Maryland
Department of
the Environment

COMAR 26.11.42 – Control of Methane Emissions from Municipal Solid Waste (MSW) Landfills

AQCAC October 24, 2022

Updating MSW Landfill Regulations Webinar

- Welcome to today's meeting!
- This meeting is being Recorded.
- mde.maryland.gov/programs/workwithmde/Pages/aq_cac.aspx

Maryland
Department of the Environment

Overview of Presentation

- Background
- Overview and Discussion of Regulatory Requirements
- Rulemaking Process

Why Leaking Methane From Landfills is an Even More Important Issue than We Previously Thought

- Maryland's recent efforts to update our inventory for the Greenhouse Gas Emission Reduction Act (GGRA) have covered all emission sectors for carbon dioxide (CO_2), methane (CH_4) and other greenhouse gases (GHG)

- Landfills are the largest methane emission source in the Maryland Department of the Environment (MDE) inventory

Maryland Commission on Climate Change (MCCC)

- Original Climate Change Commission established through Executive Order in 2007
  - Developed a 2008 Climate Action Plan that led to the 2009 GGRA
- GGRA reauthorized in 2016 with new goal of 40% GHG reduction by 2030
- MCCC codified in 2015, established a balanced, bipartisan Commission
  - Representatives from the Maryland General Assembly, state and local government, the private sector, environmental advocacy groups, labor, the general public & more

- Basic charge of the MCCC:
  - Provide recommendations on how to reduce GHG emissions and adapt to the impacts of climate change
  - Reducing leaking methane emissions has been a very high priority for the MCCC

Climate Change – Increasing Urgency

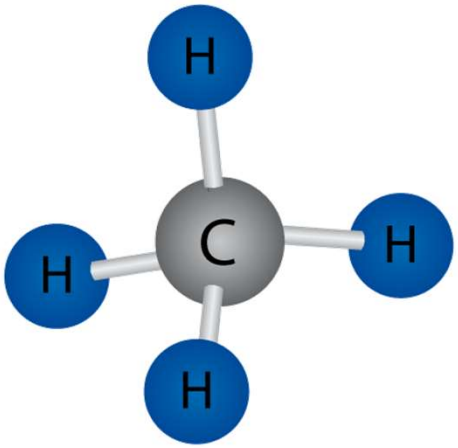
- MDE continues to rely on scientific evidence to guide its regulatory process
- The international research community is urging for quicker action to reduce GHG emissions to prevent negatively impacting public health due to rising temperatures and increases in the frequency of extreme weather events
  - This is exemplified by the experience of communities in Ellicott City, which have had to deal with three “once in a thousand-year rainfall events” over the last decade alone
- In early 2021, MDE submitted the final 2030 GGRA Plan to the Governor and the Maryland General Assembly

Climate Solutions Now Act of 2022

- Maryland now has the most ambitious GHG reduction goals of any state in the nation:
  - Reduce statewide GHG emissions 60% (from 2006 levels) by 2031
  - Achieve net-zero statewide GHG emissions by 2045
- 20-year global warming potential (GWP) for methane
  - More info on this on the next slide
- Landfill regulation is a critical measure for meeting the state's GHG reduction goals
- Building Energy Performance Standards
  - More on this soon

Methane Potency

- Climate Solutions Now Act of 2022 directs MDE to use the 20-year time horizon when considering the GWP of GHGs
- The 20-year GWP is now the standard measurement for evaluating progress towards Maryland's GHG reduction goals
- Methane is a super potent GHG
  - 28 times the warming impact of CO_2 over 100 years
  - Over 80 times the warming impact of CO_2 over 20 years



Source: mde.maryland.gov/programs/air/ClimateChange/Pages/GreenhouseGasInventory.aspx

Maryland's 2020 GHG Inventory

MDE recently released the MD GHG Emissions Inventory for 2020

- The state reached 30% reduction from 2006
- New goals
  - 60% reduction by 2031
  - Net-zero by 2045

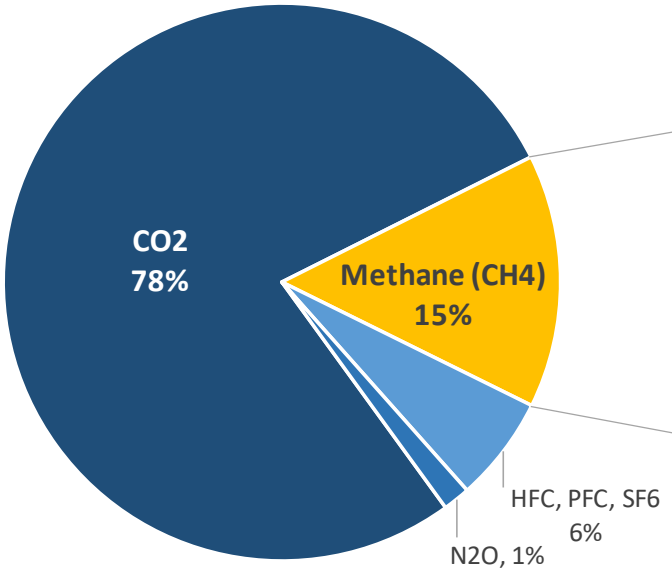
Methane makes up 15% of the state's GHG emissions

