

Perpetual Biocell - Sustainable Resource Management



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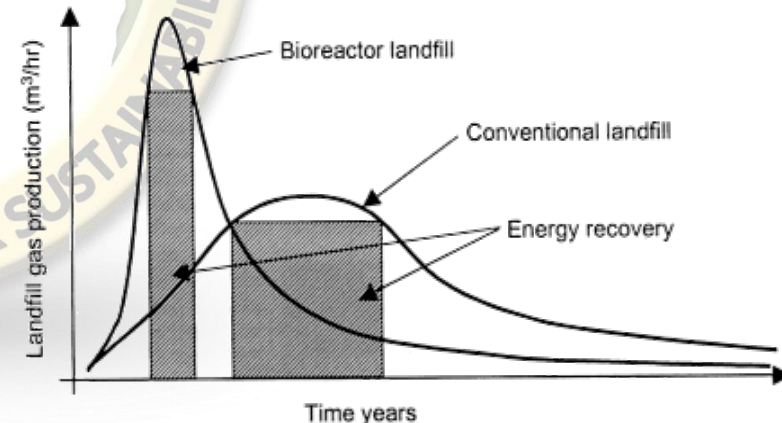
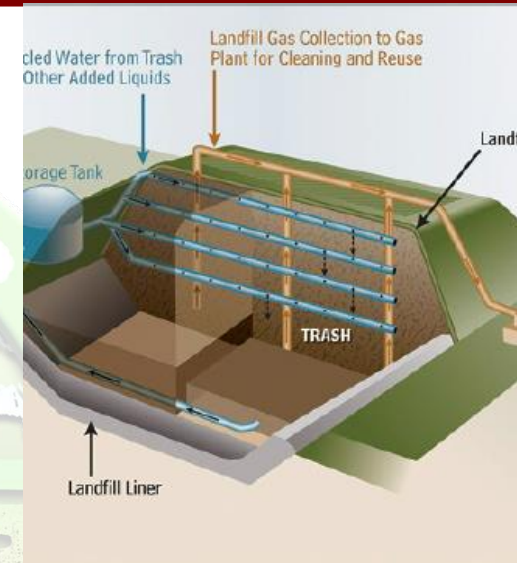
Landfills:

Conventional/Traditional Landfill:

- Minimum amount of moisture intrusion and retention

Enhanced Leachate Recirculation (ELR) / Bioreactor Landfill:

- Moisture addition and leachate recirculation (min average moisture content of 40% by weight)
- Rapid decomposition & Waste stabilization
- Enhanced gas production
- Space recovery





Introduction and Background



Major Issues with ELR/Bioreactor Operation:

- Monitoring moisture movement within the MSW due to Bioreactor operation
- Determining moisture content within MSW during Bioreactor operation

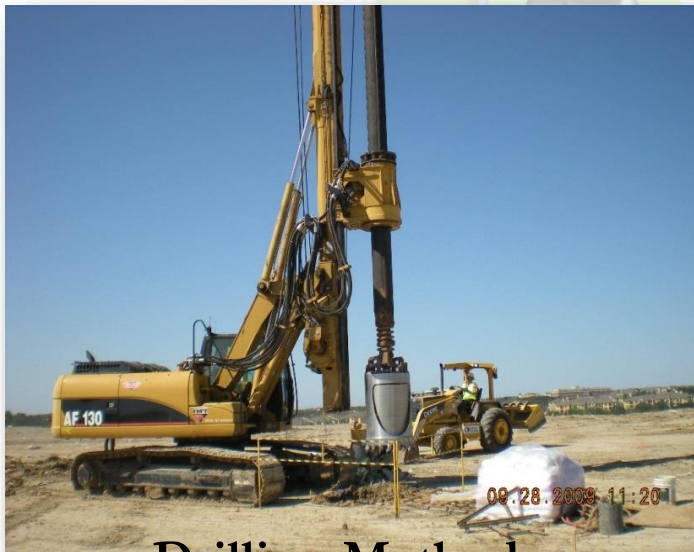




Introduction and Background



- Provides information at certain points
- Not a general view of the site
- Expensive and not practical for long-term monitoring
- Highly invasive
- Thousands of feet of wiring used
- Sensors placed permanently within the waste



Drilling Method



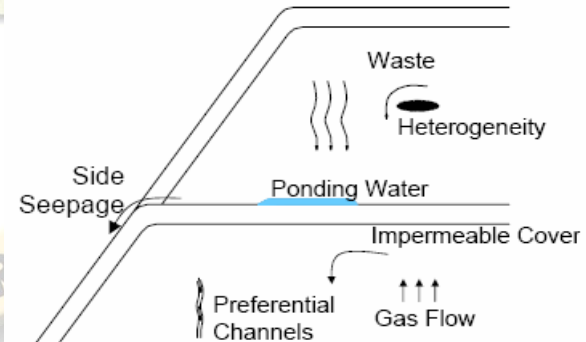
Instrumentation



Resistivity Imaging



- Provides continuous image of subsurface.
- Non-destructive to the containment of the waste.
- Provides large scale coverage.



