

11th Intercontinental Landfill Research Symposium

Asheville, North Carolina

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Successful Management of an ETLF: Conditions Fourteen Years after Intervention

By Craig H. Benson¹, Jesse P. Varsho², Daniel Drommerhausen³, and Matthew Walker⁴

This presentation describes a case history of an elevated temperature landfill (ETLF) that has been successfully managed since 2009. The landfill was constructed in the 1970s in a former limestone quarry in the midwestern United States. The landfill is deep (>100 m) and has near vertical sidewalls associated with the historical quarry operations. The landfill base was in shale or compacted shale, and the sidewalls are lined with compacted shale. The base of the landfill is substantially below the regional groundwater elevation, and a leachate extraction system within the waste imposes an inward hydraulic gradient to provide containment. Elevated temperatures, elevated leachate pressure, off-site below-grade methane migration, and strong odors emerged in 2006. A multilayer geosynthetic cap was installed in phases in 2007-2008 along with dual-phase extraction wells to remove landfill gas (LFG) and leachate, a perimeter below grade gas extraction system, an on-site leachate treatment facility to pre-treat strong leachate produced by the ETLF prior to discharge to the local wastewater treatment plant, and a thermal oxidizer to treat LFG with low methane content. Instrumentation was installed to monitor temperatures and pressures within the waste mass. Conditions at the landfill demonstrate that the actions undertaken in 2007-2008 and thereafter have successfully managed the ETLF. Odors and odor complaints have diminished to de minimis levels, temperatures and pressures within the landfill have moderated, VOC concentrations in groundwater have diminished substantially, and leachate is being successfully managed in collaboration with the local wastewater treatment plant.

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Successful Management of an ETLF: Conditions Fourteen Years after Intervention (2008-2022)

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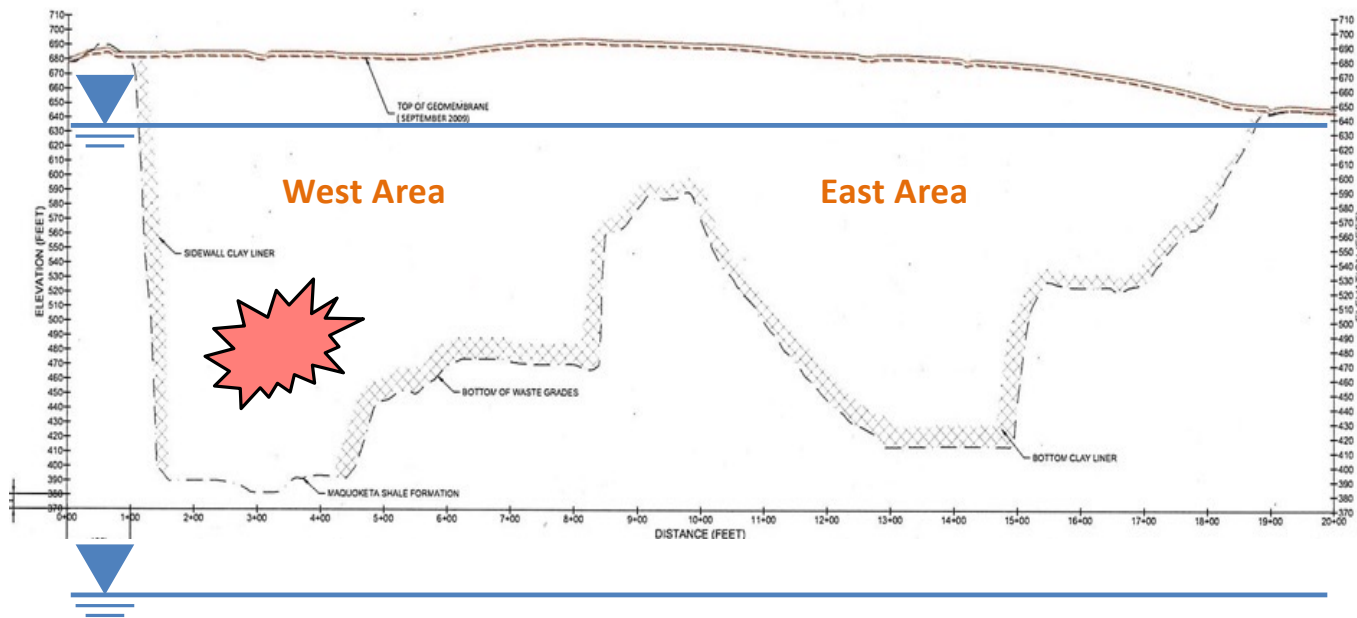
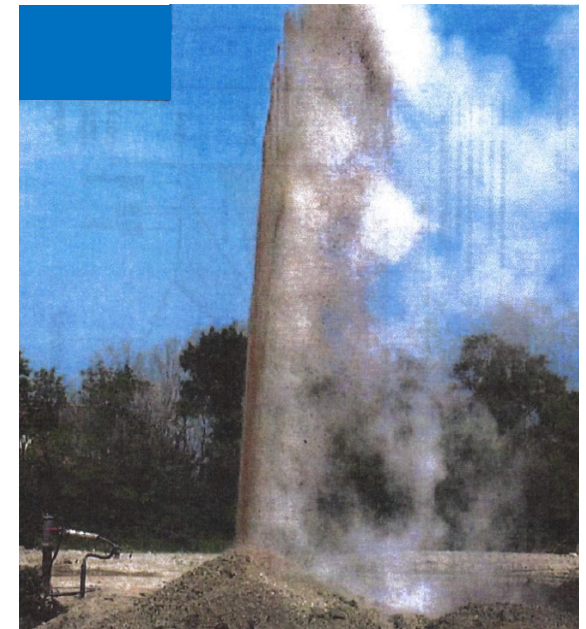
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Congress Landfill: Quarry Landfill in Chicago