- Using the 20-year Global Warming Potential
- Methane = 84 times the warming impact of CO_2

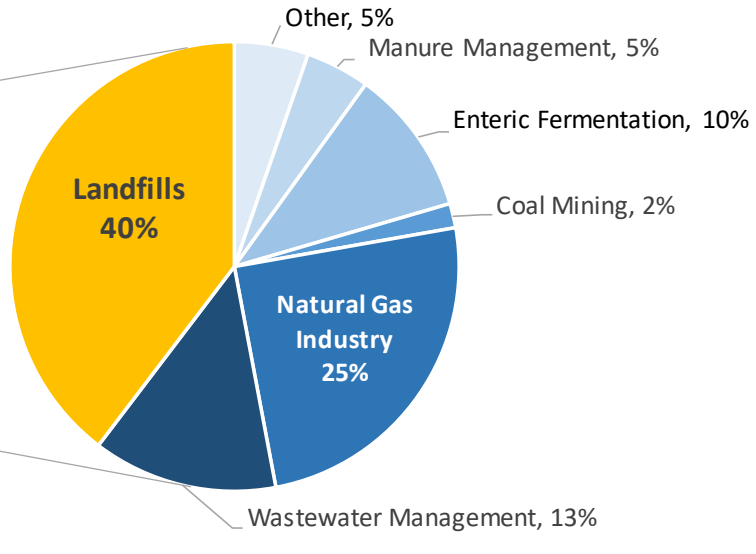
Landfills make up 40% of the state's methane emissions

- The largest methane emission source in the inventory

2020 MD Greenhouse Gas Emissions, % by gas
(total of 85.1 MMTCO2e, using 20-year GWP)



2020 MD Methane Emissions, % by source
(total of 12.5 MMTCO2e, using 20-year GWP)




RECENT COMMENTS

MDE Received Many Comments from Stakeholder Meetings Over Past 3 Years

Diverse comments and public input from advocacy groups, nonprofits, landfill owners and operators, and concerned residents

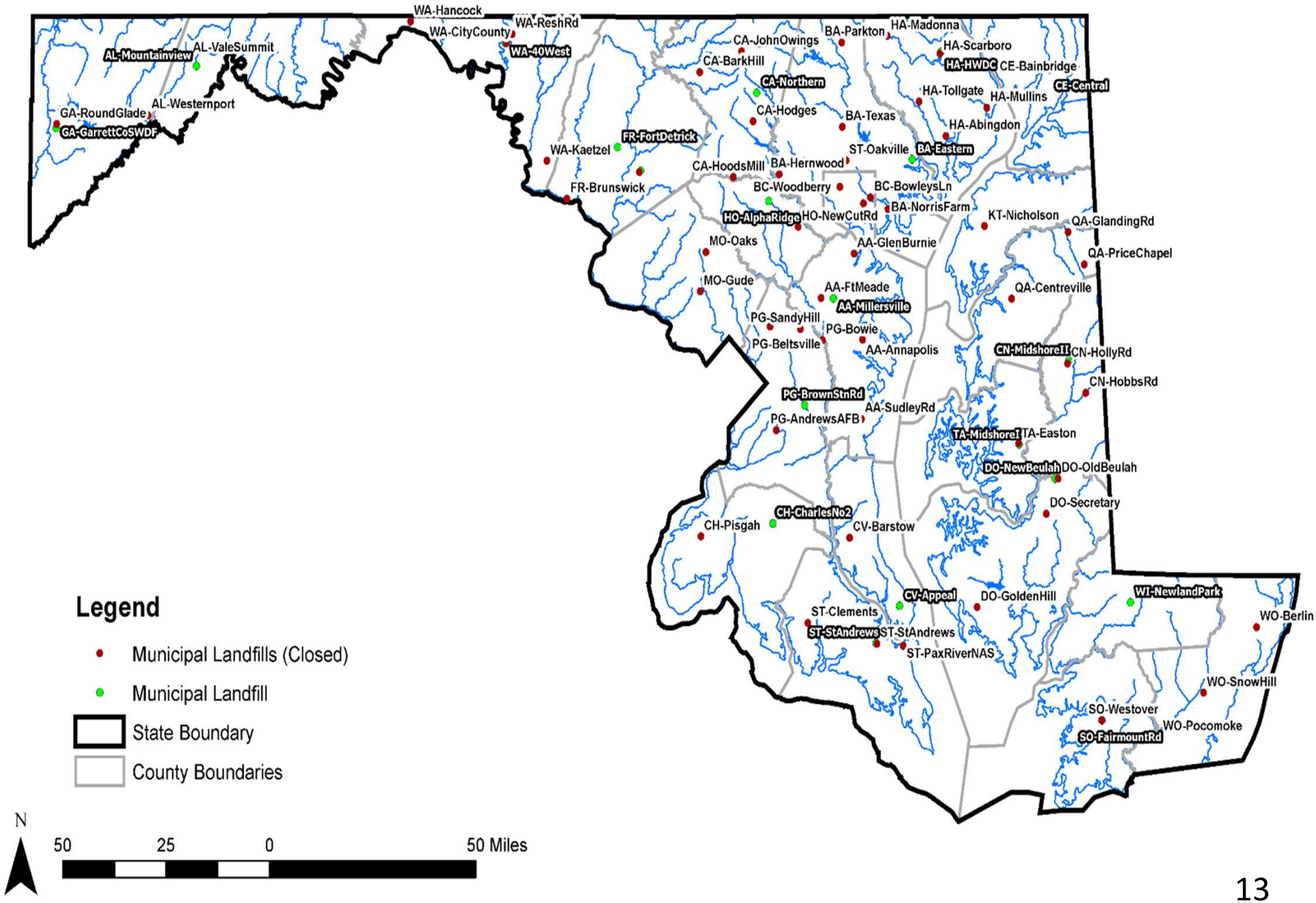
Most comments were driven by concerns over climate change and waste diversion

