Common Municipal Solid Waste Landfill Rules Compliance and Enforcement Issues

Prepared for The Mid-Atlantic Regional Air Management Association Landfill Air Emissions Regulations Webinar

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July 14, 2022

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Presentation outline:

- Resources of information related to landfill gas collection system design
- Higher landfill gas operating temperature values
- EPA's Landfill Methane Outreach Program (LMOP) Landfill Gas (LFG) Energy Project Development Handbook – Appendix A, Best Practices Procedures
- Observations from landfill inspections

Resources: Landfill Gas Collection System Design

Documents

These are some useful documents but are not explicitly endorsed by EPA:

- US Army Corps of Engineers' "Landfill Off-Gas Collection and Treatment Systems" [1]
- Solid Waste Association of North America's (SWANA) "Landfill Gas Operation & Maintenance Manual of Practice" [2]

Other Materials

- Code of Federal Regulations

  Air Regulations (MSW Landfills)
  - 40CFR62, Subpart OOO, 40CFR60, Subparts Cf and Subpart XXX
  - 40CFR63, Subpart AAAA

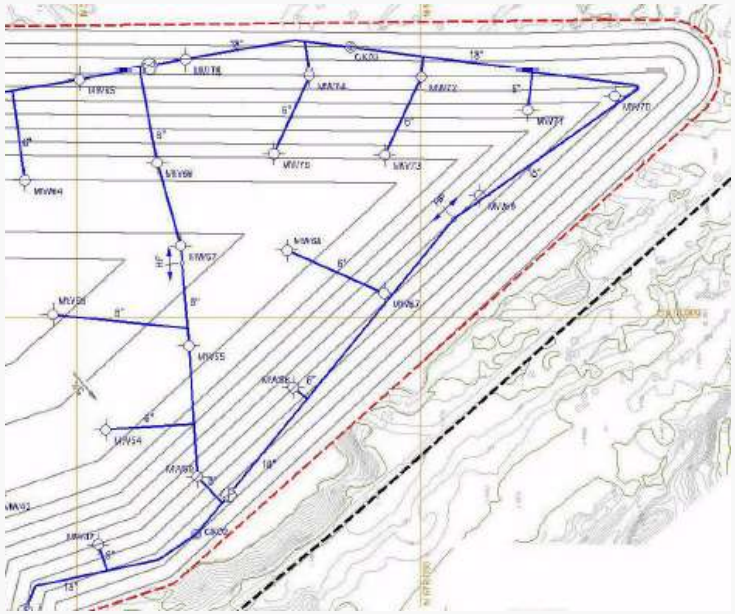
  Land Regulations (MSW Landfills)
  - 40 CFR Part 258. "MSW Landfill Criteria Technical Manual" [3]
- LMOP "Landfill Gas Energy Project Development Handbook" [4]

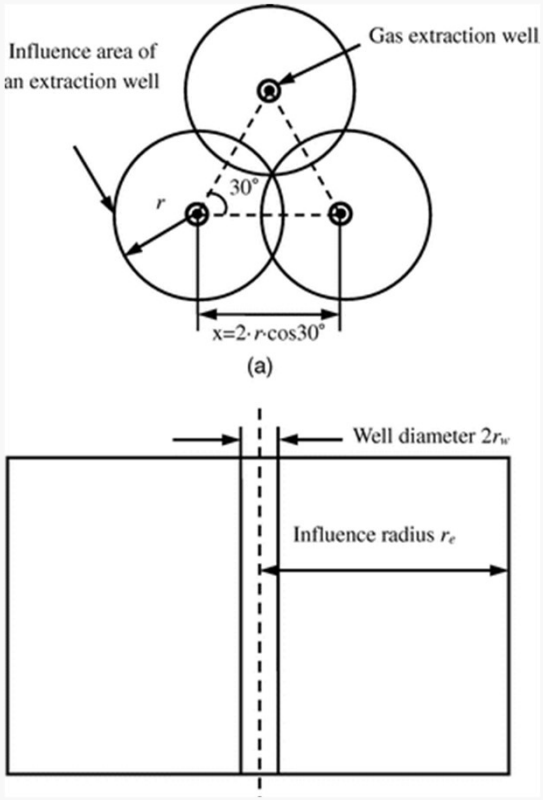
[1] https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_200-1-22.pdf
[2] https://www.nrel.gov/docs/legosti/fy97/23070.pdf
[3] https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/index-9.html
[4] https://www.epa.gov/lmop/landfill-gas-energy-project-development-handbook

Active Landfill Gas Collection Systems - Spacing

General Industry Standard

One well per acre





Radius of Influence (ROI)