- Deep quarry landfill with clay-lined sidewalls, began 1970s.
- Initially dry, but groundwater table rose.
- Poor gas collection due to third-party gas contract with RTC. Bankruptcy court **prevents** landfill owner from managing gas.
- Elevated temperatures in gas, strong odors, **leachate geyser** in 2006.



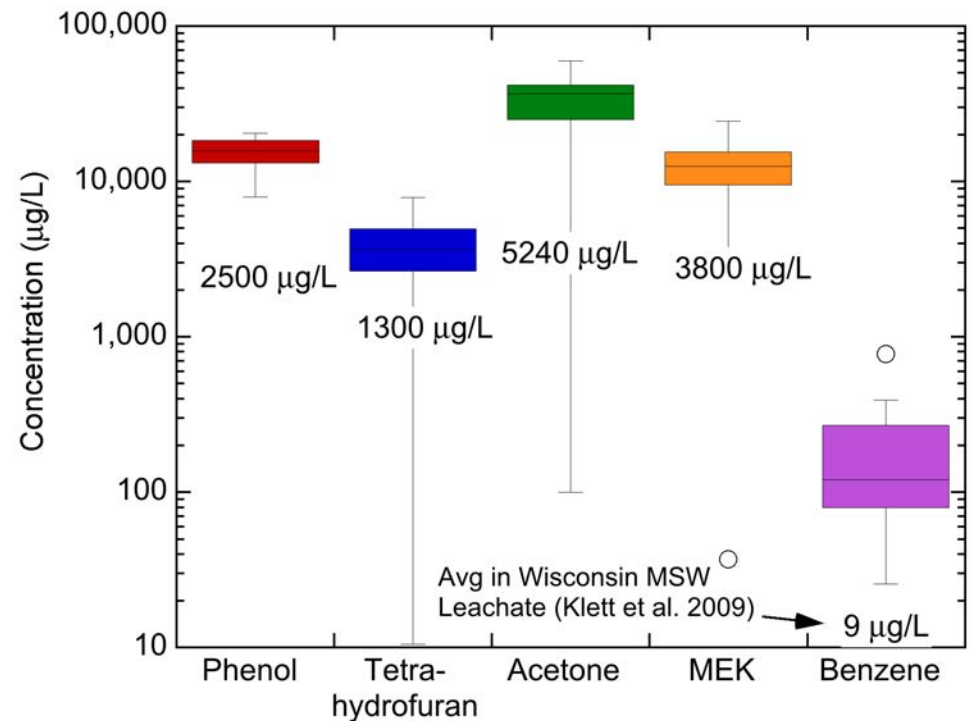
Impacts Besides Odors: Settlement & Strong Leachate

