

# Lakhodair Landfill Site

A Greener & Smarter Solution  
for Waste Disposal in  
Lahore



**THE URBAN UNIT**  
Urban Sector Planning & Management Services (Pvt) Ltd.  
A Public Sector Company.



آذربایجان و سمنان و همدان و تبریز

# Message from Chairman

## Landfil Site for a Habitable Environment

In all the major cities of Pakistan, open dumping of Municipal Solid Waste (MSW) is prevalent and waste is being dumped in an uncontrolled manner. The open dumping of MSW is one of the major causes of spread of diseases. The chemicals and other contaminants found in solid waste can seep into groundwater and can also be carried by rainwater to rivers, canals and lakes that provide essential wildlife habitat. Moreover open dumping of waste is also detrimental to the natural beauties of our cities.

The Lahore Waste Management Company (LWMC) after consolidating the collection & transportation systems in Lahore has embarked upon yet another milestone in the history of Solid Waste Management (SWM) in Pakistan by constructing the first ever sanitary landfill site of Pakistan at Lakhodair, Lahore. Although, disposal of solid waste in a sanitary landfill is the last step in waste management hierarchy, yet, it is very important to dispose of the wastes in conformity with a suitable technique and in a manner that does not damage the human and environmental health. Lakhodiari landfill site has been designed to handle 2000 tons of MSW/day for about ten years and will soon be operational.

This landfill site has all the important features of a landfill including leachate collection and gas capturing systems. The landfill gas captured from the sanitary landfill will be used for energy generation. The sanitary landfill site has been designed and constructed by Turkish companies, however, local expertise and knowledge has been acquired to undertake such projects in future.

LWMC's fundamental mission is to transform Lahore as one of the cleanest cities in the world by providing customized solutions in consultation with citizens and private partners to ensure sustainable, safe, clean, and green environment. LWMC will continue to serve the people of Lahore and Punjab by offering state-of-the-art solutions for solid waste management for a more habitable environment for the people.

**Khawaja Ahmad Hassan**

Ex-Chairman LWMC

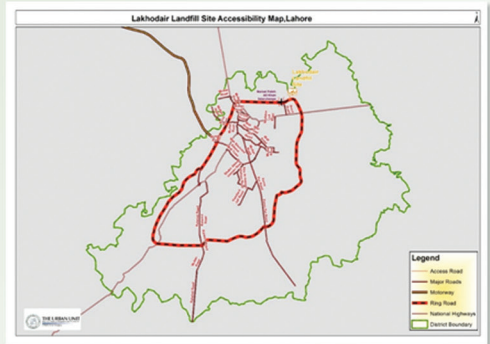
## 1. Sanitary Landfill

Sanitary landfills provides environmentally sound disposal of waste that cannot be reduced, recycled, composted, combusted, or processed by other means. Globally, solid waste disposal is an important concern that results in the demand for higher landfill capacity. To achieve this objective, it must be understood that a landfill is not a "dump site" but an engineered structure with the following distinct phases:

	Planning (inception)
	Construction (birth)
	Operation/Filling and Closure (growth)
	Reclamation/Reuse of the Landfill Site Land (death)

# 1.1. Lakhodair Landfill Site

LWMC has constructed a new state-of-the-art landfill facility at Lakhodair near Ring Road, Lahore as shown in Figure. The idea of a dedicated landfill site is to provide a separate locality outside city limits for disposing the city's solid waste. For this purpose approximately 53 hectares of land has been acquired. This initiative will not only reduce risks associated with open dumping but will also act as a role model for other cities facing the same issue.

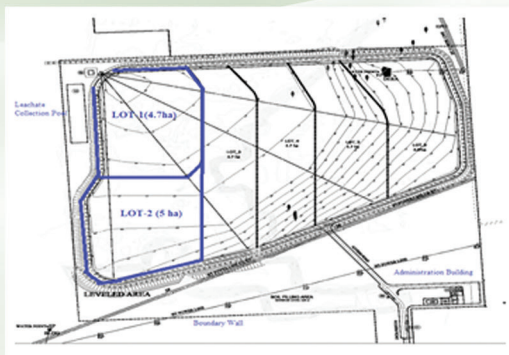


Location Map of the Lakhodair Landfill Site

Some 28 hectares is being utilized for the construction of the landfill site, with additional land available for possible future extension. The selected site is located 15 kms away from the city centre and comprises of depressions, ditches and barren land.