Processes Affecting Leachate Movement through a Landfill



Objective of the Study

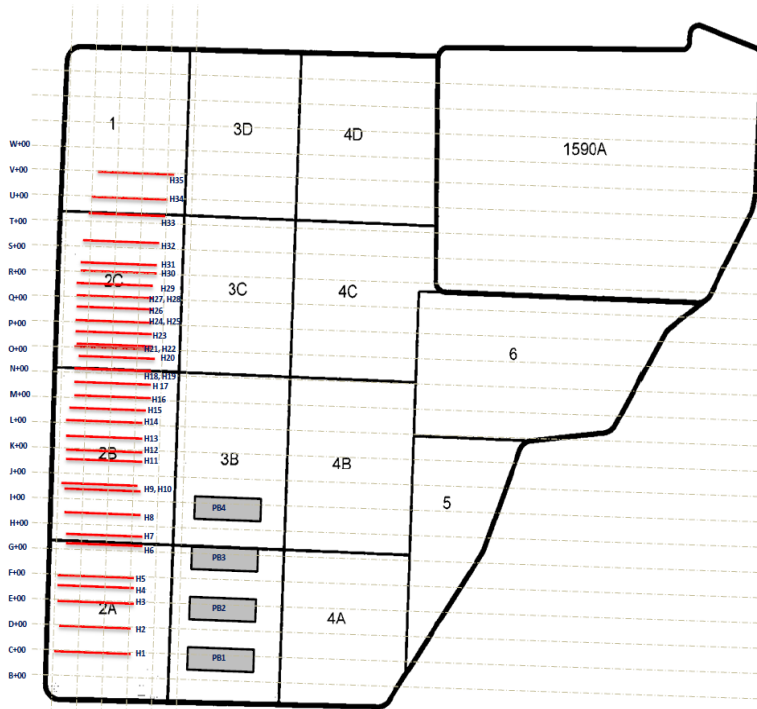


The major objectives of the current study are:

- **To monitor moisture movement of MSW during ELR/Bioreactor Operation**
- **To determine moisture content of MSW during ELR/Bioreactor Operation**



Study Area



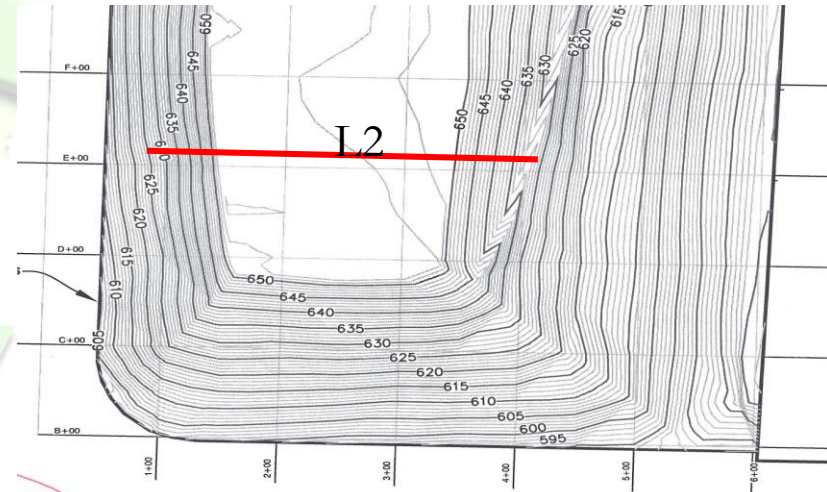
The City of Denton Landfill



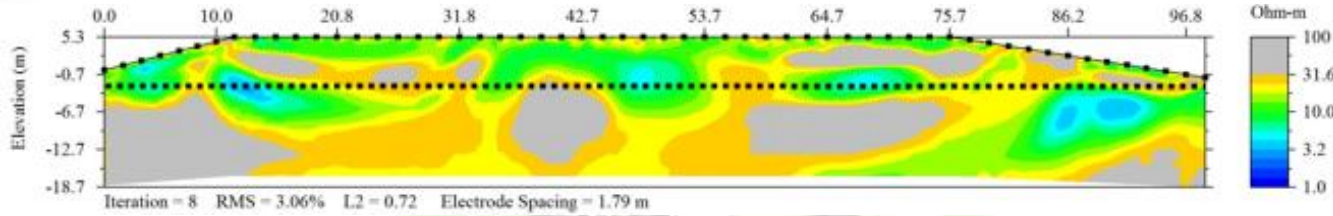
Field Investigation - RI



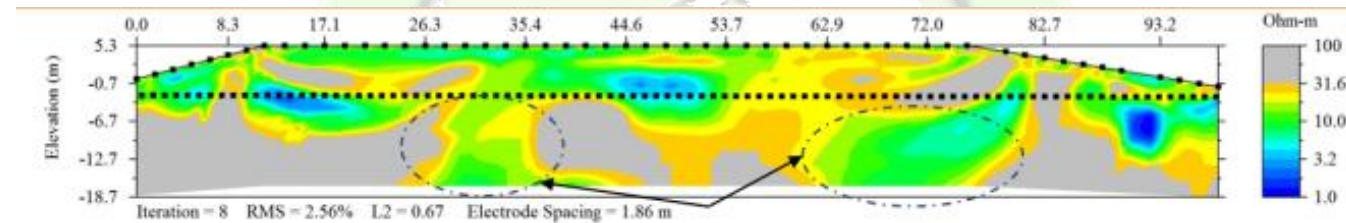
Date	Name	Comments
5/18/09	L2:5/18	Base Line Study along recirculation pipe H2
7/09/09	L2:7/09	1 hour after Leachate recirculation
7/10/09	L2:7/10	24 hours after leachate recirculation



