Procedures for Field Monitoring Landfill Gas Monitoring Wells

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Introduction

This document was developed to help guide CalRecycle's field staff and the Local Enforcement Agencies (LEA), collectively referred to as inspectors, when performing field monitoring of the landfill gas (LFG) monitoring wells to evaluate compliance with California Code of Regulations (CCR) Title 27 (27 CCR). The standardization and simplification of the field LFG monitoring procedures are intended to create an acceptable level of confidence in a site's compliance with 27 CCR section 20921(a)(2).

Applicability

The requirements of 27 CCR section 20921 apply to:

(1) active solid waste disposal sites;

(2) solid waste disposal sites that did not commence complete closure prior to August 18, 1989, which were fully implemented by November 18, 1990, in accordance with all applicable requirements; and

(3) new post-closure activities at any solid waste disposal site that may jeopardize the integrity of a previously closed site or pose a threat to public health and safety or the environment.

In addition, for all other solid waste disposal sites, such as closed legacy, illegal or abandoned (CIA) disposal sites, 27 CCR section 20919 requires operators and/or owners (collectively referred to as Responsible Party(ies) or "RP") to conduct monitoring and implement control measures to limit LFG migration if either the LEA, CalRecycle, a local fire authority, or a local building authority notifies the RP that there is cause to believe that a hazard or nuisance may be created by LFG.

Regulatory Threshold Requirement

27 CCR section 20921(a)(2) requires the RP to ensure that the concentration of methane gas in the LFG generated from their site does not exceed **5% by volume** at the facility permitted boundary or alternative boundary approved in accordance with 27 CCR section 20925.

Note: For CIA sites, the site boundary is defined by the assessor parcel number(s) that contains waste in place.

The inspector may conduct LFG monitoring during facility inspections to determine if LFG may be migrating away from the boundary by checking the perimeter monitoring wells that were designated to be compliance points as part of the perimeter monitoring network. In addition, 27 CCR section 20925(b), (c), and (d) set forth the design and construction requirements for the location, spacing, depth, and monitoring well construction for the perimeter monitoring network.

LFG Monitoring Well Typical Construction

An example of an LFG monitoring well with three nested probes is shown in Diagram 1. Various drilling methods are used depending on the subsurface conditions, which are similarly used to install groundwater monitoring wells. Those methods include Hollow Stem Auger, Solid Stem Auger, Sonic, Rotary, and Direct Push[1]. Major design components that are further referenced in this document include probe casing depth and diameter, sampling port (e.g., labcock valve), and probe ID tag.

