

# **GREDELL Engineering Resources, Inc.**

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**ENVIRONMENTAL ENGINEERING LAND - AIR - WATER**

**Offices in Jefferson City, Kansas City Metro and Springfield, Missouri**

## **Missouri Waste Control Coalition Conference (2017): Closed Sanitary Landfills - What Happens in 10-20-30 Years and Beyond!**

**July 18, 2017**

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## **ABSTRACT:**

Review the anatomy of the closed municipal solid waste "sanitary landfill" (both the pre- & post RCRA Subtitle D design criteria).

Discuss how a closed sanitary landfill remains connected to the air, land & water (surface-water and groundwater).

Present two example closed sanitary landfill case studies to illustrate what's going on at 20 years after "official closure".

Concluded with a discussion of projected potential impacts of closed sanitary landfills during the post-closure period & beyond.

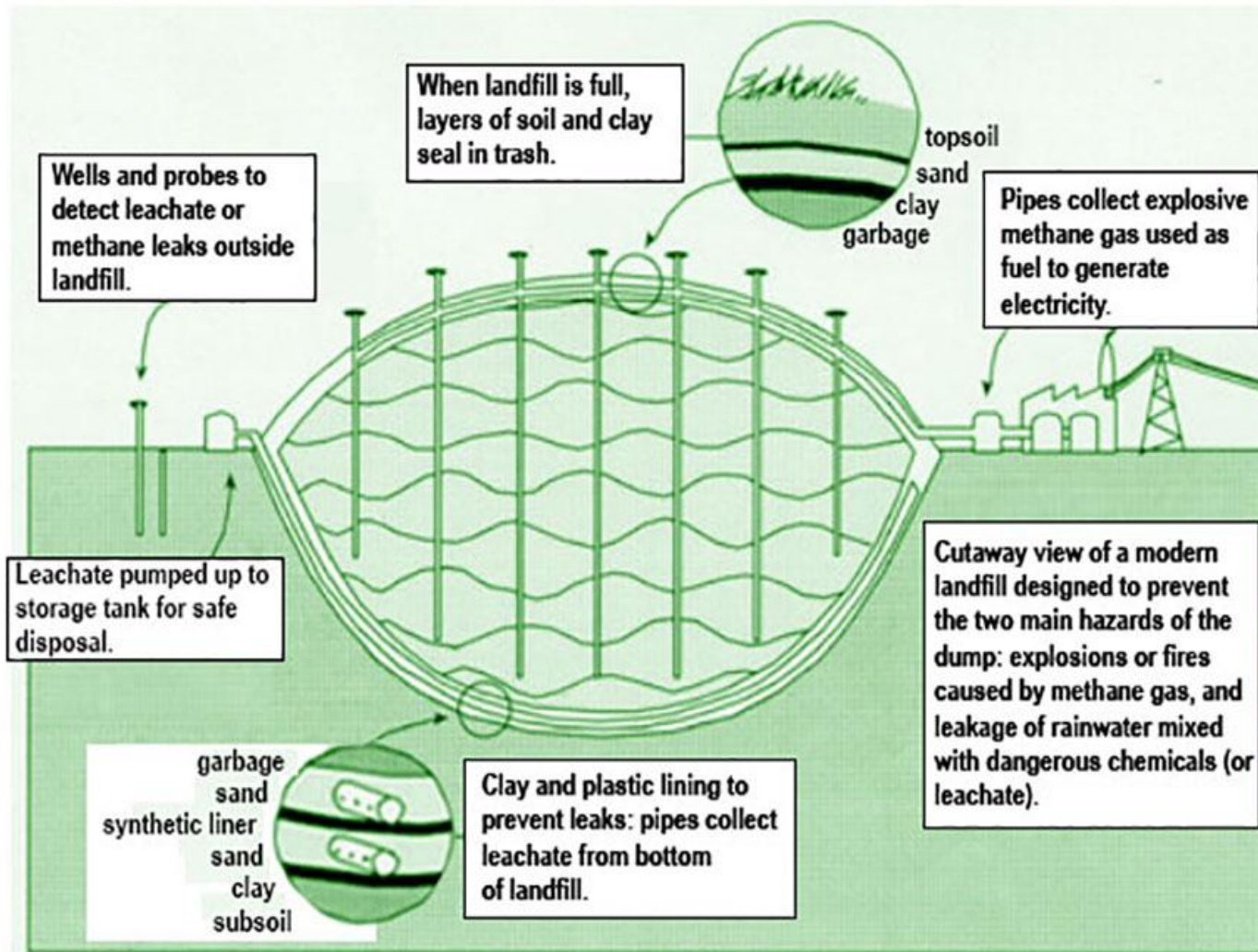
Question: Who should be responsible for providing the resources to care for and maintain these facilities into perpetuity because "all things are connected"!