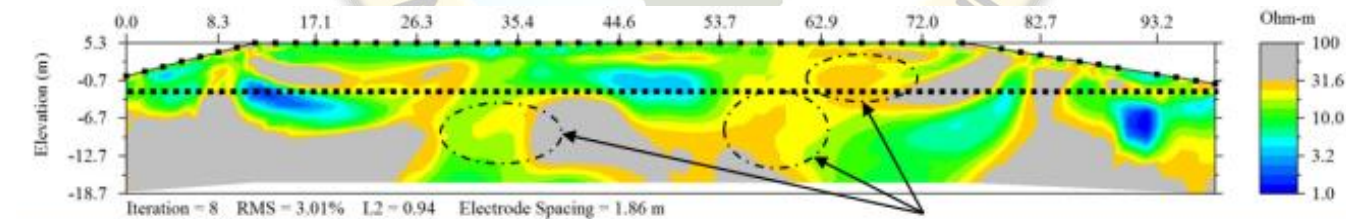
Resistivity test section along recirculation pipe H2
(Leachate injected 4000 gallons along H2)



Base line resistivity image along pipe



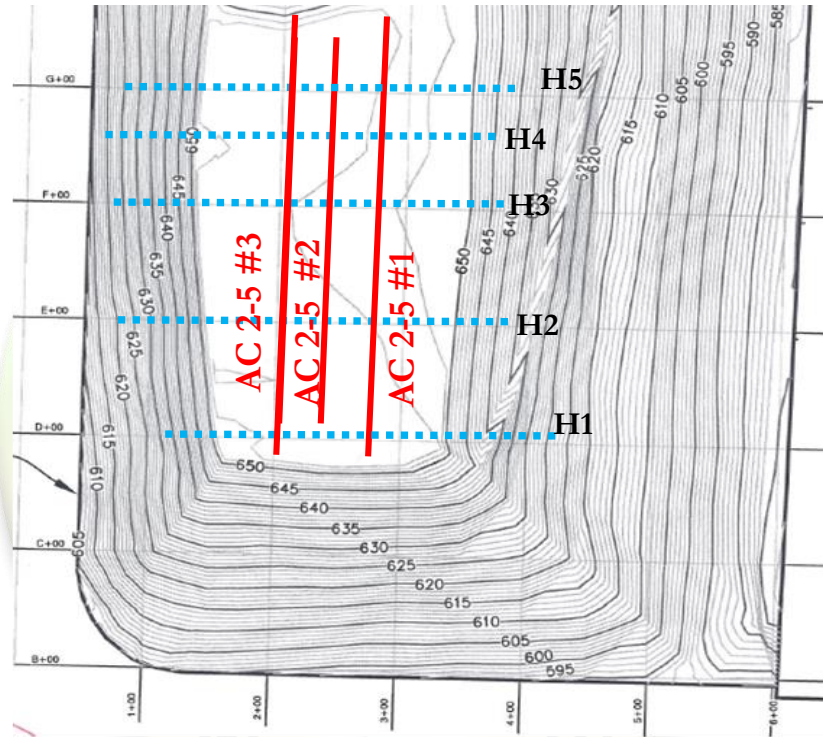
Resistivity image along pipe; 1 hr after recirculation



Resistivity image along pipe; 24 hr after recirculation



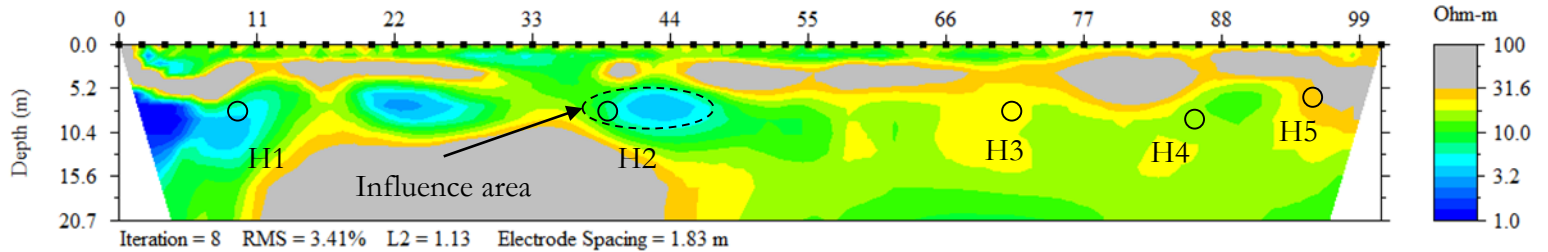
Field Investigation - RI



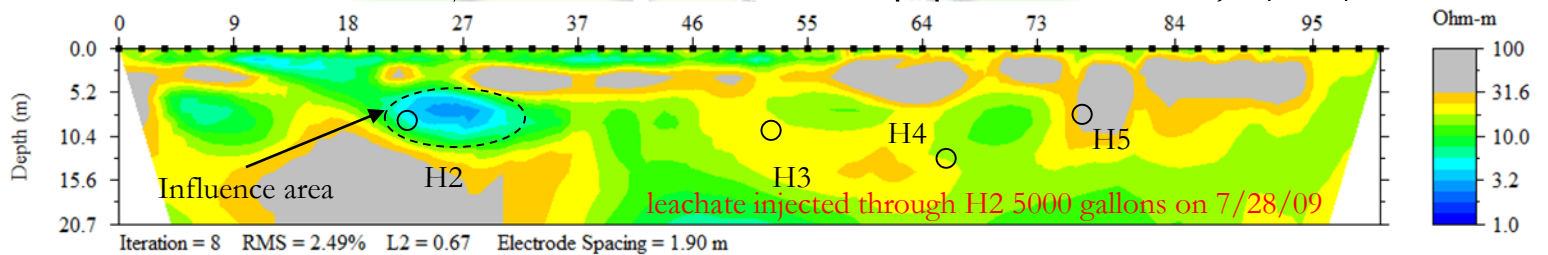
Resistivity Test Section Across Recirculation Pipe H2-H5