Large Settlements



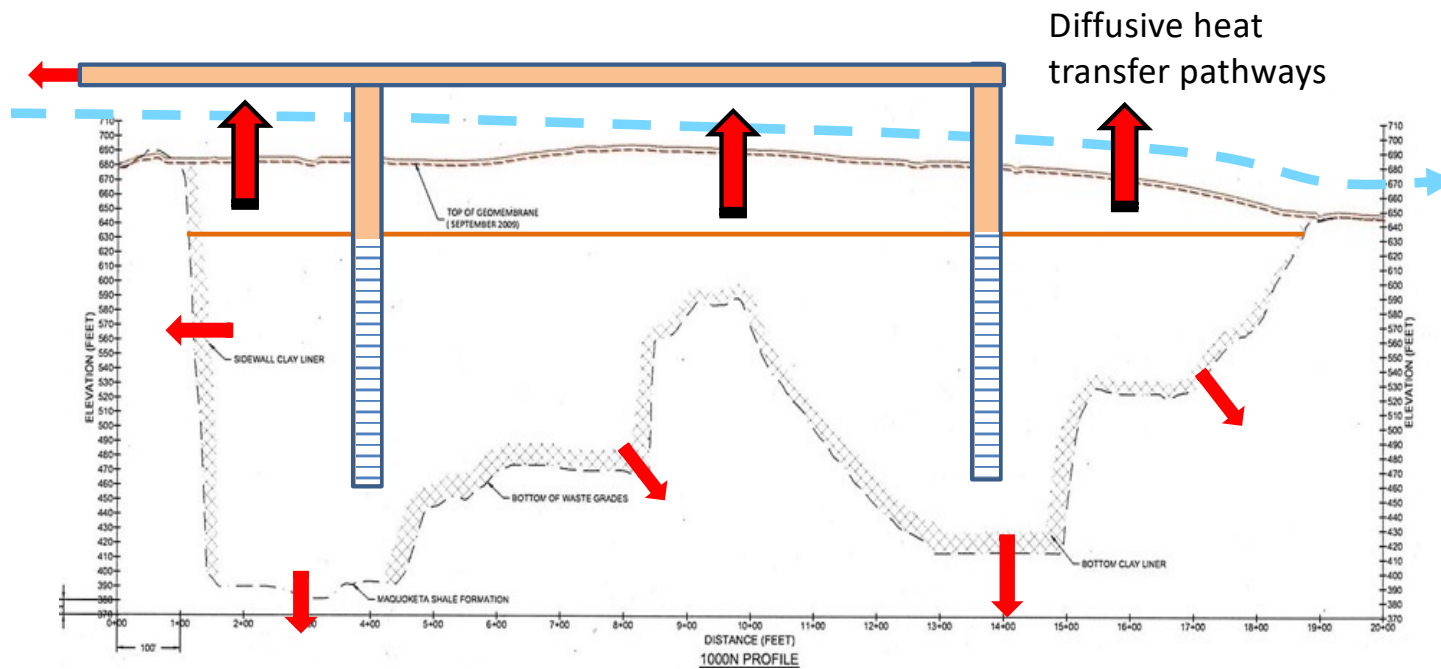
Thermal decomposition
softens waste,
inducing **rapid settlement**.

Strong Leachate



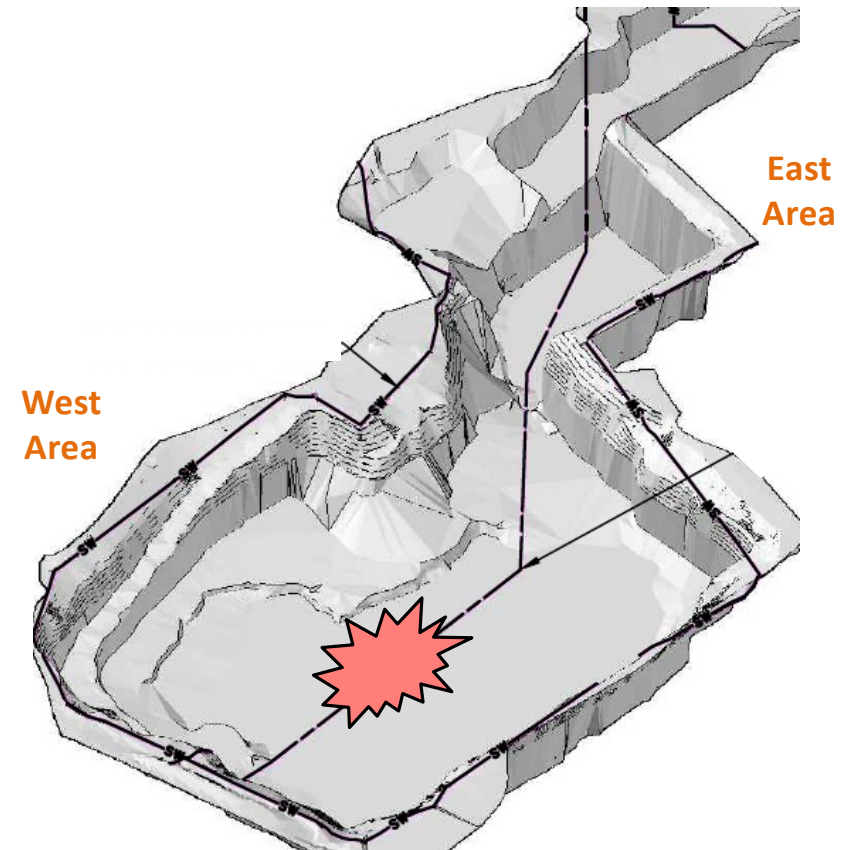
Organics concentrations **10x higher** than typical