- Theoretical radius gas well can collect from
- Included in many GCCS Design Plans

Specifications for Active Gas Collection Systems *[e.g.*, § 60.769]

PE must certify comprehensive control of gas [§ 60.762(b)(2)(i)]. Plan must include:

- Depths of refuse
- Refuse gas generation rates and flow characteristics
- Cover properties
- Gas system expandability
- Leachate and condensate management
- Accessibility
- Compatibility with filling operations
- Integration with closure end use
- Air intrusion control
- Corrosion resistance
- Fill settlement
- Resistance to refuse decomposition heat

Sufficient assessment to address landfill gas migration issues and augmentation through wells at perimeter or exterior

Gas wells must control all gas producing areas except:

- Separate asbestos/nondegradable material
- Nonproductive area if contributes < 1% of total NMOC

Specifications for Active Gas Collection Systems *[e.g.*, § 60.769]

Must construct gas components of:

- PVC,
- HDPE pipe
- Fiberglass
- Stainless steel
- Other nonporous corrosion resistant material

Must be constructed to:

- Withstand installation, static, and settlement forces
- Withstand planned overburden or traffic loads

Collection system must comply with emission and migration standards.

Vertical wells should not endanger underlying liner and address occurrence of water in landfill.

Collection wells must include:

- Positive closing throttle valve
- Seals and couplings
- Access couplings
- One sampling port

Higher landfill gas operating temperature values

Landfill Gas Operating Temperature Limits

Under 40 CFR 62.16716(c), 40 CFR 60.34f(c), and 40 CFR 60.763(c), operate each interior wellhead with a landfill gas temperature less than 131 degrees Fahrenheit, or under 40 CFR 63.1958(c)(1), operate each interior wellhead with a landfill gas temperature less than 145 degrees Fahrenheit.

The owner or operator may establish a higher operating temperature value at a particular well. A higher operating value demonstration must be submitted to the Administrator for approval and must include supporting data demonstrating that the elevated parameter neither causes fires nor significantly inhibits anaerobic decomposition by killing methanogens.

What causes Higher Operating Temperature Values?

Elevated temperatures are due to exothermic reactions within the waste and landfill management practices (moisture management, wase distribution, improper leachate recirculation practices, poor drainage, etc.). The reactions can cause changes in landfill gas composition, odors, waste settlement, leachate seeps and outbreaks, and generate strong leachate.

Examples of waste streams that are known to cause elevated temperatures in landfills:

- Ashes and dusts (e.g., waste-to-energy ash, baghouse dust, etc.)
- Aluminum, iron, and steel production by-products and wastes (e.g., dross, slag)

Changes Typically Associated/Observed with Elevated Temperatures

- Decrease of methane (CH_4) concentration
- Increase of carbon dioxide (CO_2), carbon monoxide (CO), hydrogen (H_2), and ammonia (NH_3) concentrations

Moisture Management Practices

Internal moisture content can be affected by:

- Solidification, liquids addition, or leachate recirculation practices
- Type and hydraulic properties of cover or alternative cover materials
- Management of special wastes (i.e., co-disposal or waste segregation)
- Removal of liquids from gas extraction wells

Heat and Odor Management Practices

- Apply geomembrane cover
- Add additional gas extraction wells
- Excavate and remove gaps in waste mass
- Install and operate a closed-loop heat exchanger

HOTV to Potential Fire

If the following is noted during the monitoring of extraction wells, it should be a signal to technicians that conditions are potentially becoming favorable for a landfill fire to occur, and increased monitoring and corrective action should be taken:

- Oxygen content is increasing and approaching 3 % by volume
- Nitrogen content is increasing and approaching 11 % by volume
- LFG temperature is increasing and approaching 167F

Leading Indications of Potential Fires

The following parameters are leading indications of a potential fire within the landfill interior:

- LFG temperature exceeds 167F
- Rapid settlement of the cover system
- Carbon monoxide levels are greater than 1,000 ppm
- Combustion residue is present in the LFG piping runs

Prevention of Potential Fires

Fire prevention may be assisted by:

- Decreasing the landfill gas extraction rate at individual wells, which will in turn decrease ambient air intrusion.
- Preventing ambient air intrusion by decreasing the air permeability of the landfill cover.