Other comments were driven by implementation concerns and enforcement and compliance issues

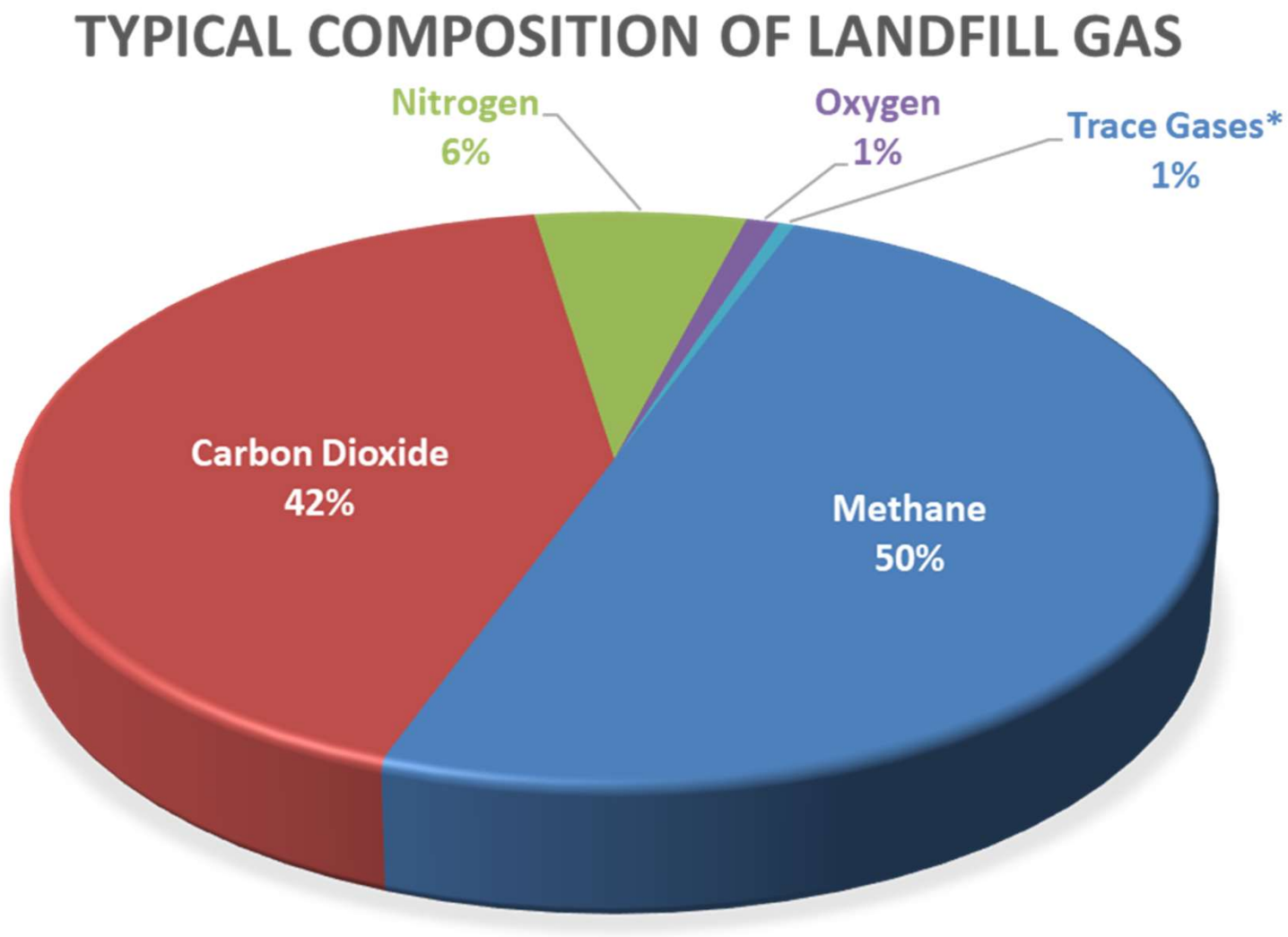
Some comments encouraged the use of voluntary measures and incentives to supplement any regulatory requirements for MSW landfills