- ⊗ The Turkish consultancy firm ISTAC was engaged for the preparation of the technical design of the facility which was reviewed by the National Engineering Services Pakistan (NESPAK).
- ⊗ The proposed landfill site has been divided into 6 cells of varying areas as shown in Figure.
- ⊗ NESPAK is responsible for the construction and supervision of the project through its experienced Civil Engineering Team.
- ⊗ Newly constructed lots (cells 1 & 2) have a design capacity of 1,390,000 Cu.m with an approximate design life of 1.5 years based upon a design load of 2,000 tonnes/day and waste density of 0.8 tons/Cu.m. With time other technologically advanced options including composting, RDF, waste for energy, incineration, et al will also be explored.

The total cost of the first phase of the Project (cell-1 and cell-2) is approximately PKR 1.3 Million.



Site Development Plan



Compaction of Local Soil



Preparation of Stabilized Embankments



Excavation in Cell-1

## 2. Essential Components of Lakhodair Landfill Site

The area method of landfill construction has been adopted for the Lakhodair site and will contain a series of waste layers/cells interacting together to achieve sustainability. The following are essential components that have been incorporated into the design of the Lakhodair landfill site.

### 2.1.1. Foundation Support and Reinforcement

This aspect is particularly relevant because Lakhodair is a new landfill constructed on a soft surface (i.e. loamy and clay soils) and may be susceptible to landslides. In order to avoid all this concern, the base of the landfill site was extensively compacted through compaction devices. Embankments have been constructed to resist any kind of erosion and incidence of land sliding. The ditches were filled and earth was excavated where required.

## 2.1.2. Improvement of Site's Geological Characteristics

In order to improve the geological characteristics of the local soil and to limit the impact of leachate losses that are ultimately anticipated to take place through any barrier system, two layers of natural clay of 0.25 m each; locally available at a distance of 10 kms from the landfill site were placed in order to enhance the water retaining capacity of the local soil.



Clay Dump for Layering



Grading of the Clay Layer



Compaction of the Final Clay Layer



Compaction of Side Slopes of Cells

## 2.1.2. Water Drainage and Filtration

Leachate arising from rainfall, from phreatic surfaces or water table adjacent to the landfill will be diverted to avoid waste pollution and to avoid possible landfill stability problems or problems with the buoyancy of the barrier. The perforated HDPE drainage pipes have been laid all around the landfill to collect rainwater from the top cover of the landfill and runoff water from the

surrounding areas. To filter coarse matter from the leachate and runoff water, round gravel has been layered on the HDPE conveyance pipe, which will also protect the HDPE pipe in the long run. The drainage pipe will carry this accumulated leachate through gravity flow to the leachate collection pond.



Drainage and Filtration System for Surface Runoff and Rain Water

## 2.1.3. Waterproofing through Membrane

This is the heart of the barrier system and is constructed with high density polyethylene raw material. HDPE geo-membrane with thickness of 2mm has been used at the Lakhodair Landfill site. It will retain the leachate and prevent it from penetrating into the ground, thereby protecting freshwater from being polluted.



Layering of Geo Membrane



Layering of Geo Membrane

## 2.1.4. Geo Membrane Protection and Separation

The geo membrane has to be protected from being punctured by sharp objects found within the solid waste or in leachate. A polypropylene (PP) based geotextiles layer has been used next to the geo membrane to provide fundamental and low cost protection to the geo membrane. The geotextile layer is also used as a separation layer between the geo membrane and gravel. A gravel drainage layer of 0.5 m has been provided next to the geotextile layer in order to modify the friction angle thereby minimizing the stresses transmitted to the membrane.