Quarry Landfills Exacerbate Heat Accumulation



- Poor heat transmission from geometry & surroundings – **promotes heat accumulation.**
- Very wet – poor leachate & gas removal – **promote heat accumulation.**

Images of Congress Landfill Prior to Filling



Strategy to Address Issues

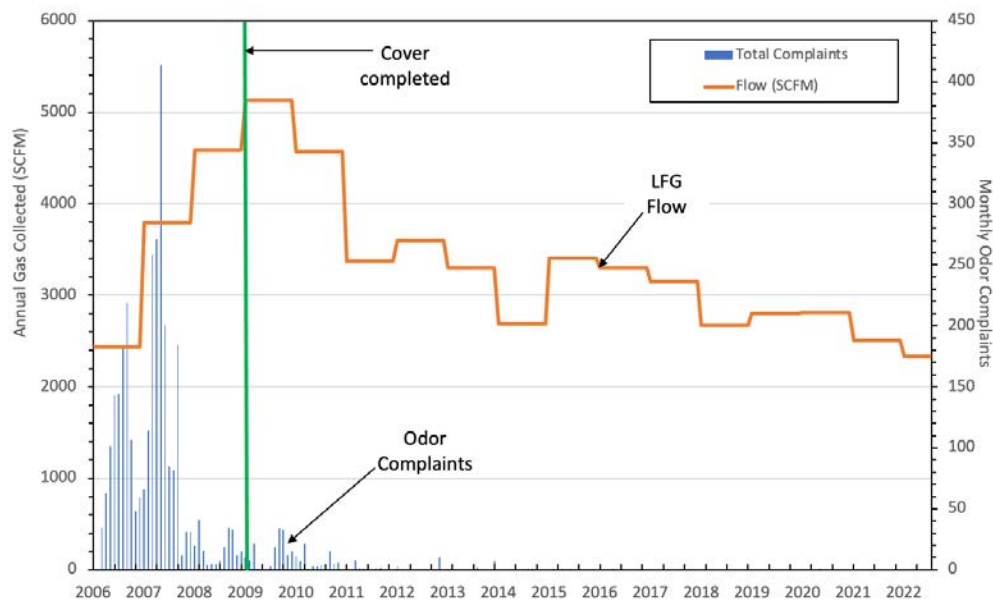
- Cover with drainage layer, composite barrier (geomembrane over GCL), gas collection layer. 190 settlement plates installed with cover.
- 126 gas collection wells, 72 with dual-phase (gas and leachate) extraction.
- 26 dedicated leachate extraction wells.
- Flare and thermal oxidizer for gas treatment; on-site leachate pre-treatment plant.
- 16 deep dedicated transducers for leachate level/pressure and waste temperature. Temperature strings for profiling (decommissioned).

Remove leachate, gas, and heat!