Fire Control

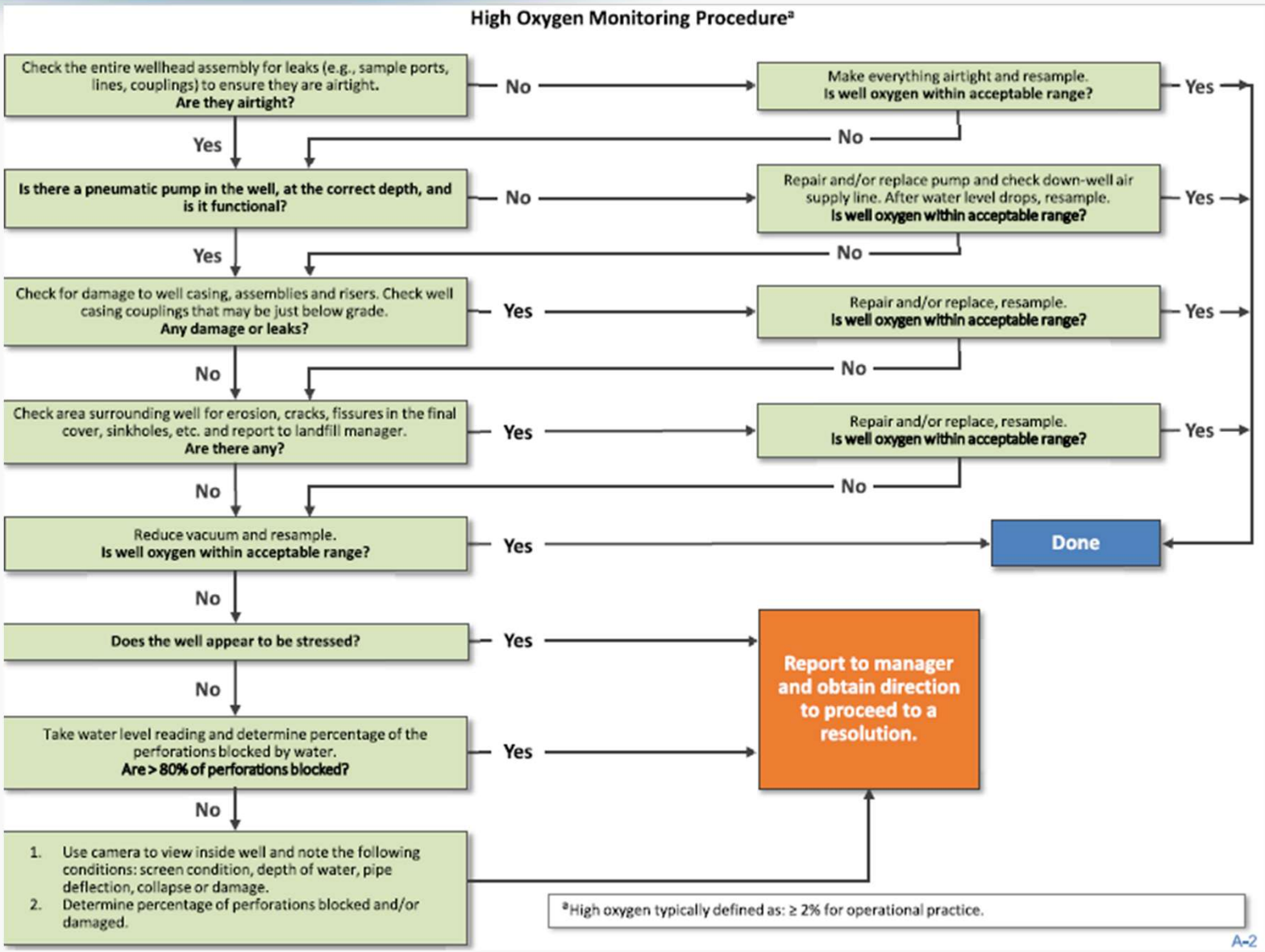
If an interior landfill fire occurs, fire control may be accomplished by the injection of nitrogen or carbon dioxide into the landfill subsurface to suffocate the fire. Water may also be injected.

Well gas extraction should also be discontinued to prevent oxygen from being drawn into the landfill.

EPA LMOP
LFG Energy Project Development Handbook
Best Practices Procedures

Appendix A

Typical Wellhead Monitoring Procedures and Operational Adjustments for Oxygen, Temperature, Methane, Flow and Vacuum