Layering of Geotextile



Layering of Gravel

Layering of Geotextile



In order to avoid the retention of leachate within the waste, it will be collected and taken to a leachate collection pond. This will be achieved using a gravel drainage layer having laid perforated HDPE in between it.

Base Sealing System of the Lakhodair Landfill Site

## 2.1.5. Leachate Treatment and Disposal

The leachate will be collected in waste cells through perforated HDPE pipes, laid with 1% slope, in the gravel drainage layer. These leachate collection pipes are connected to a leachate pond for the collection and disposal of leachate. Two leachate ponds of size 19 x 35 m and 15 x 40 m have been constructed with total capacity of 1200 Cu.m.

The leachate collected in the pond will be recirculated in both cells through re-circulation pipes and pumps installed in the leachate pond. The provision of a leachate treatment plant has also been made in the next phase of the project, with land already designated for the leachate treatment plant adjacent to the leachate pond.

## 2.1.6. Gas and Storm Water Collection System

The need to collect and ventilate Methane gas produced within the landfill, makes it essential to construct a gas collection system and chimneys. A gravel layer of 0.5 m is the typical solution for a drainage layer suitable for gas collection. For the construction of chimneys, special gabions can provide an easy and efficient method of construction.

A vertical gas extraction vent system has been constructed for the passive collection of the gas, however, an active collection system for the gas will be introduced later.

Above the surface of the waste mass (at top cover of the landfill), extraction wells will have a well head for vacuum adjustments and the collection of gas. 44 number of gas vents has been installed in Cell-1 and Cell-2.





An earthen storm water channel has been formed around the landfill site cells for rain water diversion and drainage. The storm water channel has been constructed through excavation and/or earth filling with concrete culverts at the intersection of the roads.

**Through proper collection and utilization of the landfill gas, we will be able to**

- Reduce greenhouse gas emissions
- Prevent dangerous explosions at the landfill site due to sudden expansion of the methane gas
- Reduce air pollution and pungent odour at the landfill site.
- Reduce dependence on fossil fuels by harnessing captured methane as an energy source.
- Generate revenue and to improve the social and economic stature of the society.

## 2.1.7. Final Cover

The final cover will include layers of inert soil, compacted clay, gravel and a vegetation supportive soil layer of specific thickness as per the design recommendation of the international consultants.

## 2.1.8. Gas and Storm Water Collection System

The final cover will help to:

- ⊗ Provide protection for human health and the environment
  - ⊗ Promote surface water runoff
  - ⊗ Reduce surface water infiltration
- ⊗ Provide protection against air ingress and the potential for fires
  - ⊗ Improve landfill gas generation
  - ⊗ Improve ability to collect landfill gas
    - ⊗ Reduce odour
  - ⊗ Provide vector control

Vegetable Soil (0.5 m)

Gravel layer (0.5 m)

0.25 m Compacted Clay ( $K_f = 1 \times 10^{-9}$  m/s)

0.25 m Compacted Clay ( $K_f = 1 \times 10^{-9}$  m/s)

Inert Soil

Waste Fill

Capping Structure of the Landfill

## 3. Operations of the Landfill Site

LWMC is in the process of outsourcing the operations and maintenance services of the landfill site to an experienced international firm. The firm will be bound to work in collaboration with the local engineering firms initially for a period of 5 years. This collaboration will help in technology transfer.

## 4. Ultimate Use

After the ultimate closure of dumping site, it can be used as a park or playground.

## 5. Monitoring

During waste disposal operations at the landfill site and post-closure, LWMC will continuously monitor the following:

Groundwater quality
Surface water quality
Litter in and around the landfill site
Site roads/ ramps conditions
Workforce efficiency
Leachate level and quality
Landfill gas composition and migration/leakage

Monitoring wells have been constructed to monitor leachate and gas leakage in the following alignment:

- One monitoring well on the upstream of the landfill site (based on groundwater flow directions)
- Two monitoring wells on the downstream of the landfill site.





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