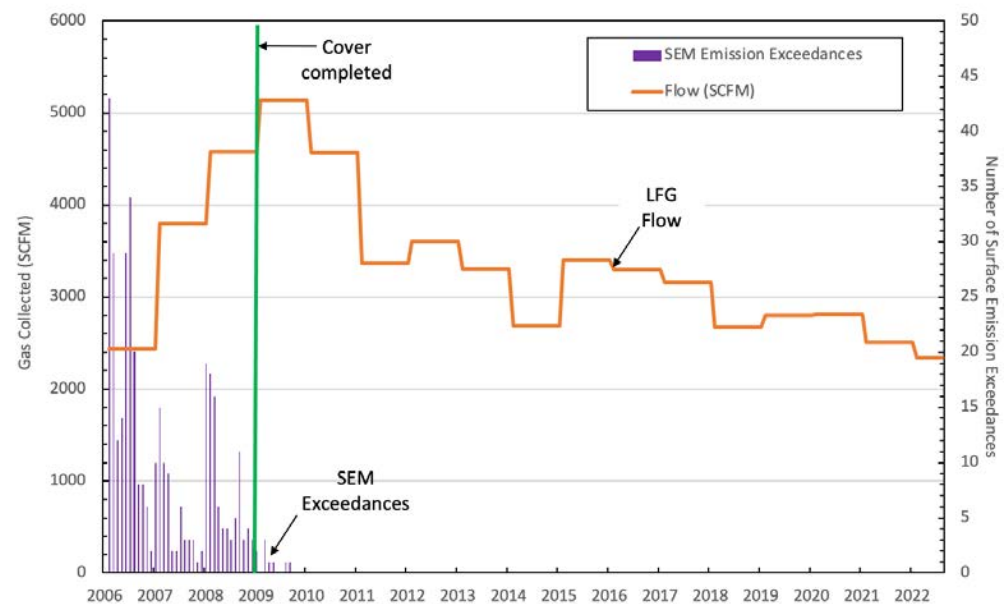
Outcomes:

Odor Complaints & SEM Exceedances Eliminated

Odor Complaints



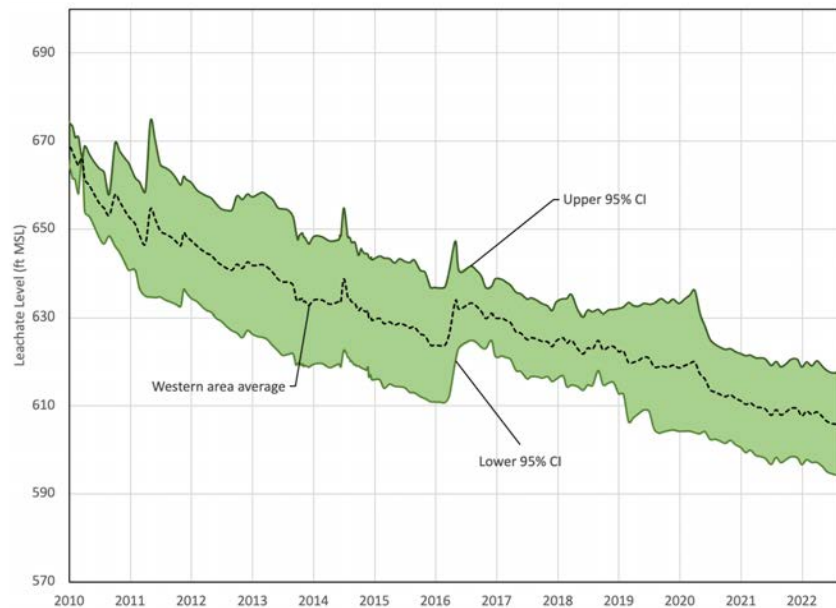
SEM Exceedances



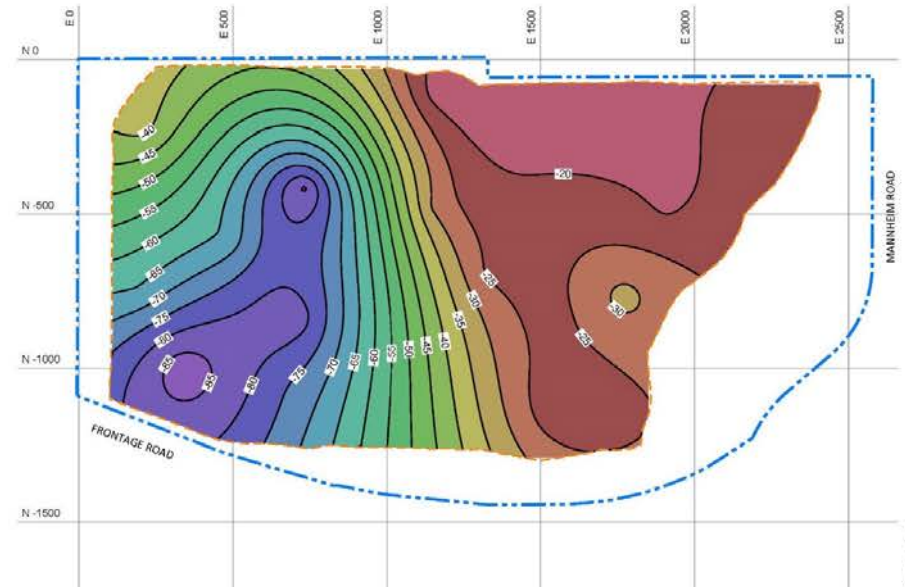
Virtually **no impacts** for **10 years!**