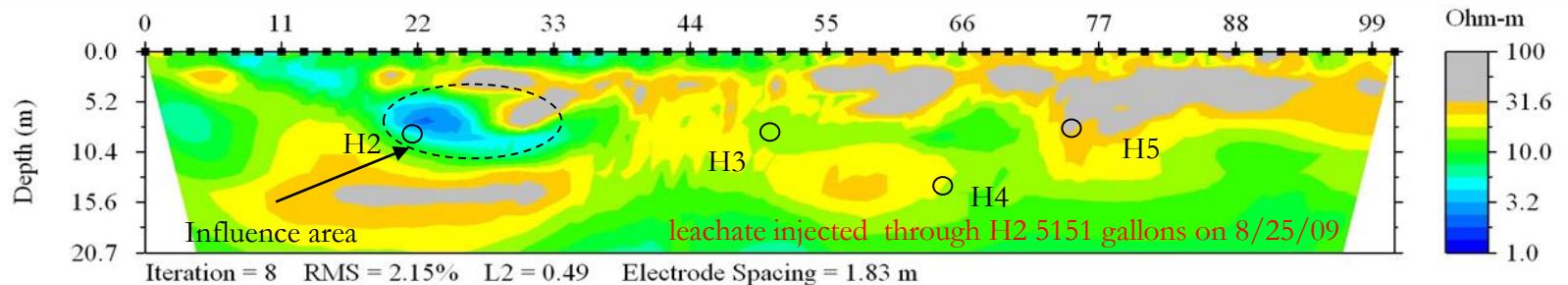
Field Investigation - RI



Base line study across recirculation pipes H2 to H5; 5/22/09



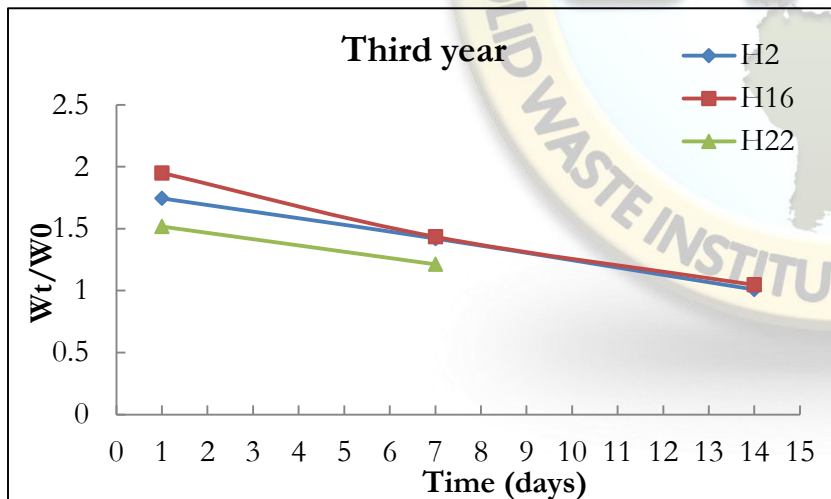
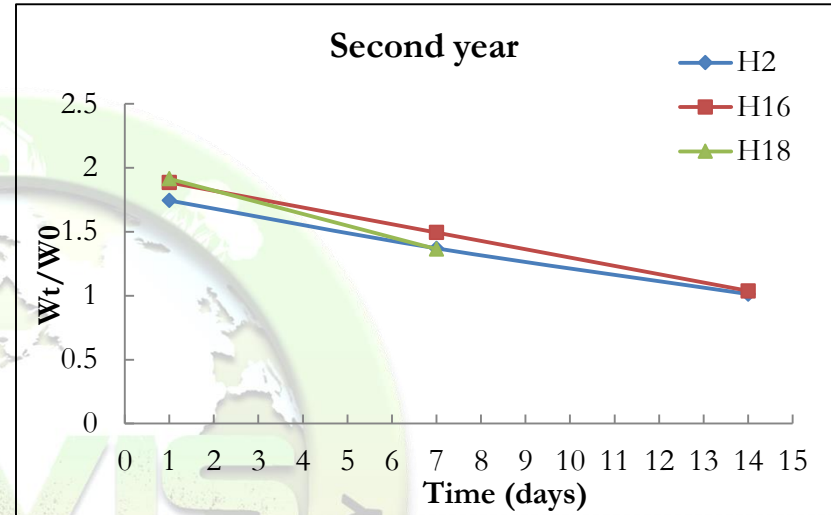
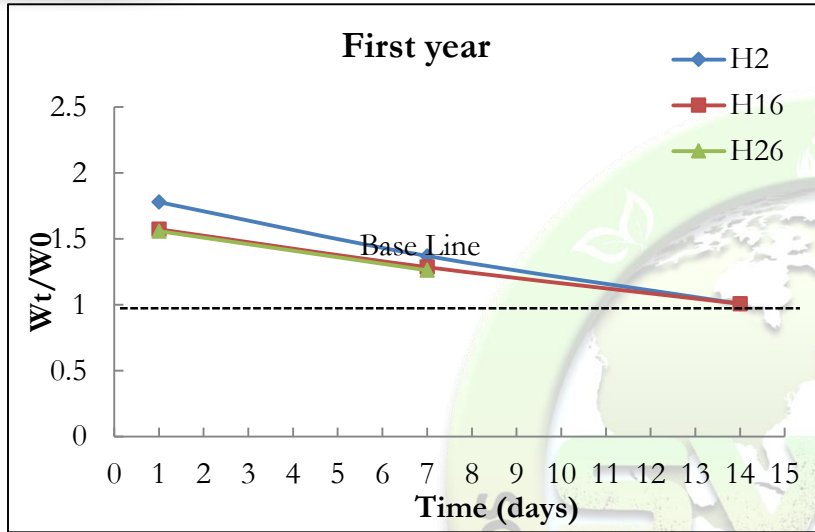
Resistivity image across recirculation pipes H2 to H5; 24 hours after leachate



