



Are we there yet?

Re-assessment of Post Closure Care (PCC)
at MSW Landfills



Key Discussion Points

- ☑ **Growing interest** in developing a defensible, data driven approach to re-evaluating PCC time frames versus regulatory mandates (e.g. 30 years).
- ☑ Concept of achieving **“functional stability”** and performance-based assessment approaches.
- ☑ **New and innovative technologies** to aid in meeting PCC goals.
- ☑ Regulatory considerations and a **path forward** in developing a technical guidance for risk-based cessation of PCC.



Interest in PCC Re-Evaluation

Subtitle D of the Resource Conservation and Recovery Act (RCRA) requires a post-closure period of 30 years for non-hazardous wastes in landfills but allows for a case-by-case review of the PCC period based on risk.

- However, actual monitoring data can indicate otherwise, in some cases (shortened, extended, ended).
- As such, states may allow reduction in PCC efforts, provided that remaining future risks to human health and the environment (HHE) are acceptable. However, to date, no nation-wide technical guidance for PCC assessment of sites has been established.
- Because of unique environments, site and region-specific evaluation is necessary.



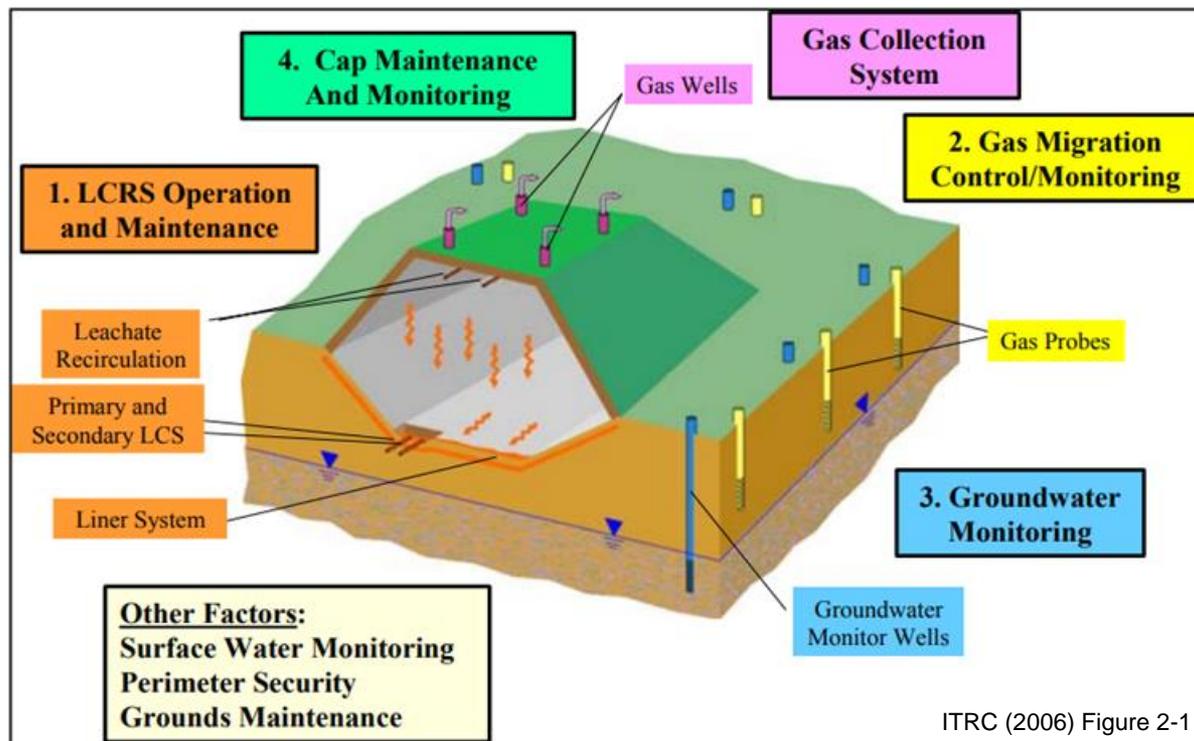
Performance-Based PCC Assessment



What is **Functional Stability**?