High Oxygen Monitoring Procedure[a]
Check the entire wellhead assembly for leaks (e.g., sample ports, lines, couplings) to ensure they are airtight.
Are they airtight?
No
Make everything airtight and resample.
Is well oxygen within acceptable range?
Yes
No
Yes
Is there a pneumatic pump in the well, at the correct depth, and is it functional?
No
Repair and/or replace pump and check down-well air supply line. After water level drops, resample.
Is well oxygen within acceptable range?
Yes
No
Yes
Check for damage to well casing, assemblies and risers. Check well casing couplings that may be just below grade.
Any damage or leaks?
Yes
Repair and/or replace, resample.
Is well oxygen within acceptable range?
Yes
No
No
Check area surrounding well for erosion, cracks, fissures in the final cover, sinkholes, etc. and report to landfill manager.
Are there any?
Yes
Repair and/or replace, resample.
Is well oxygen within acceptable range?
Yes
No
No
Reduce vacuum and resample.
Is well oxygen within acceptable range?
Yes
Done
No
Does the well appear to be stressed?
Yes
Report to manager and obtain direction to proceed to a resolution.
No
Take water level reading and determine percentage of the perforations blocked by water.
Are > 80% of perforations blocked?
Yes
No
1. Use camera to view inside well and note the following conditions: screen condition, depth of water, pipe deflection, collapse or damage.
2. Determine percentage of perforations blocked and/or damaged.
[a]High oxygen typically defined as: ≥ 2% for operational practice.
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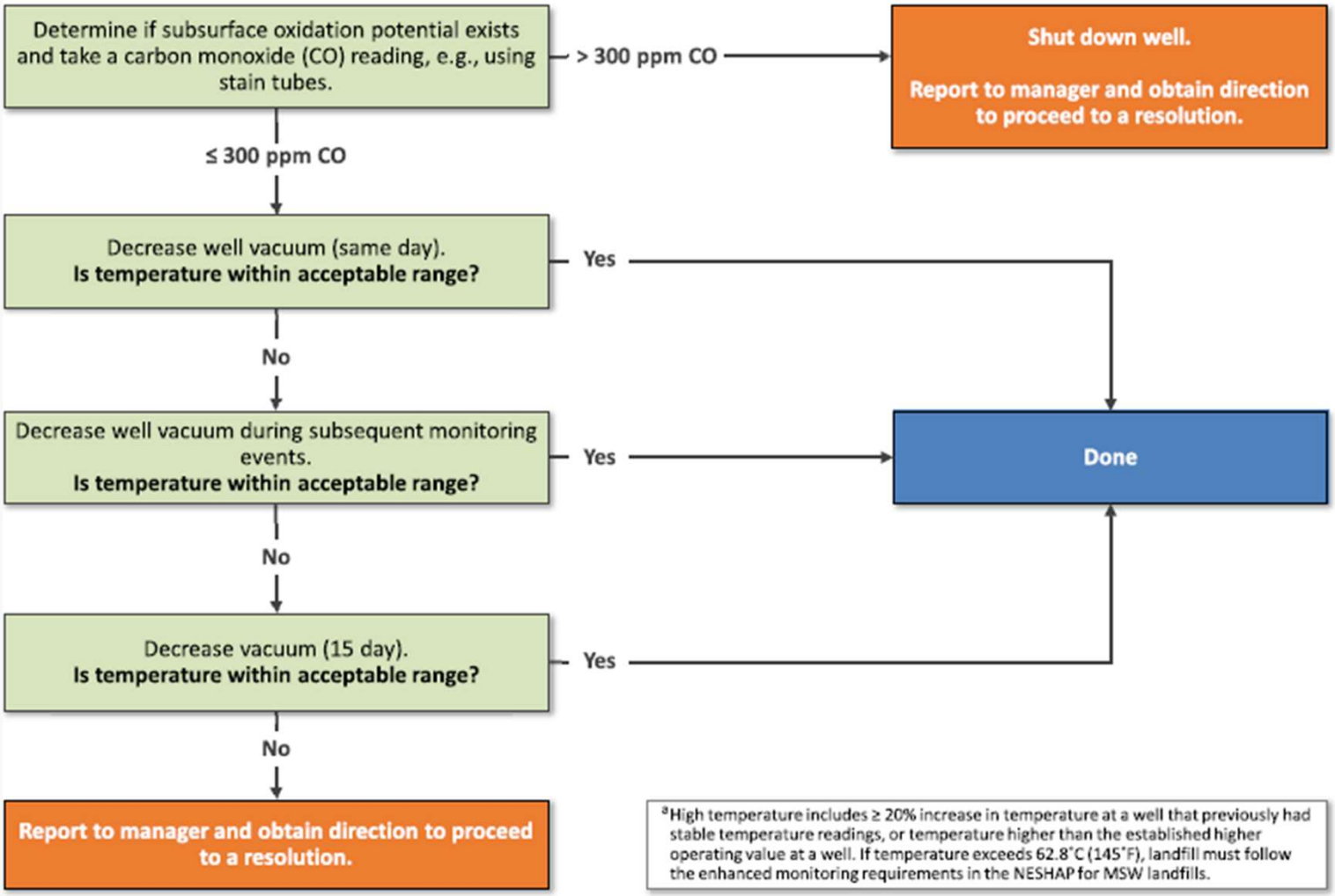
High Temperature Monitoring Procedure[a]



[a]High temperature includes ≥ 20% increase in temperature at a well that previously had stable temperature readings, or temperature higher than the established higher operating value at a well. If temperature exceeds 62.8°C (145°F), landfill must follow the enhanced monitoring requirements in the NESHAP for MSW landfills.

