Illinois’ Legacy Landfills, and Implications for Mahomet Aquifer Groundwater Resources

Christopher Stohr, PhD, PG
Engineering Geologist

Research Associate, Illinois State Geological Survey,
Prairie Research Institute
University of Illinois at Urbana-Champaign

Applied Geo-Imaging Solutions, Inc.

Champaign County Board

Mahomet Aquifer Protection Task Force
Rantoul, IL
August 6, 2018
What is the condition of 3,430 landfills in Illinois?

3,430 – unlined, thin covered landfills
1,524 – lie over shallow aquifers w/in 20’ surface
  94   – lie within karst areas
  44   – Actively operating landfills

80% - ½ km High & Medium Intensity Development
95% - ½ km H/M/L Intensity Development

Which require maintenance, remedial action? What sort of repair? When – now or later? Is there a way to use technology to help?
Why are Old Landfills Important?

“Dry Tomb” design philosophy
- Isolate wastes from ecosystem,
- Infiltration (leaky roof) = gas & leachate,
  - ~50% of precipitation infiltrates landfill cover,
- Added head pushes leachate > sides and bottom,
- Contaminated fluids degrades water/air quality,
- Cover is only part accessible from surface.

$4,000,000 to re-cover a landfill. Spot repairs are less expensive.

~36 inches of rain falls on Illinois / year. What happens to that rainfall?
Where does leachate go?

- Fluids travel laterally or vertically or both.
  - Shallow aquifers recharge streams.
  - Migration between aquifers?
  - Gas, liquids likely differ in composition over time.
- Not a problem – until it is.
  - Nobody really looks for trouble unless stream or well contamination is discovered.
- So, is this a problem?
  - Expendable aquifers?
  - Future water needs?

Some communities already facing water shortage.
Postclosure Monitoring Strategies

- **Passive** – what is currently being performed.
  - Monitoring wells
  - Field “walkover” inspections

- **Active** – sustainable asset management
  - Remote sensing technology, “aerial traverse”
  - Focused field inspection for preventive maintenance
  - GIS-based sustainable asset management
Flaws of “walkover traverses’

- Entire landfill will NOT be traversed in 1 hour.
- Human perception is obscured by vegetation.
- Observations skewed by season, rainfall, access.
- Paper tracking and memory.

Is there a better way?
Postclosure Maintenance Strategies

- **Passive** – what is currently being performed.
  - Monitoring wells
  - Field “walkover” inspections

- **Active** – sustainable asset management
  - Remote sensing technology, “aerial traverse”
  - Focused field inspection for preventive maintenance
  - GIS-based sustainable asset management
Advantages of “aerial traverses’”

- Synoptic perspective – “bird’s eye view.”
- Performed in office prior to onsite visit.
  - Image-based record of features
  - Compare changes
  - Virtual revisits
  - Focused inspections
Defects and Features of Interest Developed in Landfill Covers

- Leachate seep
- Erosion
- Depressions, wet spots
Improved Postclosure Monitoring
Sustainable Asset Management
“aerial traverse”

• LiDAR $\rightarrow$ Surface topography
• Aerial Photography $\rightarrow$ Feature detection
• Focused walkover reconnaissance
• GIS/CAD + measurements + field notes
LiDAR or lidar
Light Detection And Ranging

Pulse is measured 5 times.
Used to make topographic maps.
DEM = digital elevation model

- First
- Second
- Third
- Fourth (last)

‘solid’ mesh ~ shaded relief

vector point cloud data

Depression
sLope instability
gully
sLope instability
3D perspective view of CIR photo draped over LiDAR with contours aids in defect identification.

2D view of CIR photo with contours and interpretations.
Improved Postclosure Monitoring Sustainable Asset Management

“aerial traverse”

- LiDAR ➔ Surface topography
- **Aerial Photography ➔ Feature detection**
- Focused walkover reconnaissance
- GIS/CAD + measurements + field notes
Digital Aerial Photography

- Digital Mapping Camera
  - 4 bands = VNIR = blue, green, red, near infrared
  - Orthophotography – radial displacement removed
  - Georeferenced - image map for GIS/CAD

Not calibrated, unknown processing

VNIR – 4 band + Panchromatic Boresite viewer
Publicly-Available Aerial Imagery

- **Google Earth** – Good resolution, convenient, No adjustment or enhancement, No color infrared
- **Satellite** – Has RGBN, but costs $$, coarse resolution.

**Better way is GIS-base + publicly available**

- **NAIP** – National Agricultural Imagery Prog, leaf on, VNIR
- **DOT** – airborne lidar, leaf off, VNIR
- **Counties** – airborne lidar, leaf off, VNIR
Improved Postclosure Monitoring and Custodial Care

“aerial traverse”

- LiDAR → Surface topography
- Aerial Photography → Feature detection
- **Reconnaissance map** → Focused walkover
- GIS/CAD + measurements + field notes
Sustainable Legacy Landfill Management

- Identify, measure, check, and assess.
  - Which legacy landfills pose risk to Mahomet Aquifer?
  - Identify defects on earthen covers for field verification.
  - Prioritize maintenance and repair of defects.
- Sustainable maintenance.
  - Update training of field inspectors.
  - Collect landfill data and information into a geodatabase.
  - Subsequent use w/ Forest & Park Districts, C-Clubs.
  - Minimize deferred maintenance risk. [stitch in time]

Maintenance - Important, unglamorous.