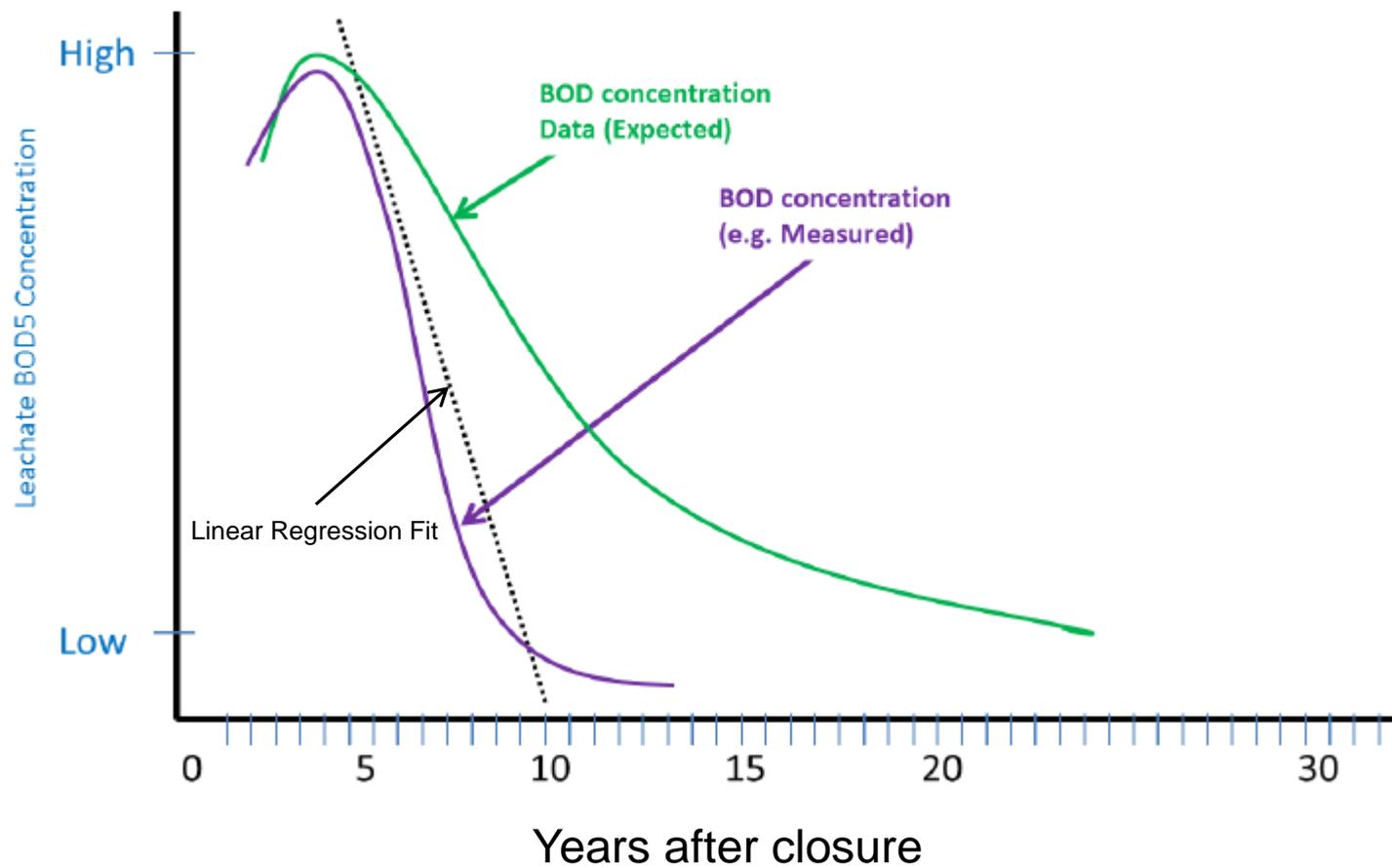
“A landfill is functionally stable when it does not present an unacceptable threat to HHE.”