BACKGROUND

Municipal Solid Waste Landfill Facilities in Maryland



Municipal Solid Waste (MSW) Landfill



*Trace gases includes ammonia, non-methane organic compounds (NMOC), sulfides, hydrogen, and carbon monoxide

Source: atsdr.cdc.gov/HAC/landfill/html/intro.html

Existing MD Regulations Applicable to MSW Landfills

- Subtitle: Regulation of Water Supply, Sewage Disposal, and Solid Waste
  - COMAR 26.04.07.04 - Sanitary Landfills — General
  - COMAR 26.04.07.06-08 - Sanitary Landfills — Municipal Landfills — Phase I-III Reports
  - COMAR 26.04.07.09 - Sanitary Landfills — Municipal Landfills — Other Requirements For Permits
  - COMAR 26.04.07.10 - Sanitary Landfills — Municipal Landfills — Minimum Operating Procedures
- Subtitle: Maryland CO_2 Budget Trading Program
  - COMAR 26.09.03.03 - Landfill Methane Capture and Destruction Project Standards
- Subtitle: Air Quality
  - COMAR 26.11.19.20 - Control of Landfill Gas Emissions from Municipal Solid Waste Landfills

Federal Regulations Applicable to MSW Landfills

- 40 CFR 60, Subpart Cf (Emission Guidelines) (*August 29, 2016*)- applies to MSW landfills that accepted waste after November 8, 1987 and have commenced construction, modification, or reconstruction on or before July 17, 2014

- 40 CFR 60, Subpart XXX (New Source Performance Standards) (*August 29, 2016*)– applies to MSW landfills for which construction, reconstruction, or modification commenced after July 17, 2014

- 40 CFR 63, Subpart AAAA (National Emissions Standards for Hazardous Air Pollutants) for MSW landfills (*March 26, 2020*)

- 40 CFR 62, Subpart OOO (*May 21, 2021*) – applies to existing MSW landfills in states without a state plan


DISCUSSION OF REQUIREMENTS

MDE's Regulatory Approach

- Two basic drivers:
  - The new federal New Source Performance Standards (NSPS) and Emission Guidelines (EG) for MSW landfills
  - The need for additional requirements to minimize leaking methane emissions as part of the State's climate change efforts
- MDE looked at prior and current regulatory efforts on MSW landfills in other states

Source: https://pixabay.com/photos/antietam-maryland-burnside-bridge-80552/)

MSW Landfills - Applicability

Requirement	NSPS (Subpart XXX) and EG (Subpart Cf)	COMAR 26.11.42
Applicability	**Type**: MSW Landfills	**Type**: MSW Landfills
	Size: ≥2.5 million megagrams (Mg) waste mass and 2.5 million cubic meters (m^3) waste volume	**Size**: ≥450,000 tons of waste-in-place (WIP)
	Age: EG - Existing MSW landfills constructed, reconstructed, or modified on or before July 17, 2013, and accepted waste after November 8, 1987 NSPS - MSW landfills constructed, reconstructed or modified after July 17, 2014	**Age**: MSW landfills that received waste after November 8, 1987

MSW Landfills - Exemptions

Requirement	NSPS (Subpart XXX) and EG (Subpart Cf)	COMAR 26.11.42
Exemptions	**Size**: <2.5 million megagrams (Mg) waste mass and 2.5 million cubic meters (m^3) waste volume	**Size**: Closed and inactive MSW landfills with <450,000 tons WIP or a design capacity less than 2.75 million tons and 3.26 million m^3 that last accepted waste on or before December 31, 1993
	Types: Hazardous waste landfills, C&D landfills, landfills regulated under Environmental Response, Compensation, and Liability Act (CERCLA)	**Types**: Landfills permitted to accept controlled hazardous substances as defined in COMAR 26.13.01.03B, landfills regulated under CERCLA
		Additional: Closed or inactive MSW landfills (or closed or inactive areas of an active MSW landfill) that have installed and operated solar panels or arrays on or before January 1, 2024 that meet certain conditions