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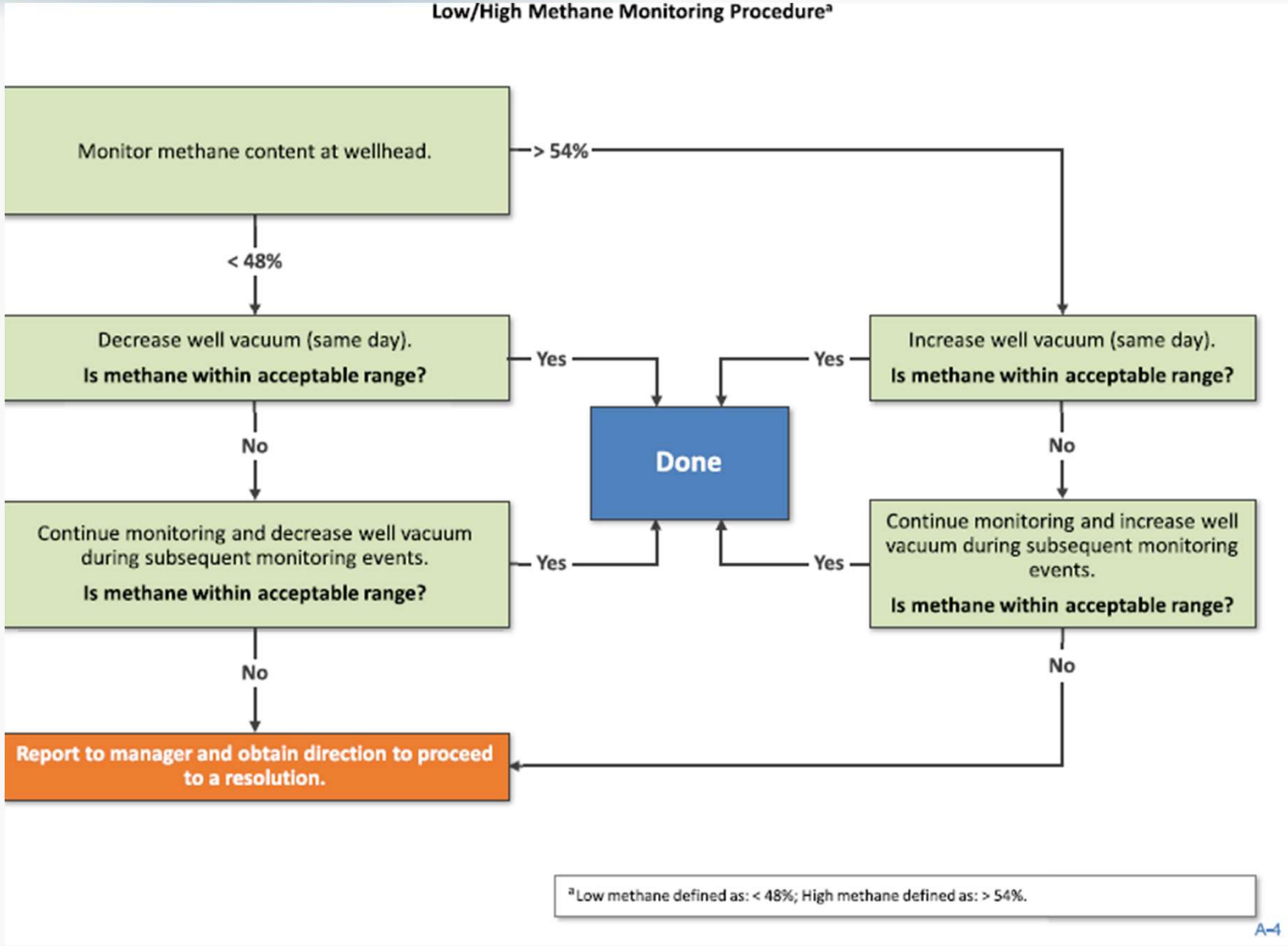
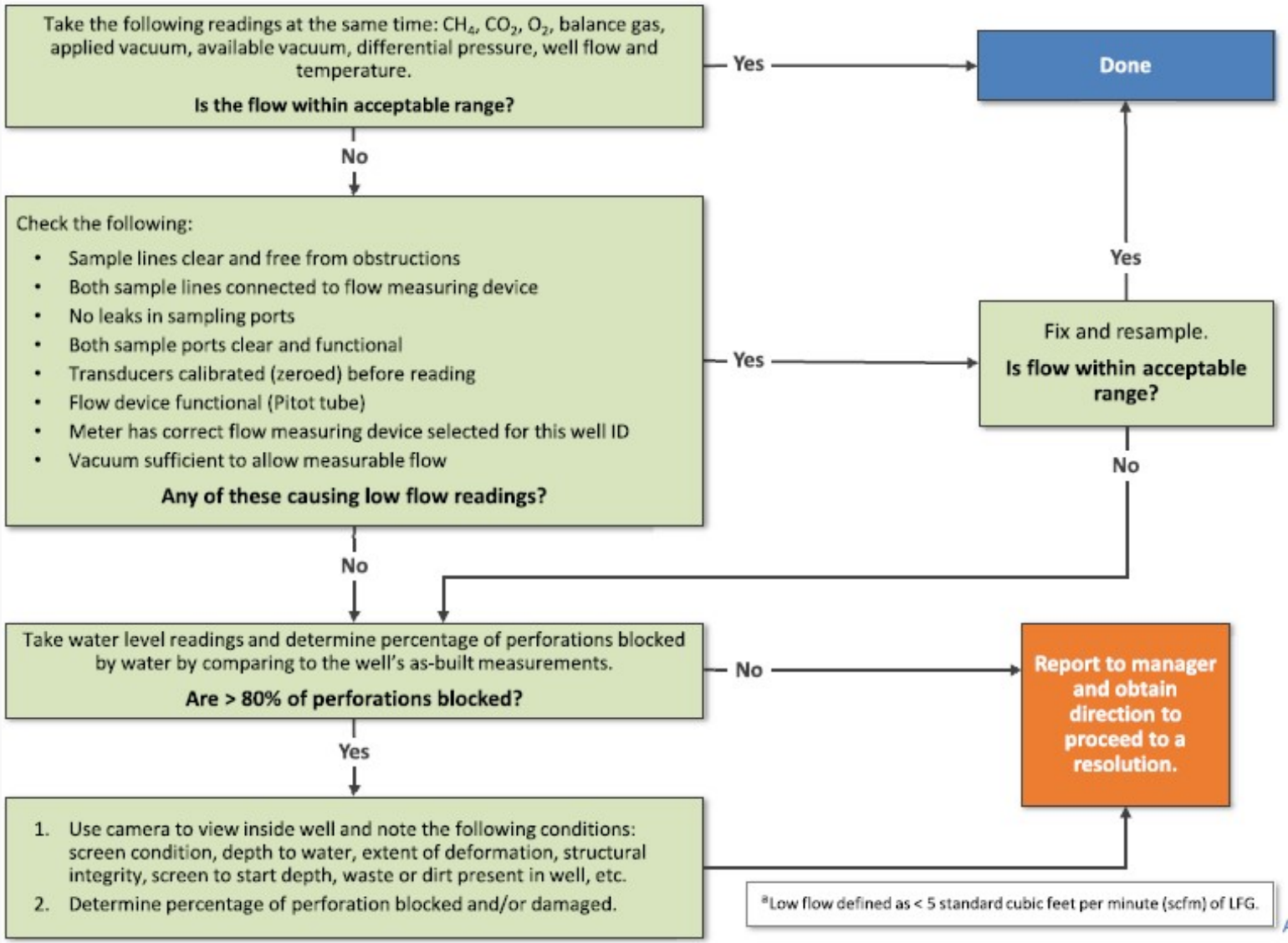