Outcomes: Leachate Elevation is Dropping

Leachate Level Dropping

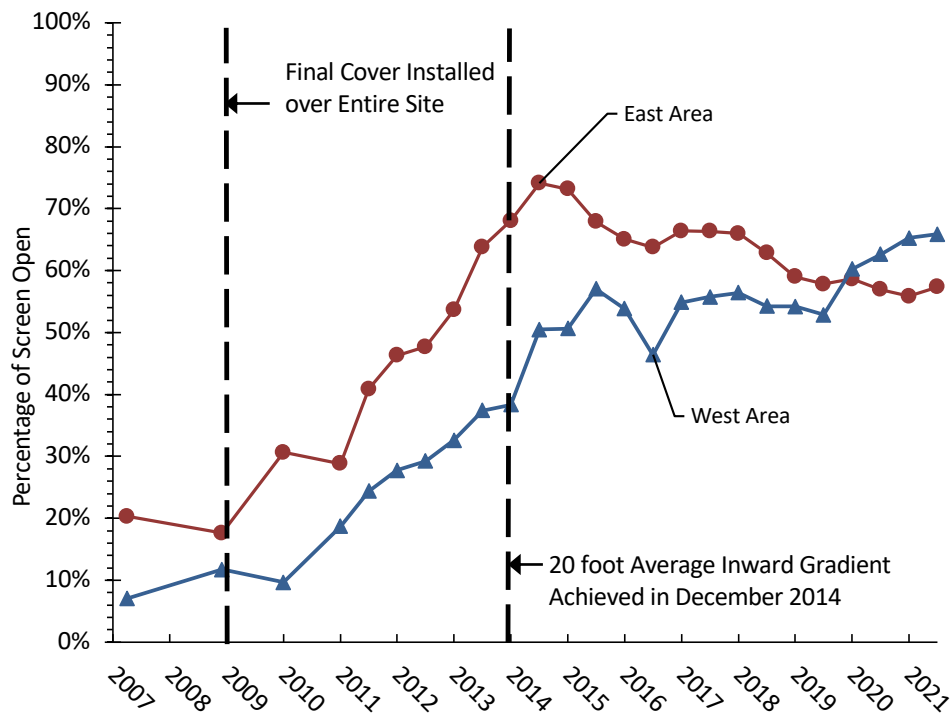


Inward Gradient Established 2014



Extraction is dewatering waste, removing heat, providing containment, and opening pores for gas flow

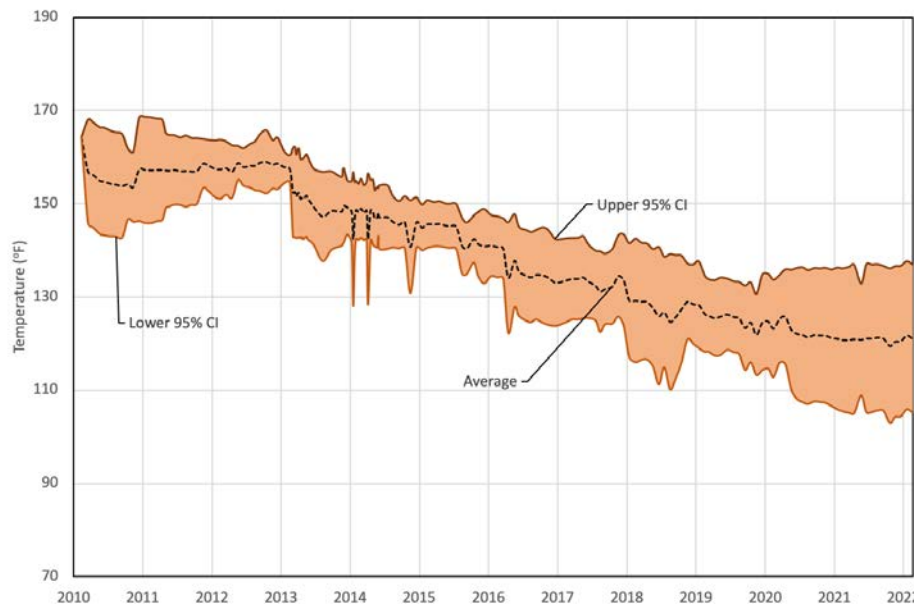
Outcomes: Open Gas Well Screens Increasing