Resistivity image across recirculation pipes H2 to H5; 24 hours after leachate recirculation (8/26/09)



Field Investigation - RI



W_0 = Moisture content with respect to base line

W_t = Moisture content with time



Moisture Content Quantification without Drilling



Best model (determined using SAS):

$$\log y = 3.35056 - 0.0240825X_1 - 0.01936X_2 - 0.018156X_3 + 0.00023668X_1X_3$$

$$x_1 = \frac{3.35056 - \log y - 0.01936x_2 - 0.018156x_3}{0.0240825 - 0.00023668x_3}$$

$$R^2 = 0.8111$$

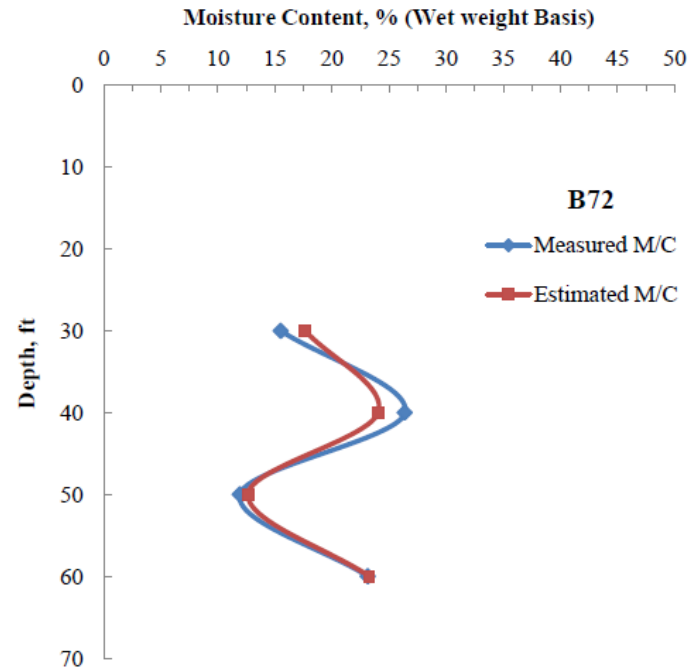
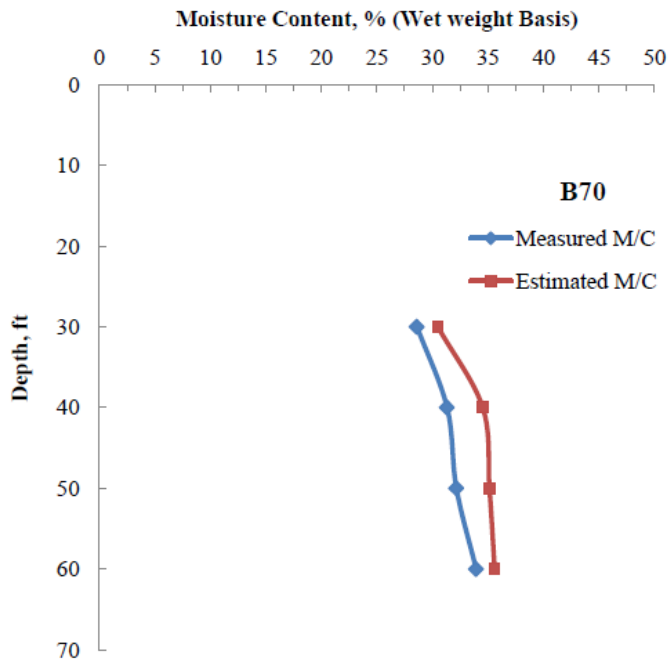
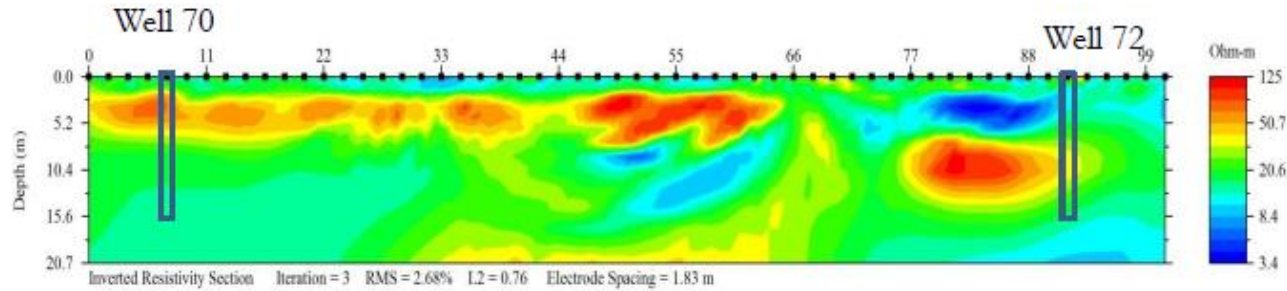
$$\text{Adj-}R^2 = 0.7875$$

where

- y : electrical resistivity (ohm-m)
- X_1 : moisture content (wet weight basis, %)
- X_2 : unit weight (lb/ft³)
- X_3 : percentage paper



