Solid Waste Landfill Rules Meeting

Agenda

1. Introductions and meeting purpose

2. NW&RA general thoughts on proposed rule changes and recognition of beneficial changes including:
   - Elimination of RSL thickness calculation
   - Leachate ponds to meet siting criteria
   - Use of limits of waste instead of facility boundary for underground mine siting criteria
   - Elimination of ASTM standard years

3. Which NW&RA comments that were made did Ohio EPA not understand?

4. Which comments that were made did the Ohio EPA not agree with?

5. Understanding basis for some these Ohio EPA proposed draft rules

6. Rule amendment implementation? 10-year anniversary?

7. Follow-up and Next Steps
About five holes per acre

>300 sites over >800 acres

More than 85 percent of the damage is during drainage layer or cover soil placement.

71 percent stone damage

More than 85 percent of the damage is during drainage layer or cover soil placement.

15.6 percent equipment damage

About one hole for every five acres

about four percent extrusion welds
About one hole for every 10 acres

About 2.3 percent wedge welding
Nip roller pressure cut along inside edge of seam.
This kind of hole can be missed by pressure tests.

https://assets.website-files.com/5977726d80d12837b9592f43/5bbc1000b509492977ac0742_03-2018-CQA-Toepfer-8-1-18.pdf
Current Practices Concerning Wrinkles

Wrinkles are seven to nine inches tall and spaced 10 to 20 feet apart.
Current Practices Concerning Wrinkles

HDPE

Water is dammed up behind the wrinkles
In 2006, GeoEngineering Centre at Queen’s–RMC found that wrinkles may eventually fill with Compacted Clay liner.

Clay at + one percent of optimum moisture — wrinkle starts at about two inches high

70 ft of waste

140 ft of waste

280 ft of waste

So what do we know about wrinkles!

- Wrinkles Don’t go away when you cover them.
- Wrinkles don’t go away when you place waste.
- The permeability of GCLs increase under wrinkles since there is no load.
- If there is a hole on a wrinkle the whole wrinkle fills with leachate.
So why are we concerned about wrinkles in Geomembranes?

- Subtitle D requires “direct and uniform contact with the compacted soil”
- Wrinkles impound the flow of leachate, causing more head on liners
- If there is a hole on or near the wrinkle, the wrinkle fills with leachate
Leakage through a single one cm$^2$ hole making intimate contact

Gallons Accumulative

Years

- HDPE & typical GCL
- HDPE & 3ft of CCL

76 Gal
3 Gal
Leakage through one 10 cm² hole making intimate contact

- Leakage through a 7 in hole with an area of 10 cm².
- Gallons Accumulative over years:
  - HDPE & typical GCL: 37 Gal
  - HDPE & 3ft of CCL: 772 Gal
Leakage through holes into wrinkles

- 7 in
- 1 cm²

969,560 Gal (29.6 gpad)
72,350 Gal (2 gpad)


\[
Q = 2L \left[ k_s b + \sqrt{k_s D \theta} \right] h_d / D
\]
Note Extent of Interconnected Wrinkles

Note Extent of Interconnected Wrinkles

Longest interconnected wrinkle: 106 ft/ac, 8,365 ft/ac, 1,009 ft/ac
Leakage 5ft RSL: 9.4 gpad, 744 gpad, 89.7 gpad
Leakage Rates without ELL survey

19% of sites don’t meet ALR of 20 gpad
62% of sites don’t meet ALR of 5 gpad
Leak Location Survey can find a 1/16-inch diameter leak with exposed geomembrane. It can also find holes on wrinkles if the wrinkle is pushed down during testing.
Leak Location Survey can find a ¼-inch diameter leak under two feet of cover material.
It cannot find a hole on a buried wrinkle.
Electrode

Power Supply

Drainage Layer or Cover soil

0.5V Portable Digital Data Recorder

Electrode

Isolation trench

Leak

Current Flow
Electrode

Power Supply

Drainage Layer or Cover soil

Electrode

Isolation trench

Portable Digital Data Recorder

1.0V

Leak

Current Flow
Standard Leak Location Survey can not find a leak that is on a wrinkle.
Leak Location Liners: Conductive Geomembranes
51% of sites don’t meet ALR of 5 gpad
Recommendations for ELL surveys

- CQA only: 69%
- Dipole survey only: 51%
- ELL on uncovered GM + Dipole: 12%
- ELL on uncovered white GM + Dipole: 0.6%
- ELL on uncovered conductive GM + Dipole: 0%