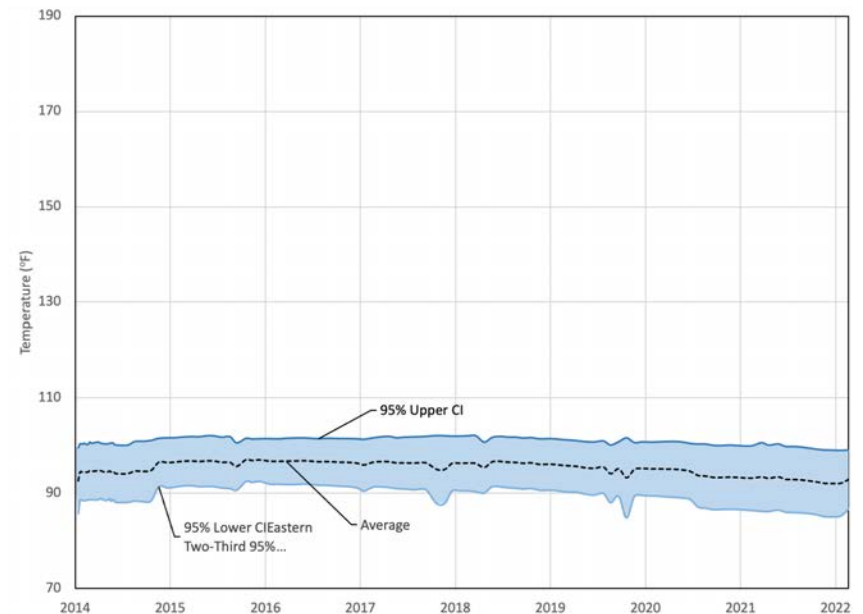
- Fraction of open gas well screen increased as leachate level dropped.
- Improving gas flow and heat removal.

Outcomes: Waste Temperatures Decreasing

West Area



East Area



West Area cooled to normal landfill temperatures.
Slowly approaching East Area condition.

Outcomes: Wellhead Temperatures Diminishing

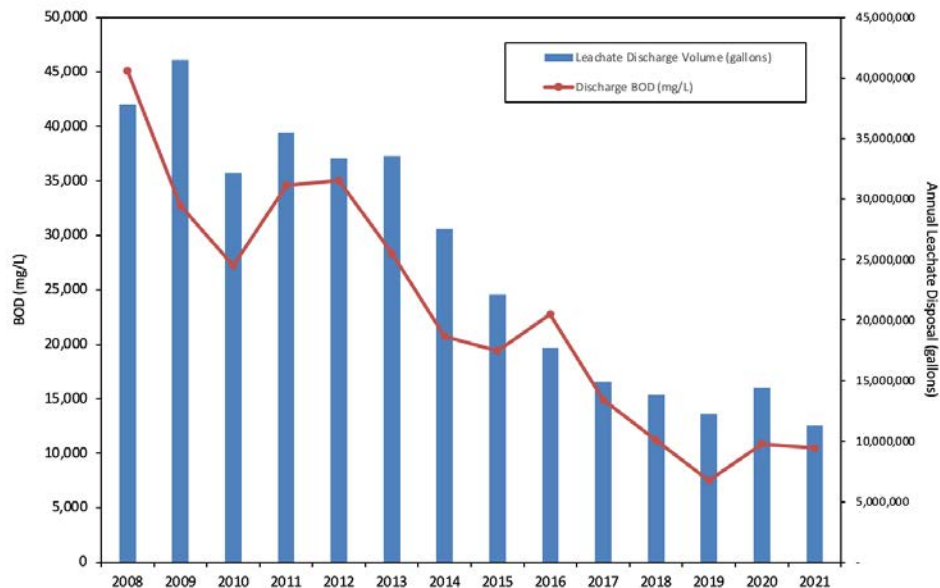


Wellhead
Temperature (°F)