- Solid Waste Association of North America (SWANA) Bioreactor Committee, 2004



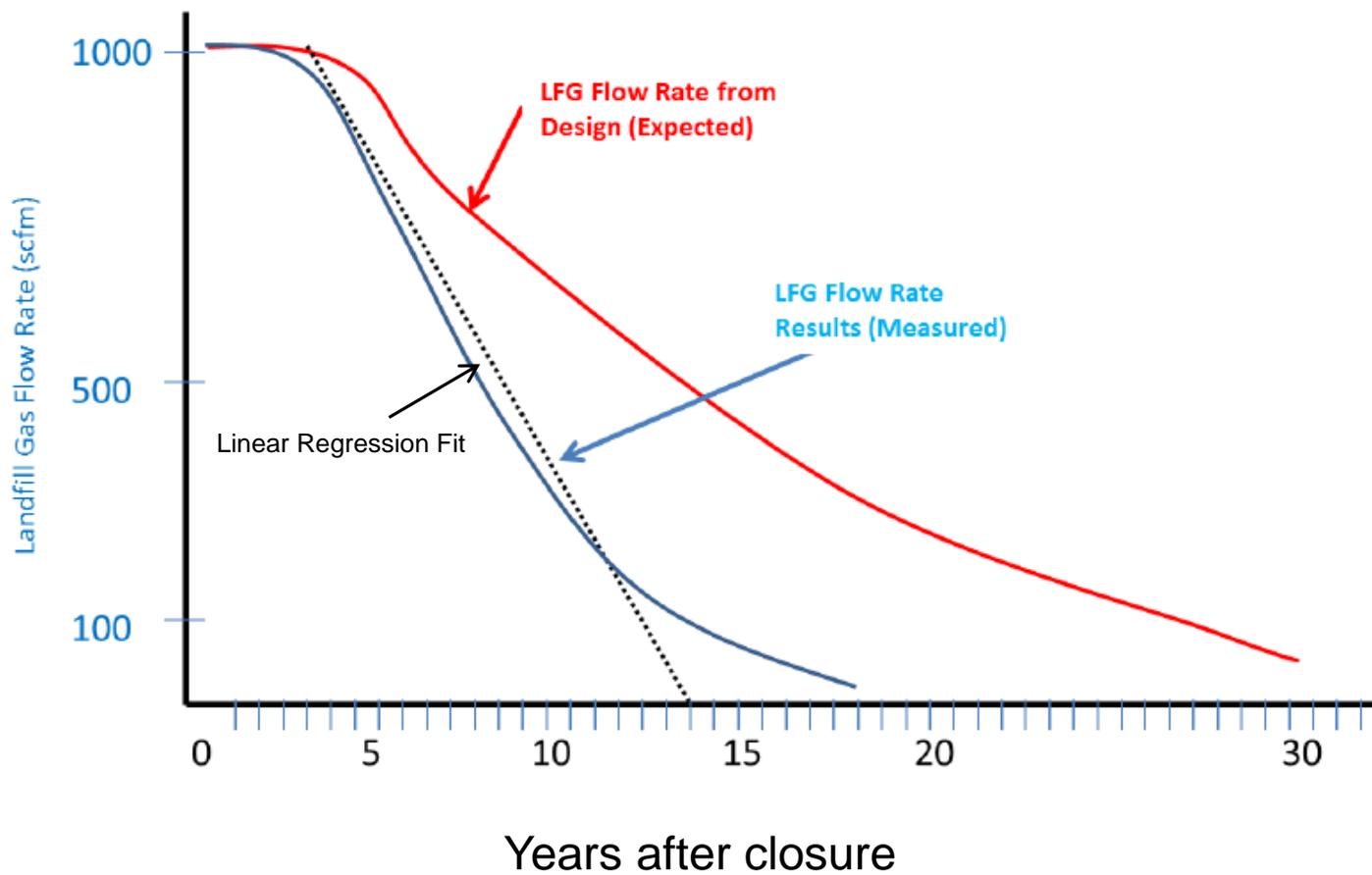
Basis for Re-Assessment

Leachate quality (e.g. organic indicators)