Moisture Content Quantification without Drilling





Gas to Energy Project City of Denton Landfill



- ❑ Denton Landfill installed a landfill gas collection system in 2008
- ❑ 73 vertical wells and 34 horizontal gas collection system.
- ❑ The collected gas is directed to an electric power generator on-site which is connected to the Denton Municipal Utilities electric grid.
- ❑ Equipment: One Caterpillar 3520 Engine Generator (Capacity: 1.6 Mega Watt/hour)
- ❑ Number of Household Served: 1600

- ❑ **Gas Flow Rate** : 300 cfm – 2009
: 700 cfm - 2012
: 900 cfm - 2014



Gas to Energy – Generators to Convert Electricity





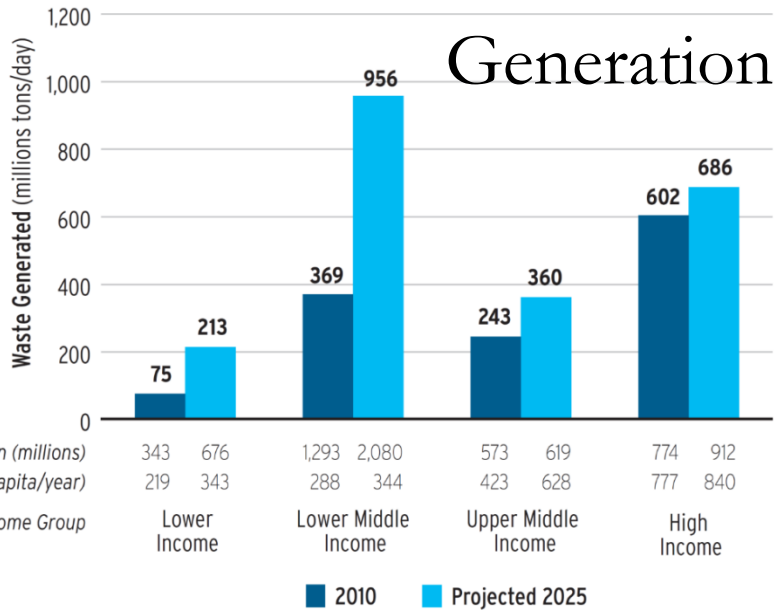
Global Waste Management Practices



- 70% - Dumpsites and sanitary landfills.
- 11% - Thermal and Waste to Energy (WtE)
- 19% - is recycled or treated by Mechanical and Biological Treatment (MBT), including composting



Current Waste Generation and Collection Scenario





Major Issues in Developing Countries (Collection)



Uncollected solid waste contributes 1

Air pollution

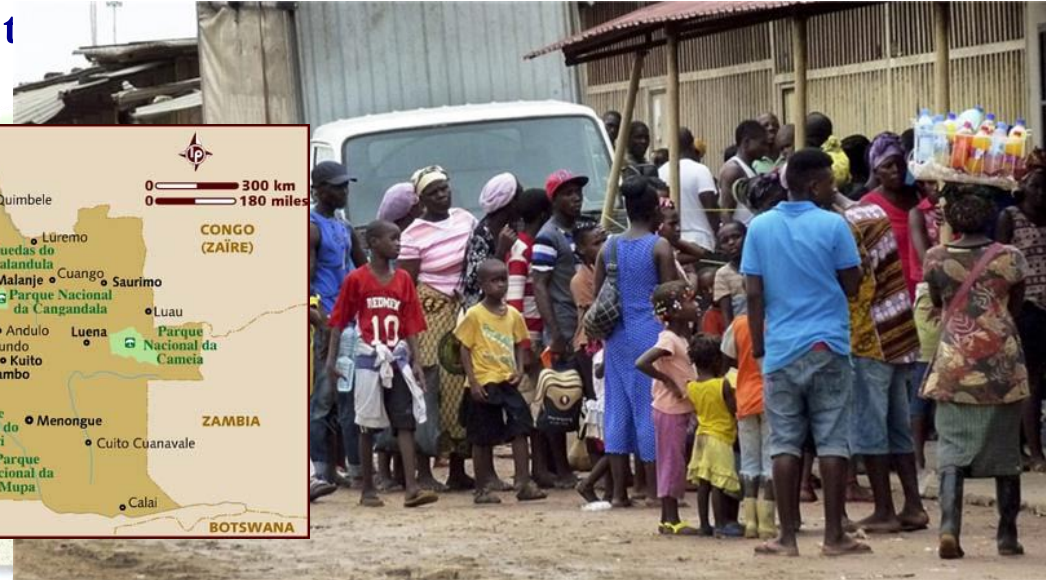
Flooding

Public health impact

Respiratory ailment

Diarrhea

Dengue fever



Angola plagued by Yellow Fever outbreak (CIDRAP, 2015)

- Reduced their budget for rubbish collection
- Biggest epidemic in past 30 year in the country
- 241 people were infected and 51 people died
- Increase in Diarrhea, Cholera, and Malaria





Major Issues in both Developed and Developing Countries (Available Land or Space)