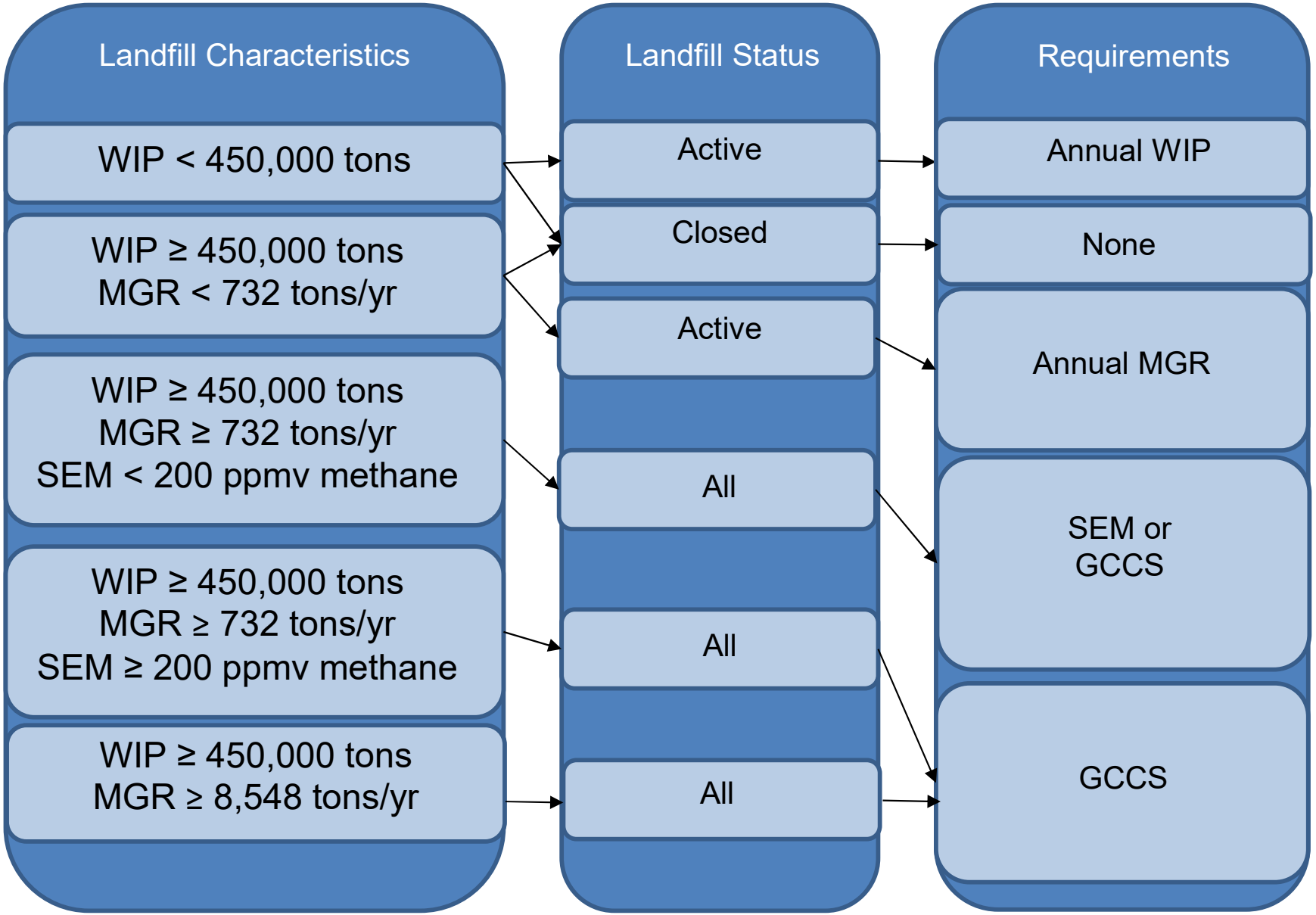
Proposed Requirements For MSW Landfills

Requirement	MSW Landfills <450,000 Tons WIP	MSW Landfills ≥450,000 Tons WIP
Reporting – Waste in Place (WIP)	**Active MSW Landfills**: Submit annual tonnage reports until WIP ≥450,000 tons or submittal of closure notification to MDE	**Active and Closed MSW Landfills**: Submit initial waste-in-place report
Methane Generation Rate Report	Not Applicable	**Active and Closed MSW Landfills**: Calculate the methane generation rate and submit report to MDE
Liquids Addition (Bioreactor Landfills)	Not Applicable	Landfills that add liquid other than leachate in a controlled fashion to reach a minimum average moisture content of at least 40 % by weight to accelerate or enhance the anaerobic biodegradation of the waste are required to install and operate a gas collection and control systems and comply with requirements of the regulation
Maintenance Standards	Maintain cover integrity and implement program for cover repairs	Maintain cover integrity and implement program for cover repairs