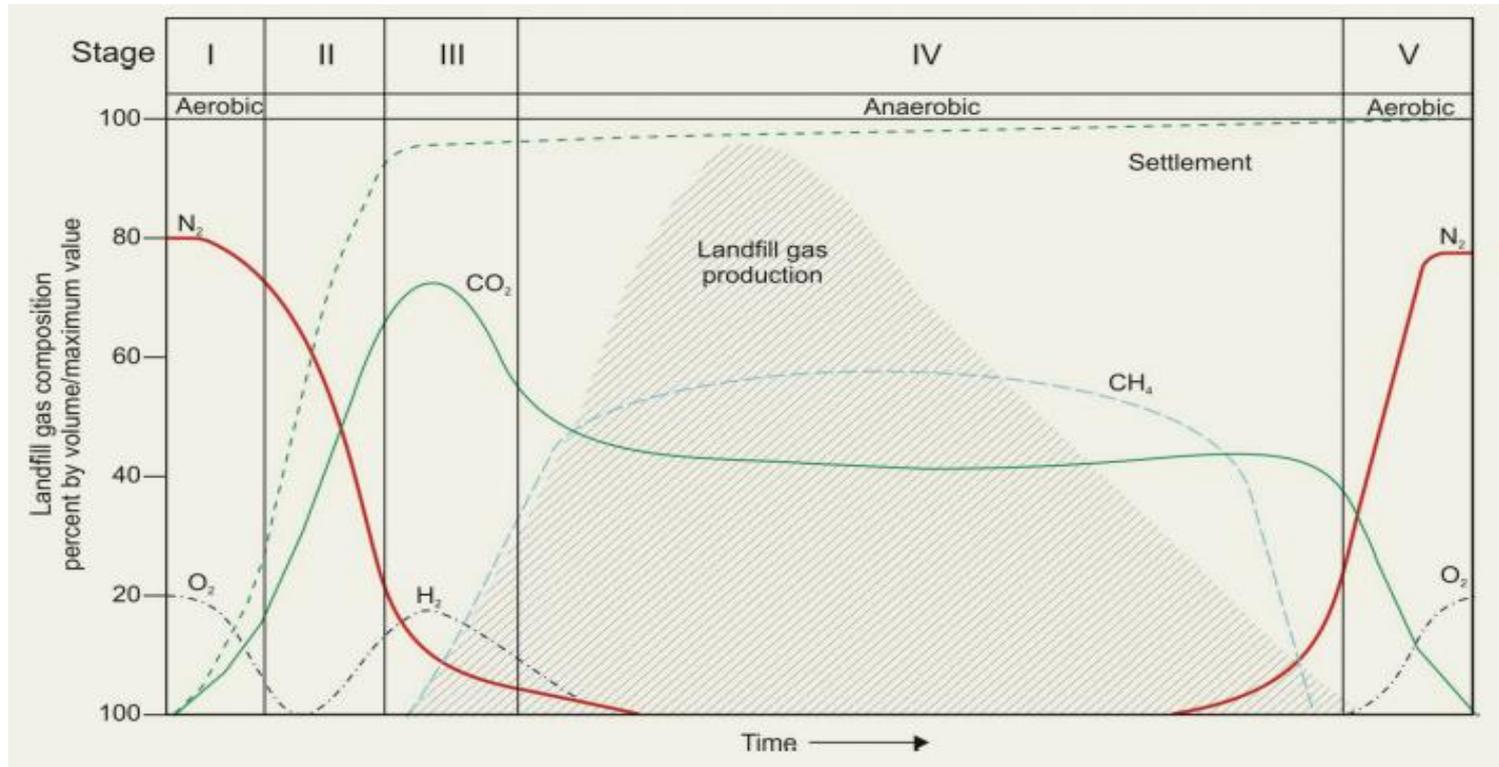


Basis for Re-Assessment

Landfill gas production after closure

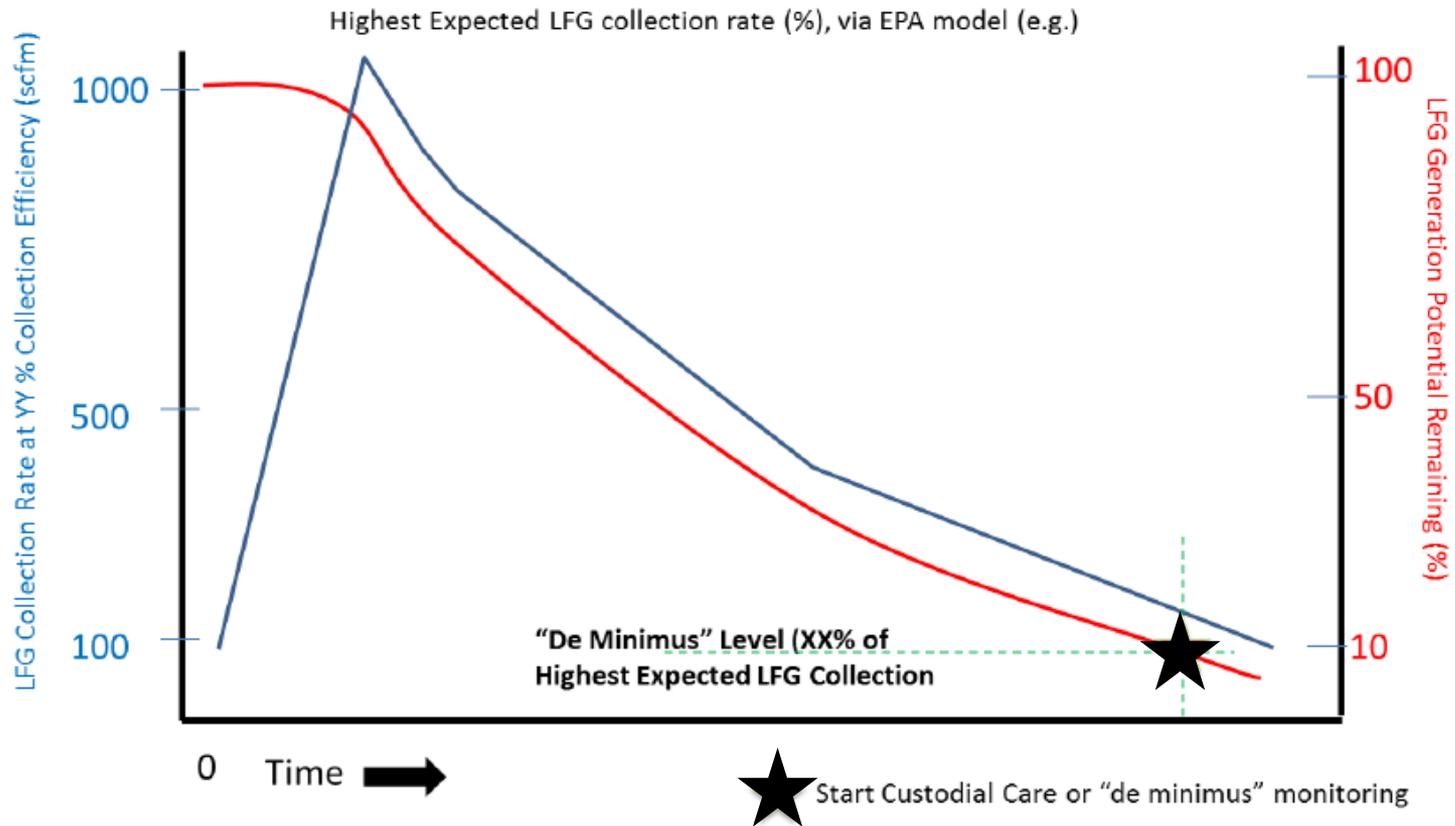


Impact of Anaerobic Decay on LFG



Farquhar, G.J and Rovers, F. A., "GAS PRODUCTION DURING REFUSE DECOMPOSITION" Department of Civil Engineering, University of Waterloo, Canada, 1973

LFG Assessment



Cap Assessment

$$\text{Settlement Rate (\%)} = [\text{LFG}(T-1) - \text{LFGT}] \div [\text{LFGC} - \text{LFGT}]$$

Where:

LFGC = future area under the LFG generation curve in year of closure, C

LFGT = future area under the LFG generation curve in any year T

LFG(T-1) = future area under the LFG generation curve in year T-1

- Some support that stability is achieved when the annual rate of post-closure secondary settlement is estimated to have declined to **less than a 5%** de minimus rate