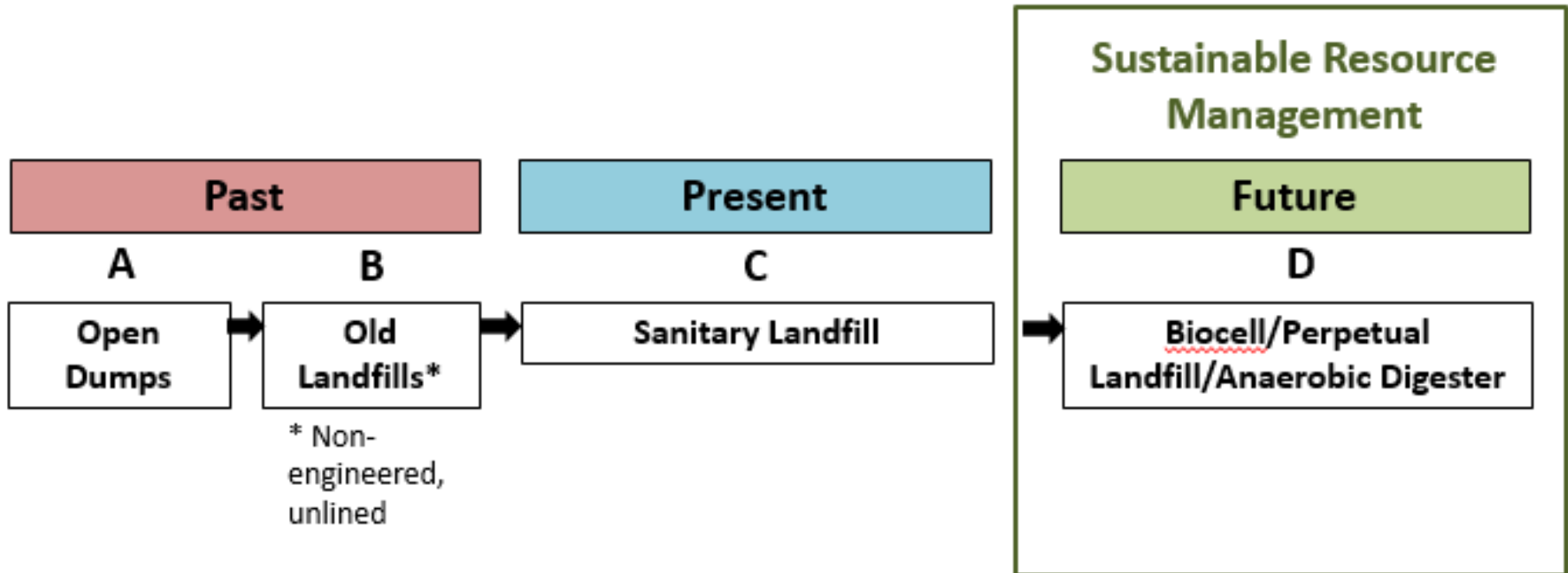
Riot in Naples
(The Guradian, 2010)

Lebanon Waste Crisis
(The Washington Post, 2015)

USA's Largest Landfill in California Runs out of Space (TRIB, 2013)



Future-Sustainable Waste/ Resource Management





Future-Sustainable Waste/ Resource Management



- Methods: vehicle
- Routing
- Time and frequency
- Manpower training
- Social awareness and media