Proposed Requirements
Methane Generation Rate

Calculated Methane Generation Rate	MSW Landfills <450,000 Tons WIP	MSW Landfills ≥450,000 Tons WIP
<732 tons/yr	Not Applicable	**Active MSW landfills**: Calculate annually until methane generation rate ≥732 tons/yr or submittal of closure notification to MDE **Closed or Inactive MSW Landfills**: Submit final methane generation report and closure notification report to MDE
≥732 tons/yr - <8,548 tons/yr	Not Applicable	**Active and Closed MSW Landfills**: Install and operate a GCCS or demonstrate via quarterly surface emission monitoring (SEM) methane concentration levels <200 ppmv
≥8,548 tons/yr	Not Applicable	**Active and Closed MSW Landfills**: Install and operate a GCCS and comply with the requirements of the regulation

Flowchart of Requirements for MSW Landfills



Proposed Requirements
Surface Emissions Monitoring

Quarterly SEM	MSW Landfills <450,000 Tons WIP	MSW Landfills ≥450,000 Tons WIP
Methane Concentration Levels <200 ppmv	Not Applicable	**Active MSW Landfills**: Recalculate methane generation rate annually, continue quarterly SEM, and submit annual instantaneous SEM report to the Department **Closed MSW Landfills**: Submit final WIP report, closure notification, final 1-yr SEM report, and satisfy requirements for permanent shutdown and removal of GCCS
Methane Concentration Levels ≥200 ppmv	Not Applicable	Install and operate a GCCS and comply with the requirements of the regulation
Timetable and Frequency		Monitoring must be conducted four times a year (quarterly) Quarterly surface emission monitoring must be conducted no less than 90 days after submitting methane generation report

Proposed Requirements
Gas Collection and Control Systems

Requirement	Description
Design Plan and Installation – Timetable	If a GCCS meeting the requirements in the regulation has not been installed, landfill owners and operators must submit a design plan within 1 year of: • Effective date of the regulation, or • Detecting any measured concentration of methane of 200 ppmv or greater during surface emission monitoring
	Landfill owners and operators must install and operate the GCCS within 30 months after approval of the design plan
Operating Standards and Requirements	Stipulates landfill owners and operators must satisfy certain standards and requirements when operating a GCCS, including routing or drawing the landfill gas to the gas control device

Proposed Requirements
Gas Collection and Control Systems

Requirement	Description
Operating Standards and Requirements	**Enclosed Flares**: Must achieve a destruction efficiency of at least 99% by weight and meet certain specifications in the regulation **Open Flares**: Landfill owners and operators are allowed to operate existing flares until January 1, 2025; after this date only with approval by MDE; flares must be operated in accordance with 40 CFR §60.18 **Control Devices other than Flares**: Allows for the use of control devices other than flares if it meets one of the following requirements: The device is a process heater or boiler with a design heat input capacity ≥44 megawatts; the collected gas is routed to an energy recovery device or series of devices; or the collected gas is routed to a treatments system for subsequent sale or use

Proposed Requirements
Gas Collection and Control Systems

Requirement	Description
Performance Testing	**Timetable**: Landfill owners and operators must conduct performance test using test methods and procedures specified in the regulation within 180 days of startup for new devices (initial performance test) and 180 days of the effective date of the regulation for existing units
	Additional Requirement for New Devices: Conduct subsequent annual test with 45 days of the 1-year anniversary of the initial performance test
	Conditions: Tests may not be conducted during periods of malfunction
	Schedule: Annually, but if the device remains in compliance after three consecutive performance test, the owner or operator may conduct performance tests every 3 years, but if any device is out of compliance during the 3-year test schedule, the frequency returns to an annual basis
	Exemptions: Performance tests are not required for boilers and process heaters with a design heat input capacity ≤44 megawatts that burns landfill gas in accordance with the requirements for control devices other than flares