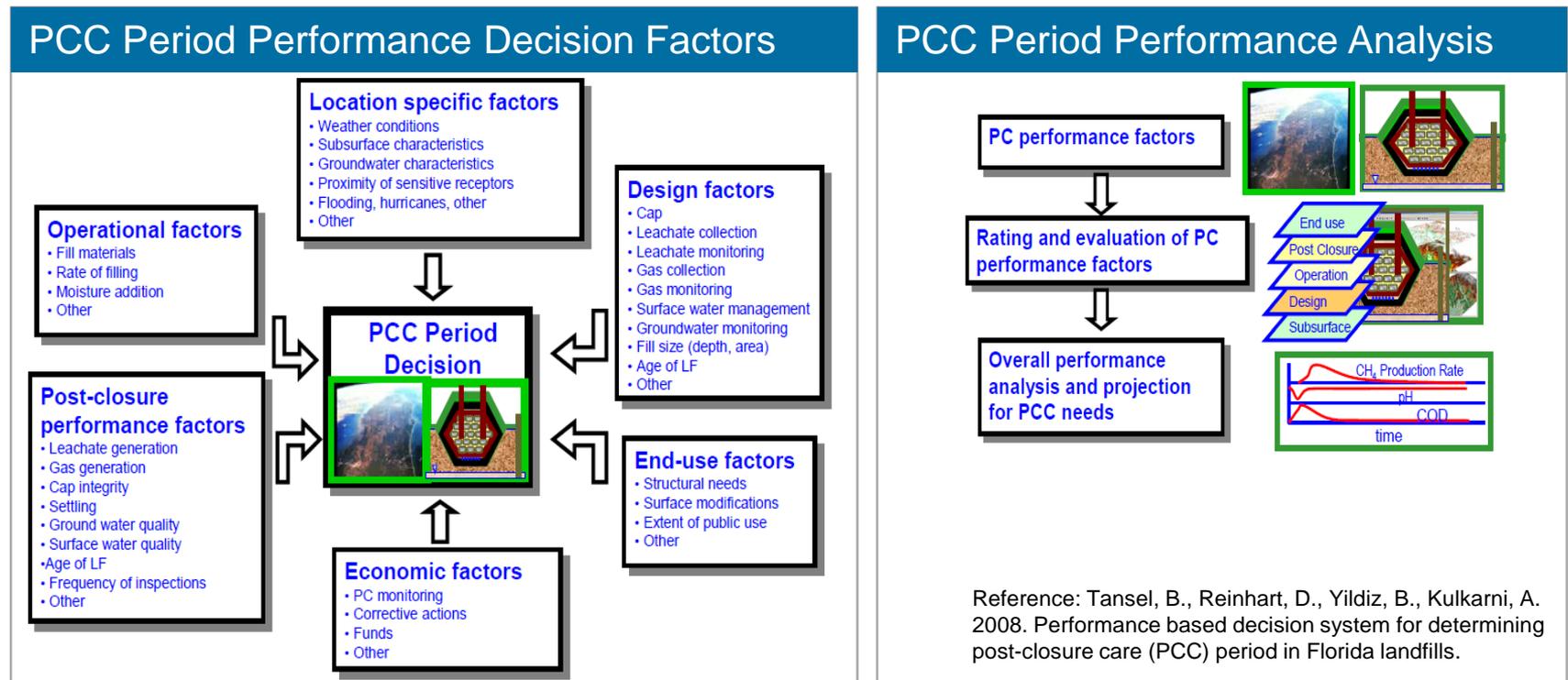
Source: "Pilot Application of the Evaluation of Post-Closure Care (EPCC) Methodology at a Closed Landfill in the Mid-Atlantic United States," Geosyntec and AquaTerra for Waste Management (2009, rev. 2011)



Case Study: PCC evaluation for two Florida landfills

A systematic approach analyzing key performance decision factors is necessary to determine whether to extend or shorten the PCC period, should be based on landfill's threat to human health or the environment

- Looked at two landfills: **Davie Landfill** and **Alachua County Southwest Landfill**



