area critical



# Landfill site selection factors

- Site must be 60m from lakes and streams
- Site must be 1 500m from human habitation
- Site must be 2 000m from an airport

# LANDFILL OPERATION

# Topic Outline

1. Outline the importance of monitoring the landfill operations
2. State of the landfill
3. Landfill inspection
4. Landfill human resources

# State of the landfill

- Aerobic state: 4-60 days in operation
- Anaerobic state:  $\geq 60$  days in operation

Methane, carbon dioxide and hydrogen sulfide produced

Methane to carbon dioxide ratio is 65%:  
35%

Traces of hydrogen sulfide  $\leq 1\%$

# Landfill human resources

- Operations manager
- Security officers
- Machine operators
- Drivers

# Landfill inspection

- Waste analysis and quantification
- Manage hazardous materials
- Control release of gases and odors
- Quality of gas monitoring
- Borehole water monitoring
- Maintain equipment to minimize wear and tear
- Human resources adequacy

# LANDFILL CLOSURE AND POST CLOSURE

# Topic Outline

1. Planning for sealing of cells
2. Application of final cover on cells
3. Planning for long term leachate and gas monitoring systems



# Landfill post closure

- Post closure environmental monitoring system of up to 30 years
- Landfill site remediation
- Landfill site can be used for parks and golf course after rehabilitation

# LANDFILL LEGISLATION

# Topic Outline

1. Define environmental legislation
2. Role of the Environmental Management Authority (EMA)
3. National Legislation on Waste Management

# Environmental Legislation and Role of EMA

- Environmental legislation is statutory law that has been enacted by an environmental authority
- Waste and Solid Waste Disposal Regulations, Statutory Instrument No. 6 of 2007
- Landfill construction supervision carried out by a consultancy registered with EMA
- EMA enforces the requirements for landfills during and after operation

# National Legislation on Waste Management<sup>7</sup>

- The Environmental Management Act Chapter 20:27
- The Urban Councils Act: Chapter 29:15
- The Rural Councils Act: Chapter 29:13
- The Regional Town and Country Planning Act: Chapter 29:12
- The Water Act: Chapter 20:22
- The Public Health Act: 15:09

## OTHER ACTIVITIES:

- Training Programs
- Staff Meetings
- Cross-Training
- Communication

# REFERENCES

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