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# DEFINITION

- ▶ Anatomy is the science concerned with the structure of things.
- ▶ Therefore, of concern is the structure of the closed sanitary landfill.
- ▶ Both Pre- & Post- Subtitle D

# The Closed Subtitle D MSW Landfill (US EPA MSW Website)



## Pre-Subtitle D MSW Landfill

Primary differences:

- ▶ No composite liner.
- ▶ No or limited leachate collection system.
- ▶ No active landfill gas collection system.
- ▶ No composite cap.

# Definition

- ▶ 260.200 (7) "Closure", the permanent cessation of active disposal operations, abandonment of the disposal area, revocation of the permit or filling with waste of all areas and volumes specified in the permit and preparing the area for long-term care;
- ▶ 10 CSR 80-2.010 (12) Closure means the permanent cessation of active disposal operations, abandonment of the disposal area, revocation of the permit or filling with waste of all areas and volumes specified in the permit and preparing the area for long-term care.
- ▶ 10 CSR 80-2.010 (29) Final closure means that a solid waste disposal area has ceased taking waste, has completed all closure activities applicable to the Solid Waste Management Program's law and rules and has obtained closure approval from the program.

# The Closed Landfill's Connection to Air, Land & Water

- ▶ Landfill gas generation continues.
- ▶ The MSW remains within the land.
- ▶ Stormwater continues to result in runoff.
- ▶ Leachate continues to be generated within the landfill.

# What's Happening Inside and Outside?

- ▶ Physics – Uneven settlement, shifting of wastes, slope migration/failure.
- ▶ Chemistry – Acids mixing with bases, Cations reacting with Anions, Oxidation/reduction reactions, inorganic reactions.
- ▶ Biology – Aerobic activity, anaerobic activity, organic degradation, gas formation.
- ▶ Hydrology – Infiltration of precipitation, condensation of water vapor, water vapor formation. Leachate formation & extraction. Leakage into groundwater.
- ▶ Geology – Seismology, settlement/shifting within the subgrade and bedrock formation.



# **MDNR/SWMP 2010/11 Closed MSW Landfill Assessment Report Findings**

## 7 Categories of Deficiencies (58 Landfills)

1. Off-Site Methane Gas (3%)
2. Off-site Leachate (13%)
3. Lack of Maintenance (91%)
4. Land Use Impacts (19%)
5. Monitoring Deficiencies (100%)
6. Public Safety Concerns (52%)
7. Long-Term Stewardship Issues (22%)

## Case Study 1: Landfill A

Location: Timbuktu

Land Area: 39 acres

MSW Footprint: 12 acres

Year Ceased Accepting Waste: 1995

Year Officially Closed: 1997

Type of Operation: Combination Trench/Area

Owner/Operator: Private Waste Company

## Post Closure Conditions

### At Closure:

Final Cap: Three feet of Soil. Seeded in hardy stand of fescue grass.

Bench terraced 3H:1V final slope.

Leachate System: Perimeter collection drains discharging to an on-site lagoon. Off-site disposal at local POTW.

Groundwater monitoring system: None.

## **Post Closure Conditions**

Landfill Gas System: Passive vent through final cover.

Maintenance: Mowing and erosion repair as needed. Restriction of access through maintenance of perimeter fencing and secure gate.

## Post Closure Issues

In 1999 (2 years after official closure & 4 years after the landfill ceased accepting MSW for disposal)– State Agency conducted a perimeter landfill gas monitoring study for gas migration beyond the landfill property line. Landfill gas was detected on adjacent properties along one property line.

The state agency notified Owner/Operator of the findings and initiated enforcement action. The state requested the owner/operator notify adjacent property owners within 1,000 feet of the landfill property boundaries. Also to offer adjacent property owners inside gas detectors for their buildings.

# Post Closure Issues

Owner/Operator was directed to conduct a gas migration study and based on the finding develop a remediation corrective action plan.

Owner/Operator was directed to update the postclosure plan.

Owner/Operator was assessed a administrative penalty and required to sign a consent agreement.

Results of gas migration study were:

Detection of gas beyond the property line.

The designed and installation of an active landfill gas collection system consisting of 11 collection wells and a gas flare.