Probability of exceeding an ALR of 5 gpad (47 lphd)
## Costs Installed

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Black Geomembrane</td>
<td>$29,403</td>
</tr>
<tr>
<td>White Geomembrane</td>
<td>$30,274</td>
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<tr>
<td>White Conductive Geomembrane</td>
<td>$36,329</td>
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<tr>
<td>Leak location survey exposed geomembrane</td>
<td>$1,200 (for cells 5 ac or larger)</td>
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<tr>
<td>Leak location survey after drainage layer</td>
<td>$1,200 + cost of isolation trench</td>
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<tr>
<td>Cost of 1 foot of RSL</td>
<td>$8,000 - 20,000</td>
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<tr>
<td>GCL</td>
<td>$40,510</td>
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</table>
Current 5’ of Clay and GM

$81,998/ac
≈35.4 gpad 400’ wrinkle

Current 3’ of Clay, GCL and GM

$101,470/ac
≈2 gpad 400’ wrinkle

Proposed 3’ of Clay, and GM with leak location surveys

$63,360/ac
≈3.6 gpad 400’ wrinkle

Proposed 2’ of Clay, GCL and GM with leak location surveys

$93,351/ac
≈0.24 gpad 400’ wrinkle

*Cost do not include drainage layer and cushion layer. Clay cost $6.52 / CY average from closure plans.
Need for Appropriate Cushion layer

GMB Strains

70 ft of waste, 185°F, #24 Gravel Angular and GTX - 16 oz/yd²

Strains up to 15%
Ruptured in < 3 years

Sand Protection layer
Minimal strains (< 1%)

Ewais, Rowe & Brachman (2014)

Rowe, Abdelaal & Brachman (2013)
60 mil HDPE
Assuming Appropriate Cushion Layer

<table>
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<tr>
<th>Temperature (°F)</th>
<th>Composite liner (years)</th>
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<tr>
<td>140</td>
<td>42</td>
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<tr>
<td>95</td>
<td>733</td>
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Fig. 15. Effect of particle size on the variation in service life of LCSs with the drainage path (drainage layer thickness = 0.3 m).
Cushion layer - 200’ of waste

#57 Gravel
Sub-rounded 28 oz/yd²
Angular 50 oz/yd²

#8 Gravel
Sub-rounded 6 oz/yd²
Angular 8 oz/yd²

Without the appropriate cushion layer gravel will eventually cause a stress failure in the geomembrane
Current Seismic Method
• Determine seismic acceleration
• Increase acceleration due to predicted waste damping effect
• Run stability analysis
• If FOS <1.0 redesign

Proposed Seismic Method (Bray’s screening analysis)
• Determine seismic acceleration
• Decrease acceleration by multiplying it by 0.75 (This predicts deformation of <15cm for bottom and <30cm for cap)
• Run stability analysis with a large displacement shear strengths
• If FOS <1.0 reanalyze using Bray’s simplified method to predict deformation length.
90% of Ohio has an acceleration of <0.10

<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Sat. Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>Cohesion (psf)</th>
<th>Phi (deg)</th>
<th>Water Surface</th>
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<tbody>
<tr>
<td>Waste</td>
<td>Yellow</td>
<td>90</td>
<td></td>
<td>Mohr-Coulomb</td>
<td>400</td>
<td>33</td>
<td>None</td>
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<tr>
<td>Protective Cover</td>
<td>Green</td>
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<td>Mohr-Coulomb</td>
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<td>Water Surface</td>
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<tr>
<td>RSL</td>
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<td>Piezometric Line 1</td>
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<tr>
<td>Rock</td>
<td>Cyan</td>
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<td>Mohr-Coulomb</td>
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<td>0</td>
<td>Piezometric Line 1</td>
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<td>Final Cover</td>
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<td>140</td>
<td>Mohr-Coulomb</td>
<td>100</td>
<td>21.6</td>
<td>None</td>
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<td>Large Displacement</td>
<td>Teal</td>
<td>120</td>
<td></td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>9</td>
<td>None</td>
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Transitional cover

- 24” of well-compacted loam, silt loam, clay loam, silty clay loam, silty clay or other soil types

- 24” of $1 \times 10^{-6}$
Fig. 15. Effect of particle size on the variation in service life of LCSs with the drainage path (drainage layer thickness = 0.3 m).
Landfill Cap

- 30”-36” Cap Protection layer
- Drainage Layer
- FML
- 18” of 1x10^{-6}

- 30”-36” Cap Protection layer
  CL or 1x10^{-5}
- Drainage Layer
- FML
- 18” of 1x10^{-6}
Figure 9-5, Excessive head in final cover drainage layer caused a slope failure (on right) and a sand boil (on left) taken at two different landfills.