Landfill Redevelopment
Overview

• Landfills: How they are built, operated, and closed
• Environmental Issues at Closed Landfills: What they are and how they are managed
• Redevelopment of Closed Landfills: Why and how
• Examples
• Del Rio Landfill Feasibility Study
What Is a Landfill?

- Modern Landfills
- Older Landfills
- Closed Landfills
- Types of Waste
Typical Modern Landfill
Older Landfills
Del Rio Landfill
Closed Landfills
INDEX OF AREAS

City-Owned (dash indicates location uncertain)
Not City-Owned
Inactive Landfill, Mixed Waste (Approved Closure)
Inactive Landfill, Mixed Waste
Inactive Inert Debris Landfill
Active Inert Debris Landfill
No Pattern Indicates Waste Not Identified by Phase II Investigation
Open Hatch Pattern Indicates Intermittent Waste

EXPLANATION

1  19th Avenue Landfill
2  7th Avenue North
3  Rio Salado #33
4  Rio Salado #32
5  Central Avenue North
6  United Metro Plant #1
7  North Bank, Central to 7th St
8  Central Avenue South
9  Del Rio, West of Del Rio
10  Gibson Lane/Rio Salado #30
11  Rio Salado #26
Potential Environmental Issues at Closed Landfills

• Physical Contact with Waste
• Air Quality
  – Landfill Gas
  – Dust
• Groundwater
Landfill Gas

• Generated from decomposition of waste
• Moisture
• Can be explosive
• Can migrate out of the landfill to air or groundwater
Groundwater

• Leachate
• Landfill gas
• Hazardous wastes
Landfill Covers

- Contact with Waste
- Air Quality
- Groundwater
Landfill Gas Control

• Limit moisture in waste
  – cover

• Prevent migration out of landfill
  – gas control system
Landfill Gas Control Systems
Landfill Redevelopment Can Be Smart Growth

- Good surface transportation access
- Existing infrastructure
- Growth has filled in around once-isolated landfill sites
Landfill Redevelopment Can Be Smart Growth

• Historical Approach: Can’t put buildings on a landfill

• New Thinking: More land uses are possible, and lead to better management of environmental issues
Three Key Redevelopment Elements

• Foundations
  – Settlement and Differential Settlement

• Decomposition (Landfill) Gases
  – Methane and other traces
  – Migration, control, and monitoring

• Construction Worker Safety
Foundation Issues

- Where is the waste
  - Location, thickness
- What type of waste
  - Properties
- How old is the waste
  - Settlement history
Settlement Over Time

- Total settlement over time can be 10% to 30%
- If 50 feet of waste → 5 to 15 feet over time (Years? Decades?)
Settlement With a Load

- Differential Settlement
“Soft” Edge Settlement

• Differential settlement
  – Depth, type of waste, loading

• Drainage patterns change
  – Excessive grades
  – Undulations
  – Water ponding

• Utility line grades change
  – Sewage won’t flow uphill!

• Paving cracks

• Crooked lighting, fencing, etc.
“Hard” Edge Settlement
Managing Settlement

• Ground improvement (surcharge, dynamic deep compaction)
• Waste removal and replacement with structural fill (partial or complete)
• Reinforcement (geogrids)
• Shallow footings and slabs
• Deep foundations (driven piles, drilled piers, grade beams, structural slabs)
Pre-Loading (Surcharging)

- Old, relatively inexpensive method
- Requires time and source of fill material
- Also settlement measurement & prediction
Dynamic Deep Compaction

- Depth of improvement ~25 to 30 feet in MSW
- Good for near surface stabilization
Waste Removal

- Expensive
- Health and safety issues
- Air quality issues
HINGE SLAB FROM CONSTRUCTION TO ONE HALF DESIGN SETTLEMENT (2’±)

Source: Max Keech, PE
Brian Kangas Foulk
Utility Systems
Landfill Gas Mitigation

• Nature of fill
  – More and newer trash = more elaborate gas mitigation

• Nature of development
  – Any occupied structure must be protected and/or monitored
  – Commercial development may be more suited to active controls
  – Residential development can be challenging
Landfill Gas Mitigation

• Passive Approaches
  – Passive vent trench
  – Passive vent layer
  – Passive membrane barrier
  – Combination of above

• Active Approaches
  – Pressure or vacuum
Passive Examples
Construction over Landfills Can Cost More

- Structural slabs and deep pile foundations can add $12 to $25 per square foot of building or more
- Passive gas protection system can add $2.50 to $6.00 per square foot of building footprint or more
- Maintenance cost for parking areas, etc. is higher
Construction Worker Health and Safety Issues

- Physical hazards
- Methane
- Older landfills may contain industrial & hazardous wastes
Example - Proposed Business Park, 12th St and University

• Background
  – CD and MSW landfill 1964 to 1970
  – Used for equipment and material storage for ~3 years
  – 2 to 20 feet cover
  – Trash up to 39 feet thick

• Proposed Development
  – Industrial “condominiums”
Example – City of Phoenix Maintenance/Recreation Facility, 7th Avenue/Salt River

• Background
  – CD and MSW landfill prior to early 1960s
  – Vacant, driver training lot
  – Mostly construction debris
  – High proportion of soil

• Development
  – Municipal park maintenance facility
  – Reservoir, trailhead, and parking
Example – Golf Course, Sun Lakes

• Background
  – Landscaping debris 1980s
  – Existing golf course, homes

• Landfill Gas Issues
  – Turf growth problems
  – Migration toward homes
Example – Shopping Center, 19th Avenue and Greenway

• Background
  – MSW placed during 1960s – 1970s
  – Cover averaged 5 feet thick
  – Trash thickness 10 – 25 feet

• Development
  – Supermarket
David Lorenz Park, Colorado
Lakeside Marketplace, Georgia
Chandler Landfill
Standing 40 feet above the surrounding neighborhoods, Paseo Vista Recreation Area is the Valley’s first active-use municipal park constructed on a closed landfill. This 65-acre project transformed what was once considered a less than desirable site into a point of community pride. Merging small spaces and panoramic views of the valley’s mountain ranges with large public gathering areas, Paseo Vista has become a destination for residents and visitors alike to explore its nuances and dynamic views.

Paseo Vista provides a premier community special-use park with recreational attractions such as disc golf, archery, garden areas, and a dog park. Additionally, it serves as a living experiment, advancing new techniques and technologies to reclaim this type of land resource.

Even though the landfill closed in 2009, the refuse beneath the surface of Paseo Vista is still actively decomposing. These processes require careful monitoring via environmental compliance systems that protect groundwater and air quality. This site serves as a successful example for transforming other landfills into site and public-use recreational opportunities, giving these sites back to our local communities and adding incredible value.
Tempe Center for the Arts
Tempe Marketplace
Del Rio Landfill
DRLF Feasibility Study

• Could a park facility include:
  – Soccer and baseball fields
  – Recreation center
  – BMX track and skateboard park
  – Equestrian facility
  – Open space

• Options for management:
  – Settlement
  – Irrigation
  – Landfill gas
Summary

• Scores of landfills in North America have been developed for a wide range of land uses, from recreation to retail and even residential.

• Technical challenges of settlement and foundation design, gas control, and construction worker safety have proven solutions but are highly dependent on site specifics.

• Changes in Federal and state laws to promote Brownfield redevelopment, including closed landfills.