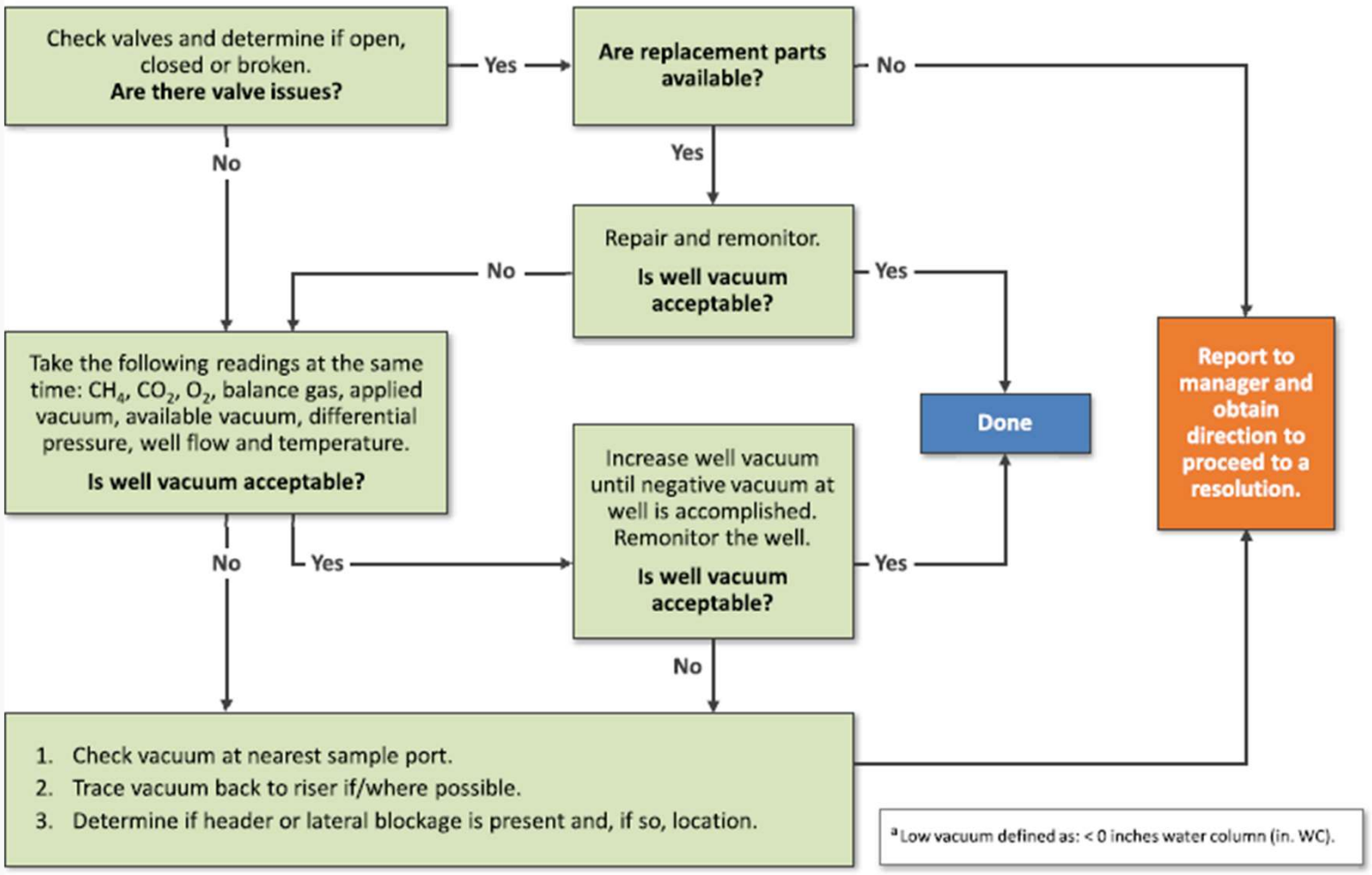