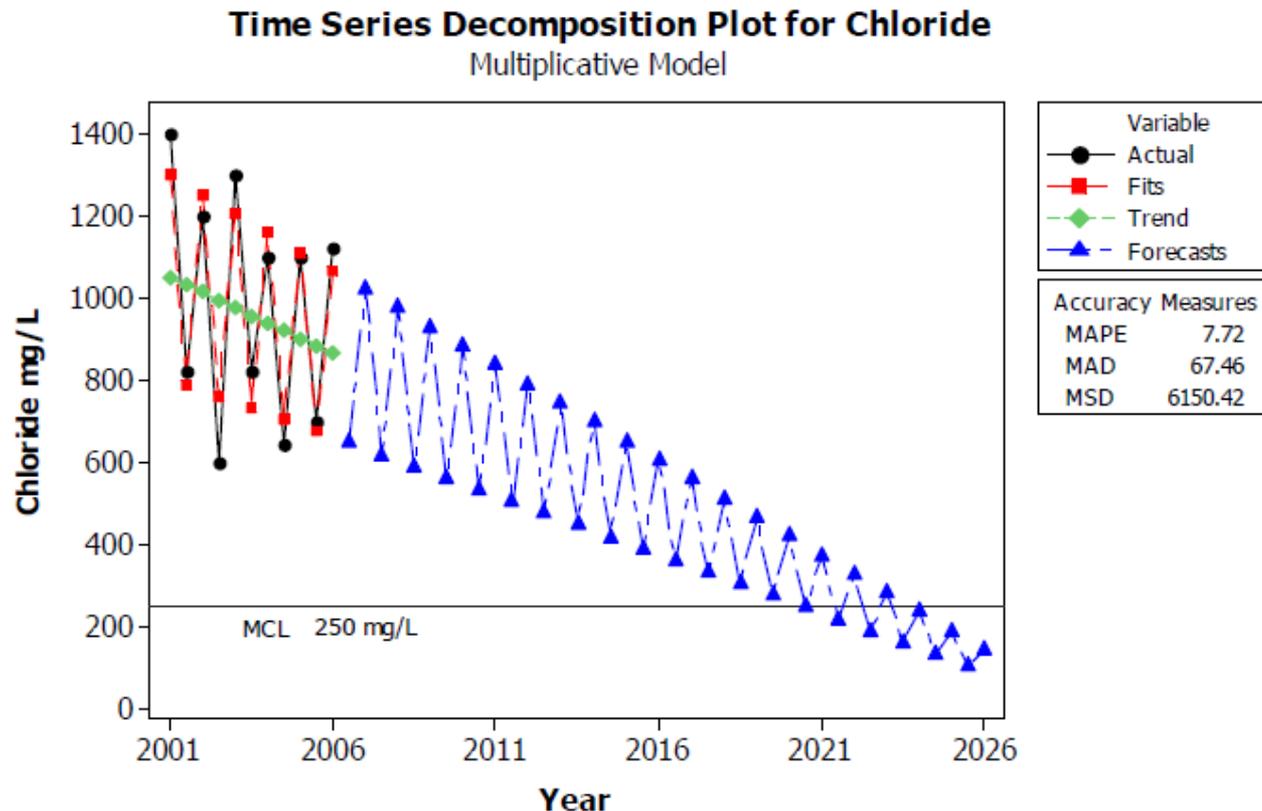
Case Study: Davie Landfill

Methodology for evaluating PCC:

- **leachate**, landfill gas, groundwater and cap modules

Leachate module: optimize, reduce or discontinue management practices

- Chloride above maximum contaminant level



Case Study: Alachua County Southwest Landfill

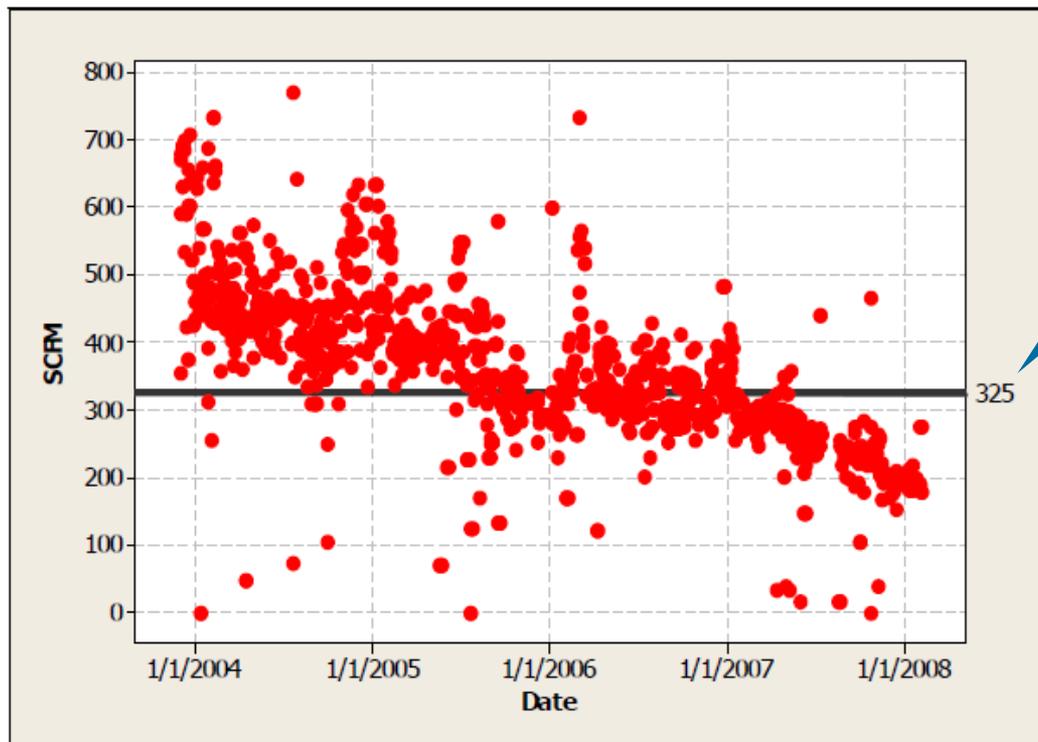
Methodology for evaluating PCC:

- leachate, **landfill gas**, groundwater and cap modules

Landfill gas module: estimate remaining landfill gas potential

- Landfill gas production steadily decreasing since landfill closure

Landfill gas generation rate (standard cubic feet per minute [SCFM])