# Post Closure Issues:

The installation 4 boundary line gas compliance monitoring wells and 3 public safety monitoring wells.

An updated post closure plan and initiation of quarterly landfill gas monitoring and operation of the landfill gas collection wells and flare system.

One public safety well continued to have methane readings above regulatory limits after the active gas collection system was installed and operating.

An additional gas migration study was conducted and six additional gas collection wells were added to the gas system in 2004.

# Post Closure Issues:

All was good until for 10 years when the state agency conducted a compliance and public safety well gas monitoring event and detected landfill gas levels above regulatory limits in two gas monitoring wells, one compliance well and one public safety well.

The state agency initiated another enforcement action and directed the owner/operator to conduct another surrounding property owner's written notification of the detection of gas beyond the landfill property boundary.

The enforcement action also:

Directed the owner/operator conduct another landfill gas migration and collection system assessment; develop a remediation/corrective action plan and update the postclosure plan. The plans had to be submitted to state agency for review and approval prior to implementation.

The owner operator was required to pay an administrative penalty and sign a consent agreement to complete the required work.



# Post Closure Issues

The engineering assessment of the landfill conditions and the active landfill gas collection system determined several landfill post closure maintenance items that could be addressed which included:

Uneven settlement of the landfill final cap resulting in ponding of precipitation on the landfill and increase infiltration of rainwater into the landfill. This required regrading of small portions of the landfill cap and importing additional soil materials for the cap.

Following the regrading of the cap the disturbed areas required reseeded to reestablish vegetation.

An outdated gas meter requiring the purchase of a new gas meter.

## Post Closure Issues:

Assessment of the landfill gas collection wells determined that routine maintenance for optimum efficiency of operation of the gas collection wells required purging of the wells to remove condensate water and maintain an open well screen. This activity was added as a maintenance item to the update post closure plan.

Result: The landfill has controlled the offsite migration of landfill gas and has returned to compliance.

## Case Study 2. Landfill B

Location: The Middle of Nowhere

Land Area: 39 acres

MSW Footprint: 26 acres

Year Ceased Accepting Waste: 1993

Year Officially Closed: 1995

Type of Operation: Area Method

Owner/Operator: Private Waste Company

# Post Closure Conditions

## At Closure:

Final Cap: Three feet of soil. Seeded in hardy a stand of fescue grass.

Bench terraced 3H:1V final side slope. 5-10 % top slope.

Leachate System: Bottom collection drains discharging to an on-site holding tank. Off-site disposal at local POTW.

Groundwater monitoring system: 2 Wells Initially (abandoned in 2002).

Landfill Gas Collection/Monitoring Well System: None.

# Post Closure Issues

When the landfill ceased accepting MSW, a new MSW landfill opened across the highway.

In 2002 the state agency approved abandonment of the two (2) on site groundwater monitoring wells.

In 2006 the landfill across the highway from the closed landfill detected VOCs in the up gradient GW monitoring well and in an onsite water supply well. VOCs were also detected in up gradient private water supply wells.

# Post Closure Issues

In 2012 state agency notified the closed landfill property owner to develop a work plan for a hydrogeologic investigation for assessment of gas migration beyond the property boundary and a groundwater monitoring system to determine if VOCs were migrating beyond the landfill property line.

Property owner contends the last landfill operator is responsible for addressing postclosure issues.

## CONCLUSIONS

Closure of a MSW landfill, ceasing to accept MSW and installing the final cap, may move the landfill into post closure status but it does not terminate reactions in the landfill that may result in environmental impact.

A variety of internal activities within the closed landfill will influence the physical, chemical, biological and hydrological rates of reactions and the resultant environmental impact of the closed landfill on the air, water and land beyond the landfill boundary.

## CONCLUSIONS

10, 20, 30 years and beyond into the postclosure period, the MSW in the closed landfill will continue to have physical, chemical, biological, hydrological and geological reactions until the organic and inorganic elements and compounds reach their lowest molecular energy state.

Today's higher landfill compaction densities and less pervious caps and bottoms will slow the MSW materials reaction and degradation rates thus extending the need for post closure care into perpetuity.



## QUESTION:

With the potential for environmental impact of closed MSW landfills extending into perpetuity who should be responsible for providing the resources necessary to control environmental impacts?

The reality is that financial funding for the perpetual care beyond the current arbitrarily selected 30 year postclosure financial responsibility period must be provided by some means to provide for the design and implementation of remedial and corrective actions.

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# **QUESTIONS?**

# **COMMENTS?**

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