- Source separation of recyclable and organic
- MRF

- Biocell
- Anaerobic Digester
- Perpetual landfill
- Landfill
- Waste-to-Energy

System

Collection

Processing

Disposal/Final Destination

Recyclable: Paper, plastic, metal

Usable commodity

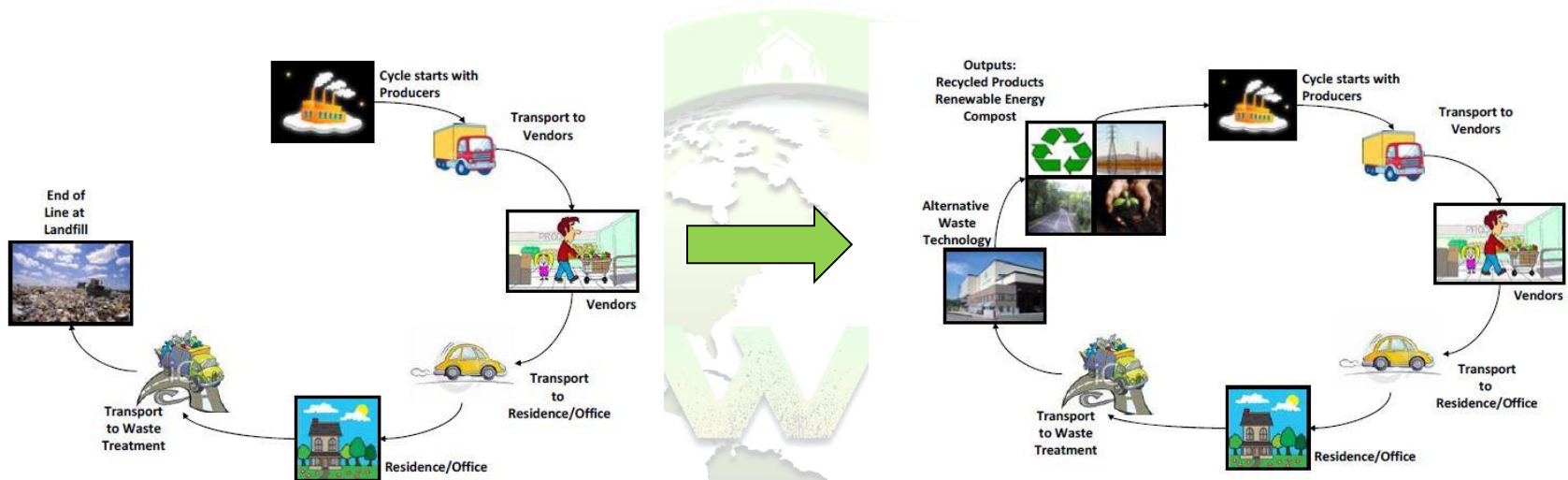
Biogas to electricity

Output





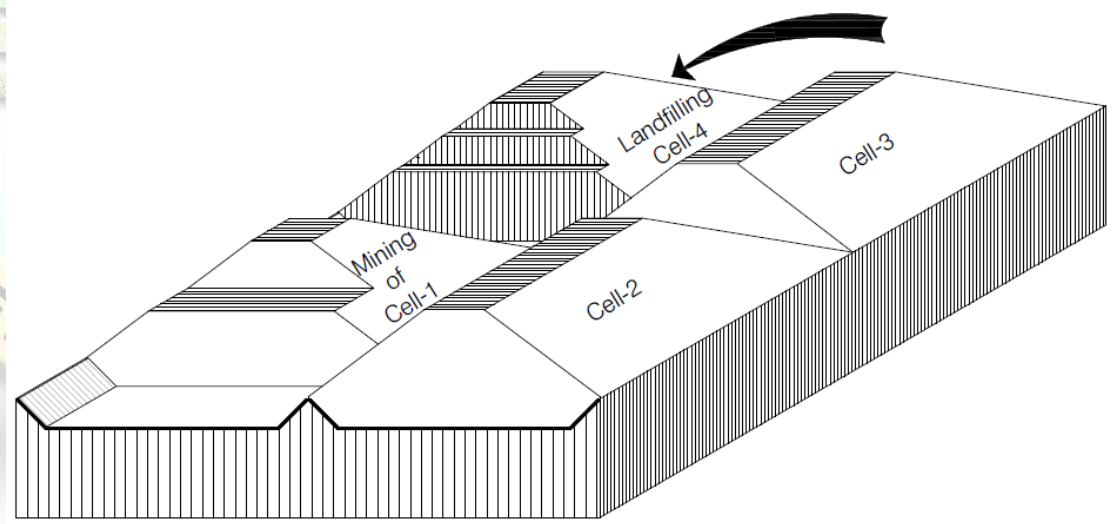
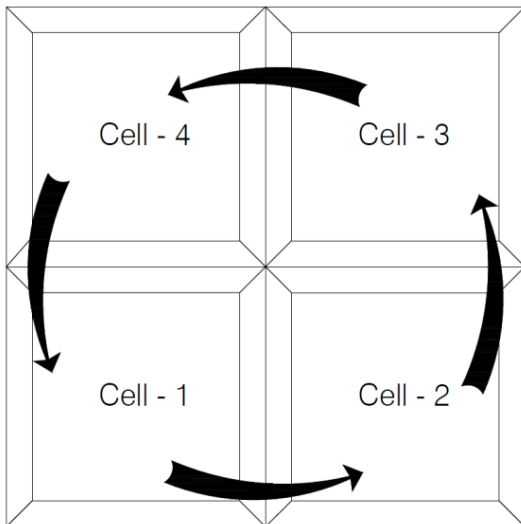
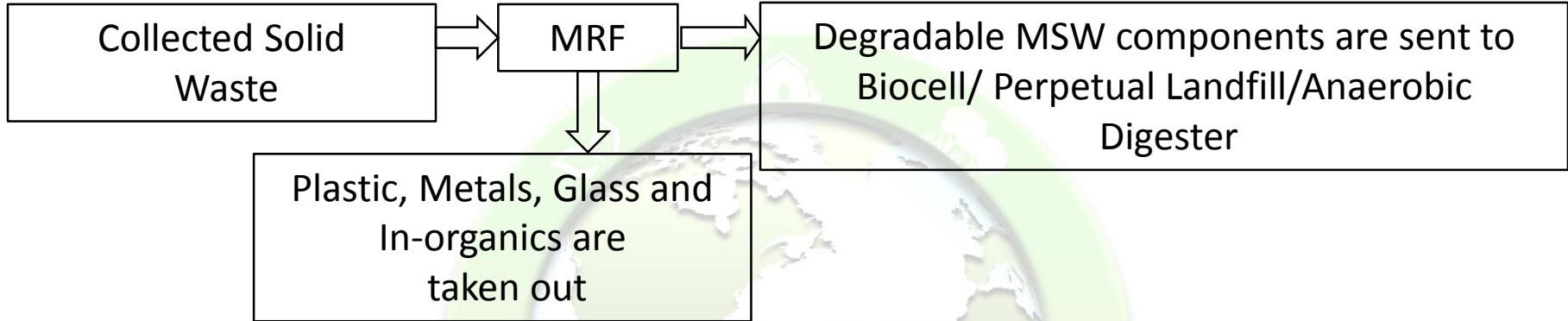
Future-Sustainable Waste/ Resource Management



- Open Loop to Close Loop Solid Waste Management
- Landfill Mining and Operating Landfill as Perpetual Landfill is Potential Way Forward



SWIS - Concepts of Perpetual/ Sustainable Landfill





Mining Sample from City of Denton, Texas



From B-70 @ 60 ft



1985: 40 ft. Depth of B70



2001: 10 ft. Depth of B70

Angola plagued by Yellow Fever outbreak



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- Routing
- Time and frequency
- Manpower training
- Social awareness and media

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Recyclable: Paper, plastic, metal

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- Biocell
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Disposal/Final Destination

Biogas to electricity



System

Output

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ASSET



SWIS Mission



- To research, develop and implement innovative solutions for sustainable waste management
- To provide training and support sustainable waste management in both developed and the developing countries.
- To help young waste management professionals develop business related to waste management.



ISWA-SWIS Winter School 2016





**Describe the Winter School
in ONE WORD**



International Projects-Ghana, Africa and Addis Ababa, Ethiopia



Ghana, Africa



Addis Ababa, Ethiopia



Thank You

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