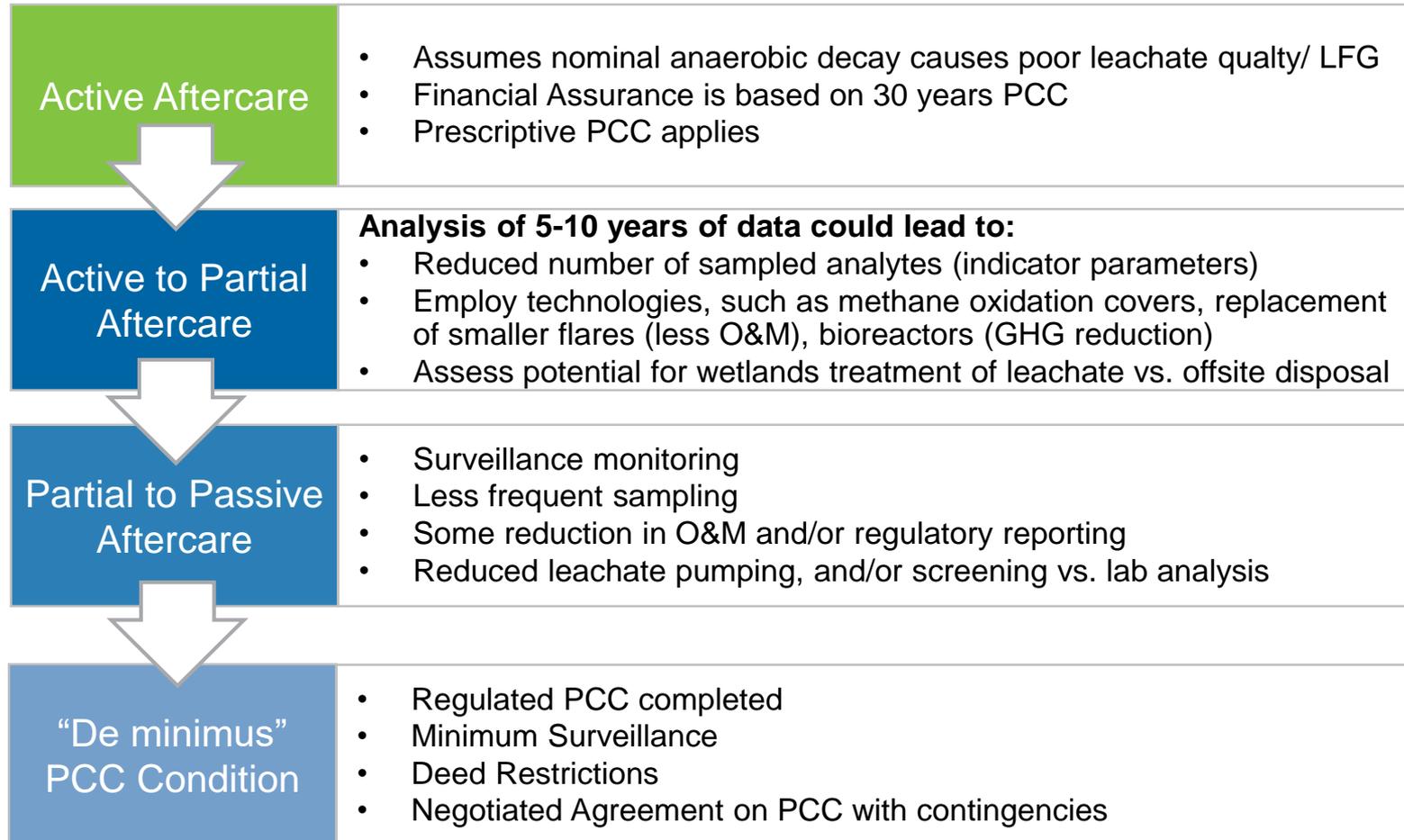
Case Study: Significance

Performance based methodology is necessary in making decisions regarding PCC

- Results from leachate, landfill gas, groundwater, and cap modules led to recommendation for reduction in monitoring frequency for both Florida landfills, specifically for parameters below maximum contaminant levels
- Threat of landfill impacts to human health and the environment should be the deciding factor
- Quality of monitoring data is very important; analysis requires historical data to make projections
- Data analysis and identifications of trends are sometimes difficult due to inconsistent data collection, quality of instruments, data reporting formats, etc.

Goal: Phased Decreases in PCC

Example regression from active to passive care



Technical Guidance on PCC

ITRC Guidance

- Alternative Landfill Technologies Team “Evaluating, optimizing, or Ending Post-Closure Care at Municipal Solid Waste Landfills Based on Site-Specific Data Evaluations.” (ITRC 2006)
- Environmental Research and Education Foundation (EREF) “Performance-Based System for Post-Closure Care at Municipal Solid Waste Landfills: a Procedure for Providing Long-Term Stewardship under RCRA Subtitle D.” (Geosyntec 2006 and 2011)

ASTM International Standard

- “Standard guide for optimization of groundwater monitoring constituents for detection monitoring programs for RCRA waste disposal facilities”. ASTM International Standard D7045-04 (2004)

USEPA

- Solid Waste Disposal Facility Criteria: Technical Manual. EPA530-R-93-017 and Landfill Gas Emissions Model (LandGEM) 1993

Academia

- “Performance Based Decision System for Determining Post-Closure Care (PCC) Period in Florida Landfills” (FIU & UCF)

Statistical Analysis (e.g. leachate)

- USEPA, Sara, Gibbons & Bull, LandSim®, DUMPStat® UPL, UCL
- Multimedia Exposure Assessment Model (MULTIMED), used to simulate the transport and transformation of chemical constituents released from any waste disposal facility into the environment

Other State Initiatives

Washington State's "Minimum Functional Standards for Solid Waste Handling," Chapter 173-304 WAC, issued in 1985, provide standards for PCC and financial assurance as well as maintenance and monitoring. Estimates are more than 60 closed landfills under PCC.

Under WAC 173-304-407(8)(b and c), to end PCC, an owner/operator needs to demonstrate that a landfill is stable by showing there is little or no settlement, gas production or leachate generation. A 2013 DOE guidance document addresses these questions:

1. How should a facility measure settlement to show there is "little or no" settlement?
2. How should a facility monitor landfill gas to show there is "little or no" gas production?
3. How should a facility measure leachate to show there is "little or no" leachate generation?