Proposed Requirements
SEM – Instantaneous Emissions Standard

Requirement	Description
SEM- Instantaneous Emissions Standard	**Emission Limit**: *With GCCS*: No location on the MSW landfill surface may exceed the 500 ppmv methane concentration limits, as determined by instantaneous surface emissions monitoring *Without GCCS*: The owner or operator must record any instantaneous surface readings of methane 200 ppmv or greater, other than non-repeatable, momentary readings
	Method: Walking pattern with 25-foot spacing interval and traverse each monitoring grid
	Frequency: Quarterly. Closed or inactive landfills or closed or inactive areas of active landfills can shift to an annual basis. The frequency returns to an annual basis with an exceedance of the methane concentration limit
	Corrective Actions: Include cover maintenance, cover repair, or well vacuum adjustments

Proposed Requirements
SEM – Integrated Emissions Standard

Requirement	Description
SEM - Integrated Emissions Standard	**Emission Limit**: No location on the MSW landfill surface may exceed an average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring
	Method: Integrated surface readings must be recorded and then averaged for each grid
	Frequency: Quarterly. Closed or inactive landfills or closed or inactive areas of active landfills can shift to integrated monitoring on an annual basis. The frequency returns to an annual basis with an exceedance of the methane concentration limit
	Corrective Actions: Individual monitoring grids that exceed an average methane concentration of 25 ppmv must be identified and remediated

Proposed SEM - Frequency, Exceedances and Testing

Requirement	Description
SEM - Frequency	Quarterly for both instantaneous and integrated SEM. Closed or inactive landfills or closed or inactive areas of active landfills can shift to monitoring on an annual basis. The frequency returns to an annual basis with an exceedance of the methane concentration limit
SEM - Exceedances	Surface areas of the MSW landfill that exceed a methane concentration limit of 500 ppmv must be marked and remediated
SEM - Surface Area Testing	The landfill surface areas with cover penetrations, distressed vegetation, cracks or seeps must also be inspected visually and with a hydrocarbon detector

Proposed Requirements
SEM - Instrumentation, Coverage and Spacing

Requirement	Description
SEM - Instrumentation	Any instrument used for the measurement of methane must be a gas detector or other equivalent instrument must meet the calibration, specifications, and performance criteria of EPA Reference Method 21, “methane” replaces all references to VOC
SEM - Landfill Area	The entire landfill surface must be divided into individually identified 50,000 square foot grids (both integrated and instantaneous monitoring)
SEM - Spacing and Patterns	The walking pattern must be no more than a 25-foot spacing interval and must traverse each monitoring grid. Spacing intervals can be modified after successful quarterly tests over a specific timeframe

Proposed Requirements
SEM – Testing Conditions

Requirement	Description
SEM–Meteorological Conditions	**Conditions for conducting surface emissions monitoring**: Testing cannot be performed when average wind speed exceeds 25 miles per hour (mph) A wind barrier (similar to a funnel) shall be used when onsite average wind speed exceeds 4 mph (2 meters per second) or gust exceeding 10 mph The wind barrier must surround the surface emission monitoring monitor and make contact with the ground to ensure wind turbulence is blocked Average wind speed determined using 15-minute average using an on-site anemometer with a continuous recorder for the entire duration of the monitoring event Surface emissions testing must be conducted only when there has been no measurable precipitation in the preceding 72 hours

Proposed Requirements
Gas Control System Equipment Monitoring

Equipment	Requirements
Enclosed Flares	Install, operate and maintain the following equipment according to manufacturer's specifications: • A temperature monitoring device equipped with a continuous recorder which has an accuracy of plus or minus (±) 1 percent of the temperature being measured, and • A device that records the gas flow to the control device(s) and the bypass of the control device
Boilers and Process Heaters	Similar to enclosed flares except a temperature monitoring device is not required for boilers and process heaters with a design input capacity >44 MW
Devices other than Enclosed Flares	Install, operate and maintain the following equipment according to manufacturer's written instructions and specifications: • An operating description of the gas control device • Operating parameters that would indicate proper performance, and • Monitoring procedures

Proposed Requirements
Gas Control System Equipment Monitoring

Requirement	Description
Component Leak Testing	**Component Leaks**: Components containing landfill gas and under positive pressure are required to be monitored for leaks on a quarterly basis: • Component leaks of ≥500 ppmv are to be tagged and repaired within 10 days • Component leaks of ≥250 ppmv are to be recorded
	MSW Landfills with Landfill Gas to Energy Facilities: Quarterly component leak testing conducted prior to scheduled maintenance or planned outage periods
	Additional: Gauge pressure in the gas collection header applied to each individual well must be measured on a monthly basis. • If positive pressure exists (unless otherwise noted), action must be initiated to correct the positive pressure within 5 days. • Any attempted corrective action may not cause exceedances of other operational or performance standards