Low/High Methane Monitoring Procedure[a]
Monitor methane content at wellhead.
> 54%
< 48%
Decrease well vacuum (same day).
Is methane within acceptable range?
Yes
No
Increase well vacuum (same day).
Is methane within acceptable range?
Yes
No
Done
Continue monitoring and decrease well vacuum during subsequent monitoring events.
Is methane within acceptable range?
Yes
No
Continue monitoring and increase well vacuum during subsequent monitoring events.
Is methane within acceptable range?
Yes
No
Report to manager and obtain direction to proceed to a resolution.
[a] Low methane defined as: < 48%; High methane defined as: > 54%.
A-4

Low Flow Monitoring Procedure[a]



Low Vacuum Monitoring Procedure[a]



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Observations from landfill Inspections

Facilities fail to account for all degradable waste when computing NMOC emission rate

All waste must be accounted for except when the waste is non-degradable. Facilities must maintain documentation to support the nature, amount and location of waste claimed as non-degradable and not count it in the NMOC rate calculations.

- Some landfills have attempted to exclude waste such as construction & demolition waste, industrial waste, and alternative daily cover (normally considered degradable).

Tier 2 Site-Specific NMOC Concentration Sampling Location

Samples must be taken from the header pipe before the gas moving or condensate removal equipment

Inspectors have observed facilities sampling at locations other than the header pipe. Some examples are:

- Pipes before it meets the header
- Top of knockout drum
- After the blower

Variations in Waste Reporting

Inspectors has noted that the waste acceptance rates used in LANDGEM calculations:

- Are inconsistent with emissions reported in 40CFR98 annual greenhouse gas emission reports
- Do not match up with the wastes reported in annual solid waste reports to states

Choices for Tier 2 Site-Specific NMOC Concentration probe sampling

Inspectors has noted on numerous occasions:

- Landfills claim a large portion of the landfill to be active and containing waste that is less than 2 years old. Inspector's preference is monitor areas over 2 years old.
- Landfills choose to sample on the edge of the landfill to avoid the bulk of the waste. This results in a smaller amount of gas samples taken from areas where the bulk waste is deposited.

High Operating Temperature Values

Inspectors has noted on numerous occasions where HOTVs are due to:

- Practices related leachate recirculation
- Porous covers which allows more rainwater to get into the landfill

Use of k and Lo not prescribed by EPA

Inspectors has noted on occasions that k (methane generation rate constant) and/or Lo [methane generation potential (cubic meters per megagram solid waste)] values are adjusted when calculating the NMOC emission rate using LANDGEM.

Conduct of Surface Emission Monitoring (SEM)

Inspectors have observed:

- Deficiencies related to the developed SEM path
- SEM fails to check protrusions and cover penetrations
- Tendencies to under report the quantity of leaks when compared to EPA monitoring
- Improper calibration of monitoring equipment
- Expired calibration gas
- Compromised calibration gas delivery system (incompatible hose connections, unsecured/loose hose connections, deteriorated hoses, etc.)

Protrusions

- Inspectors look for leaks at protrusions from the landfill at the wellhead and in other areas on the landfill (e.g., leachate manhole covers, etc.)

Gas Collection and Control Systems

- Observation of the gas collection system and the gas moving equipment
- Observation of well head temperatures
- Observation of flares
- Observation of any engines producing power at the facility, and/or heaters/boilers used as control/energy-recover devices

Observation of Landfill Surface

- Is surface mowed? Is it well kept? Are there tall bushes or trees growing on it?
- Are there signs of erosion?
- If there's water accumulated on the surface?
- Alternative daily cover can allow water infiltration and air leaks.
- Monitoring downwind from the active surface and at the base of the active portion of the landfill helps inspectors to identify leaks.
- Inspectors look for things like worn out well heads, flexible hoses that look like they are cracked, unplugged portions on the well head or the hose, or uncoupled hose connections.

Observation of Landfill Surface (continued)

- During snow events, melted patches of snow may be indications of potential leaks.
- During rain events, or for areas where water may be accumulated on the landfill surface, bubbles exiting the surface of the water are indicators of leaks.
- Distressed vegetation

Observation of Landfill Surface (continued)

An inspector is typically equipped with a handheld monitoring device - inspector may use handheld device to assist in identifying areas with potential leaks. Inspector will follow up with monitoring by a RM21 instrument to accurately assess the presence of a leak.

If a leak is identified, the record is:

- A photo of the leaking area/equipment
- Documentation of wellhead ID
- Documentation of the concentration
- Lat/Long coordinates
- Correlation of leak location to point in aerial photo/plat plan

Records of solid waste

Inspections include:

- Review of reports of annual solid waste acceptance rates provided by state agencies (e.g., types of waste by ton by year) to prove the landfill is within design capacity.
- Comparison of information facility included in the design capacity report to the waste reports, usually for smaller landfills that are under the GCCS applicability threshold.
- Review of records to determine if the facility has incorrectly subtracted waste (e.g. not including construction, demolition, and industrial waste).

Probe Sampling

- Facilities tend to locate their probe sampling on the very edges of the landfill where there's a smaller amount of waste mass, or they'll tend to bias the probe samples in the older waste mass of the landfill. The facility is required to identify all waste over 2 years old, even if it's in an active portion of the landfill, and the probe distribution should be evenly distributed.
- Newer portions of the landfill tend to have much higher concentrations. When a facility does probe sampling, make sure that they are spreading out all the probe samples evenly over the surface of the landfill without avoiding the new higher concentration areas of the landfill.

Higher Well Temperatures

- Pay attention to waste types and their distribution - high levels of industrial waste or construction and demolition waste projected to a singulare area may increase temperatures.
- Leachate recirculation rates and lots of rain travel through the landfill can accelerate the rate of decomposition or oxidation reactions. A landfill may need to turn down gas collection at certain wells or temporarily cap a well to cease water infiltration.