California's Department of Resources Recycling and Recovery (CalRecycle) promulgated revised PCC in 2012. Key elements included:

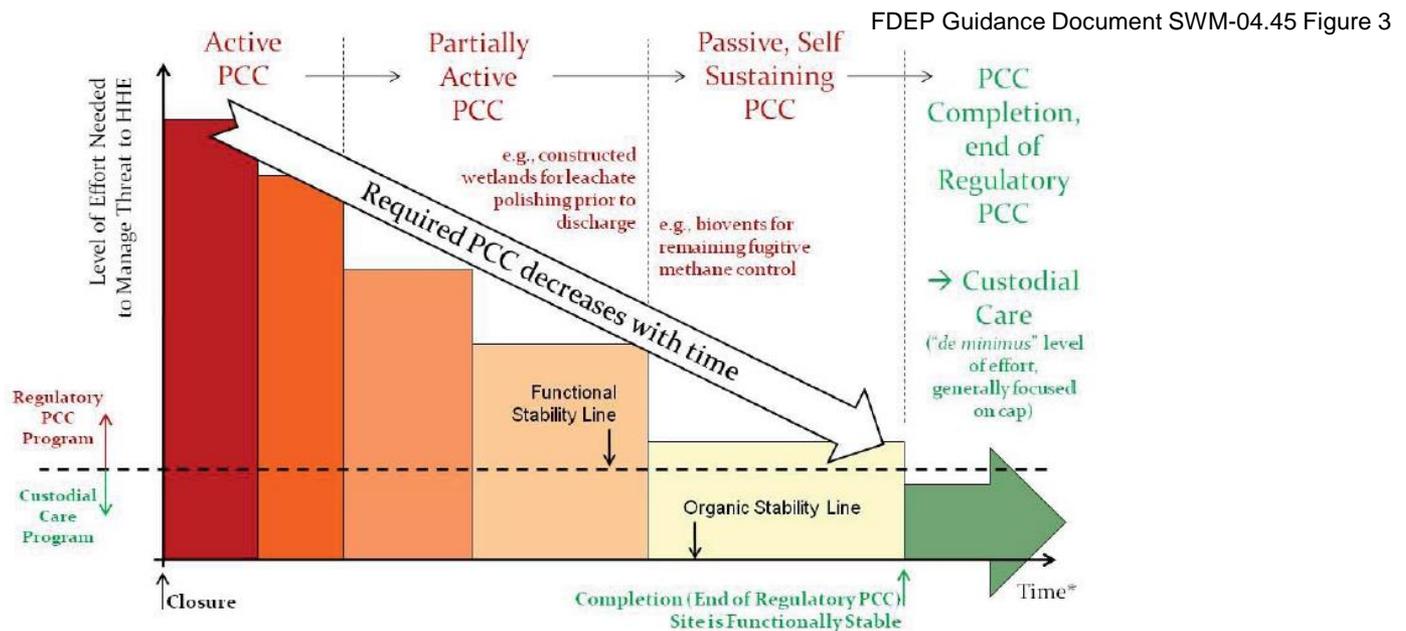
- Incorporated performance-based monitoring option as a means to address financial assurance (FA) requirements- a step down approach to reduce PCC durations
- Focus on proper designs and that a proactive monitoring program (PMP) can be developed to monitor and confirm stabilization trends. PMPs help optimize active landfill system operations which can result in a reduced PCC period; and
- Optimization of PCC systems should decrease long-term O&M costs (e.g., avoid major system overalls or system replacement) while increasing environmental protection



Other State Initiatives

Florida's “Long-Term Care at Solid Waste Disposal Facilities” Guidance Document SWM-04.45, issued in February of 2016, provided guidelines for extension or cessation of LTC (also PCC) of MSW and C&D landfills based on analysis of leachate, LFG, groundwater, and final cover.

- Allows for reanalysis of the above four exposure modules following 5 to 10 years of consistent data collection to establish trends.
- LTP/PCC responsibilities gradually decrease over time as data collected for each module shows lessened risk to HHE.
- “De minimis” performance criteria are set forth in the Guidance which mark the end of LTC/PCC and the beginning of a Custodial Care (CC) period to ensure long-term compliance with property use limitations.



* (No presumptive scale; time needed to move from Closure to Completion is site specific)

Considerations / Limitations

- ☑ Science-based, data-driven considerations are a must!
- ☑ Although there are analogs between soils and decomposing refuse, concentrations of organic carbon and the diversity of biological and chemical reactions are likely broader in landfills
- ☑ Leachate quality, the rate of existing and future leachate generation, and long-term geotechnical stability of the landfill are unique under various leachate flow and accumulation scenarios, as well as existing and potential leachate release mechanisms to receiving bodies
- ☑ Increased knowledge of the leachate mass load, as well as climatic, geologic, hydrogeologic, regulatory, and economic factors, and site specific factors such as sensitivity of the receiving environment are encouraged to illustrate the landfill's PCC condition

Who Benefits from this approach?

Re-assessment of PCC can help:

Environment

Provides more site-specific information for protection of the environment and human health

Tax Payers

Reduces the long-term costs passed on to the taxpayers and end-users

Owner/ operators

Allows for optimizing O&M costs during the PCC term, cost-effective management of potential liabilities, and defining an appropriate end to PCC so the property can be utilized for beneficial reuse

Regulators

Enables the systematic implementation of a performance-based standard that adds defensibility and credibility to decisions regarding extending, optimizing, or terminating PCC activities

Local community

Better protects HHE and provides more certainty in terms of defining the timing and extent of beneficial reuse alternatives



Thank you

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