Proposed Requirements
Wellhead Monitoring

Requirement	Description
Monitoring Parameters	Requires monthly monitoring of each individual wellhead to determine and record the gauge pressure, temperature, and nitrogen and oxygen content of gas emissions
Corrective Actions (Exceedances)	Requires corrective action for positive pressure at wellheads (exclusions for well raising and wellhead sampling)
	Requires corrective actions for a well that exceed the operating parameter for temperature be initiated within 5 days
Additional	Landfills may not cause exceedances of other operational or performance standards from any attempted corrective measures

Proposed Requirements
Monitoring Systems – Malfunction, Repair and Other Activities

Requirement	Description
Applicability	Apply at all times except for periods of monitoring system malfunctions, repairs associated with monitoring system malfunctions, and required monitoring system quality assurance or quality control activities
Malfunctions	Any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data is considered a monitoring system malfunction Monitoring system failures that are caused in part by poor maintenance or careless operation are not malfunctions
Repairs	Monitoring system repairs completed in response to monitoring system malfunctions to return the monitoring system to operation are to be completed as expeditiously as possible

Proposed Requirements – Additional Requirements and Standards for MSW Landfills

Alternative Compliance

Recordkeeping and Reporting

Permanent Shutdown of GCCS

Test Methods and Procedures

Solar Panels and Arrays at MSW Landfills

- Land Management Administration (LMA) at MDE approves solar panel requests
- Landfills that meet the following criteria are exempt under the regulation:
  - Closed MSW landfills or inactive areas of active MSW landfills that closed or last accepted waste prior to July 17, 2014
  - Have less than 2,750,000 tons or 3,260,000 cubic yards of MSW
  - Have solar panels or arrays that were installed prior to January 1, 2024

Solar Panels and Arrays at MSW Landfills (cont.)

- Maryland encourages and supports solar development at landfills
- After January 1, 2024, closed MSW landfills or closed areas of active landfills with less than 2,750,000 tons or 3,260,000 cubic yards of MSW that newly install and operate solar panels or solar arrays will be required to meet certain requirements
- Large landfills with waste capacity over 2,750,000 tons can install and operate solar panels or arrays and will be required to meet certain requirements
- Requirements:
  - An approved plan from MDE Solid Waste for the installation and operation of solar panels
  - Comply with specific maintenance requirements
  - May be required to submit an alternative compliance plan for surface emissions monitoring

Estimated Emission Reductions

- Factors to consider when estimating methane gas emissions from landfills…
  - Landfill gas generation is a function of temperature, waste composition, landfill size, waste compaction, liners and covers, moisture content, pH level, etc.
  - Rate of landfill gas generation occurs in four phases – generation is greatest 5-7 years after waste is placed (Phase II), gas is produced for several decades (Phase III), and exponentially declines after cessation of waste placement (Phase IV)

- MDE anticipates a reduction in methane gas emissions as a result of increased monitoring, minimizing and fixing leaks, and increased methane capture

- MDE estimates a 25-50% reduction in landfill gas emissions (CO_2 and CO_2e methane – using a GWP of 28) from landfills subject to the proposed regulation when fully implemented

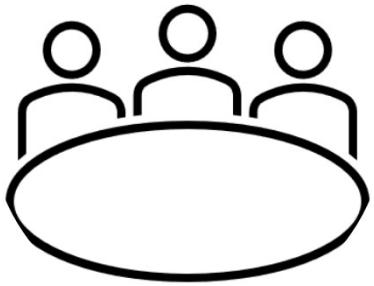
Estimated Costs - Compliance

Estimated compliance costs (per landfill) would vary based on applicability, status (i.e., closed or open), reporting and monitoring requirements, and control costs‡:

Category	Avg Costs (Est.)
Landfills Subject to Reporting Requirements Only	$4,000†
Landfills Subject to Reporting, Monitoring and Control Requirements:	
Reporting	$4,000+†
Monitoring	$60,000†
Capital Costs	$1-3 Million
Operation and Maintenance (O&M)	$150,000-$400,000†

† - Costs on an annual basis

Regulatory Schedule – Key Dates

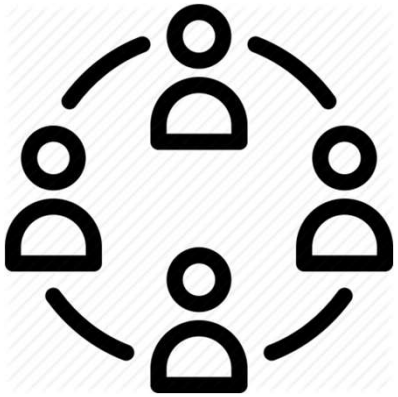


Propose Regulation and Present to AQCAC

October 2022

Signatures for Adoption Process, AELR Review

November 2022



Proposed Regulation

December 2022

Public Hearing and Final Adoption

Approximately 5 Months


QUESTIONS & DISCUSSION