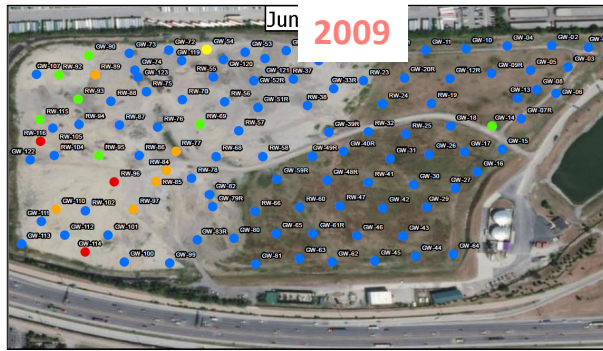
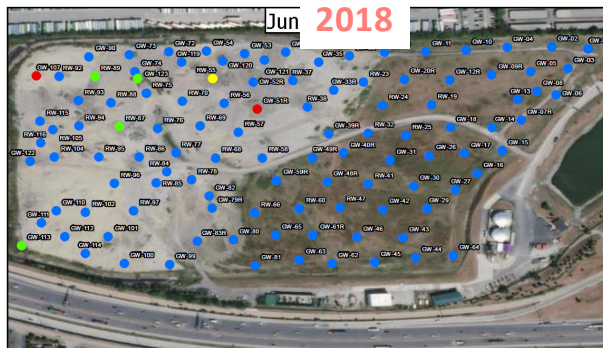
- Wellhead temperatures dropping.
- By 2022, one wellhead > 166 °F and two > 131 °F.

Outcomes: Leachate Quality Improving



- BOD elevated during high temperatures due to pyrolytic thermal decomposition of waste.
- BOD dropping as waste temperature decreases and thermal decomposition diminishes.
- BOD/COD approaching more typical conditions (not shown).

Outcomes: Methanogenesis Re-Emerging

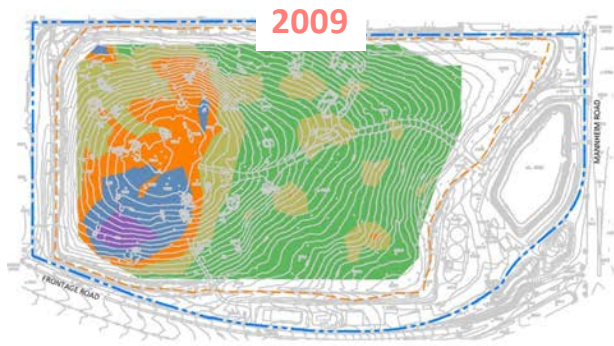
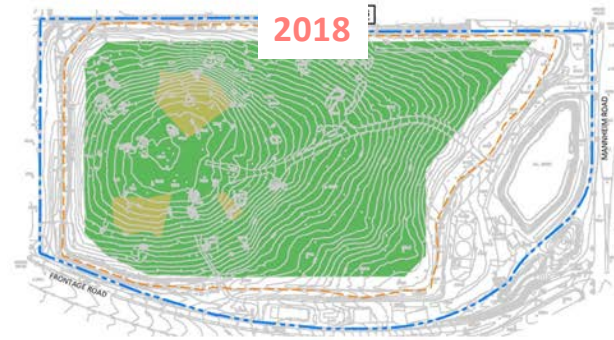


$\text{CH}_4 \div \text{CO}_2$

- < 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1
- > 1

- 2009 – 41% of wellheads in west area have primary gas ratio (CH_4/CO_2) < 0.1
- 2022 – 67% of wellheads in west area have primary gas ratio (CH_4/CO_2) > 1.0

Outcomes: Settlement Diminishing



RATE TABLE (FT/30 DAYS)			
NUMBER	MINIMUM ELEVATION	MAXIMUM ELEVATION	COLOR
1	0.000	0.250	Green
2	0.250	0.500	Yellow
3	0.500	0.750	Orange
4	0.750	1.000	Red
5	1.000	1.250	Purple



- Cooling diminishes thermal decomposition and waste softening.
- 2009 – west area > 1 ft per month.
- 2022 – < 0.25 month, west and east similar.

Summary and Conclusions

- Remedial actions at Congress Landfill a success story – was a problematic ETLF and is now a stable landfill approaching quiescent conditions characteristic of closed landfills.
- Containment of gas critical to controlling odors and local impacts of the landfill (cover with gas layer, extensive gas well network).
- Aggressive gas and leachate collection cooled site, support a return to stable conditions.