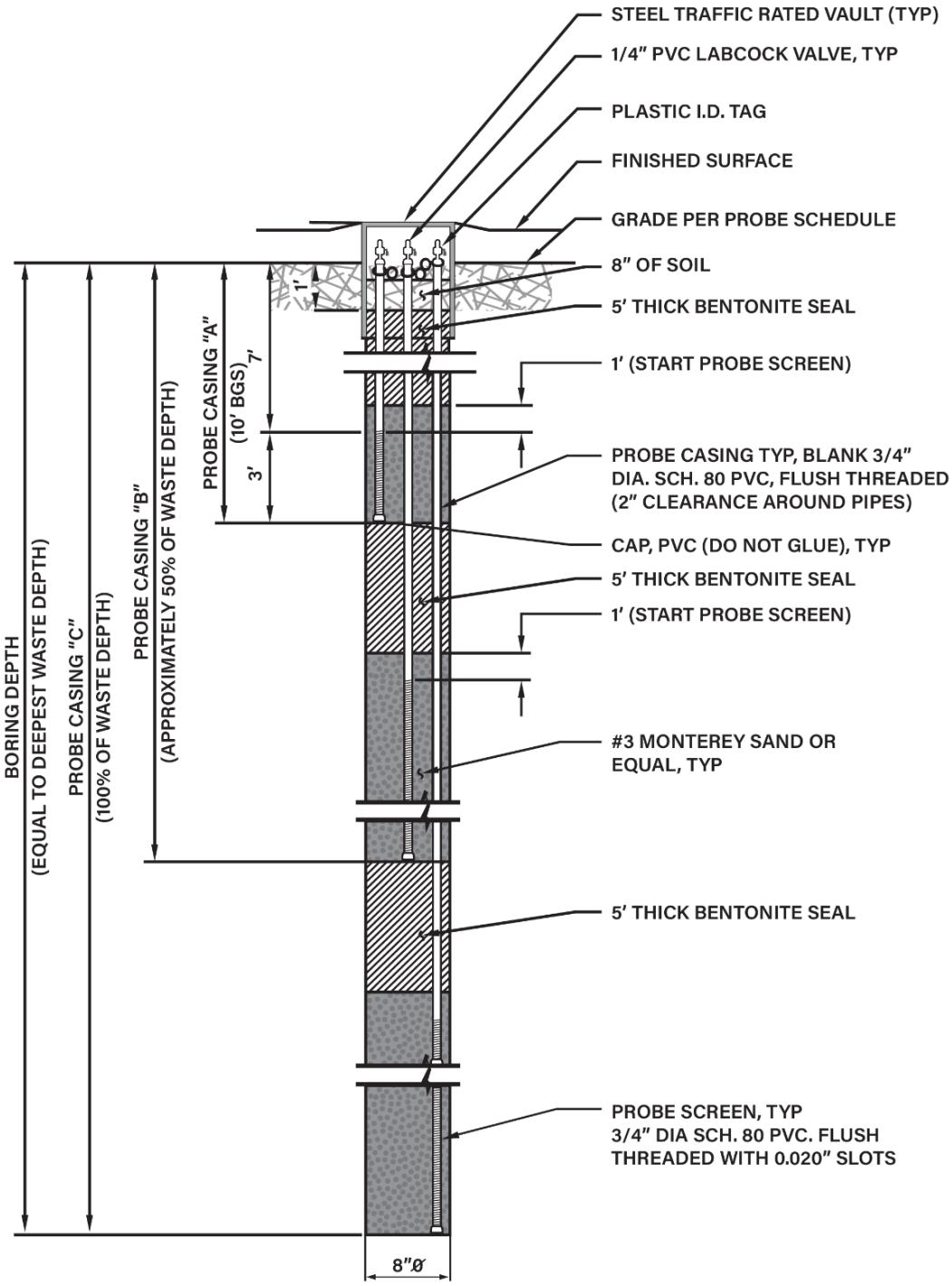


Diagram 1. Typical LFG Monitoring Well with Probe Construction Detail

[1] Design and Installation of Monitoring Wells, SESDGUID-101-R2, USEPA Science and Ecosystem Support Division, January 16, 2018

Pre-Monitoring Preparation

Document Review

The inspector should review any approved final LFG monitoring network construction reports with as-builts and monitoring plans to understand the following:

- Specific locations and identification of all compliance monitoring wells.
- Monitoring well construction details including depth of probe casings, probe casing diameters (inside and outside diameters), sample port construction, and cover or cap (i.e., vault) type.
    - Both probe casing total depth and inside diameter will be needed to calculate the amount of landfill gas that will need to be removed (also referred to as purging) from the monitoring well prior to taking a reading. Additional information on purging is provided in the Field Monitoring Procedures section. CalRecycle has developed a field monitoring log (Field Log) for inspectors to use that automatically calculates the volume and length of time needed to purge each probe depending on the field instrument used. A copy is provided in **Attachment A** (an electronic Microsoft Excel format downloadable file).
    - The type of sample port should inform the sizes and types of various tubing the inspector should bring to connect the field instrument to the sample port.
    - The types of caps or covers used to protect the probes should inform the types of tools (i.e. wrenches, pliers, screwdrivers, socket wrenches, etc.) the inspector should bring to access the probes.
    - How the caps or covers are secured. Sometimes these are secured with a lock with a number code or key. The inspector should obtain the number code or key from the RP.
- In areas near bays/oceans where groundwater elevations may be tidal influenced, check the local Tide Chart and compare the sea levels to the probe casing mean sea level depths. If the tide is higher than the probe screen depths, it is highly likely that the probe will be inundated with water. **Consider monitoring when tides are below the probe screen depths to increase chances for obtaining a reading while protecting the field instrument from water damage.** The same applies to facilities near rivers where local groundwater elevations may be influenced by the surface water elevations of the nearby bodies of water.
- If there is no existing and/or functional LFG monitoring network, the inspector may consider using other techniques such as bar hole punching. Bar hole punching is a method where a slender steel rod (approximately one inch diameter or less) is inserted into the soil to a depth of at least 3 feet by manual or mechanical means to check for the presence of landfill gas. The rods are temporary and removed once the measurement is taken. Consult with the Engineering Support Staff by emailing engineeringsupport@calrecycle.ca.gov to learn more about this option.

Equipment Preparation

The RKI Eagle series and LANDTEC GEM series are the field instruments typically used by CalRecycle and LEAs for conducting LFG monitoring. The RKI Eagle may be equipped to measure gases in addition to methane such as carbon monoxide and hydrogen sulfide and can provide results in parts per million (PPM),

percent by volume in air, or percent of the lower explosive limit (LEL). It is typically used to monitor ambient conditions for health and safety purposes but can be used to monitor LFG monitoring wells. The LANDTEC GEM measures methane from 0 to 100 percent by volume, and can also measure carbon dioxide, oxygen, static pressure, differential pressure, and calculates balance gas, and flow [measured in standard cubic feet per minute (SCFM)]. It is designed specifically for use on landfills to monitor LFG extraction systems, flares, and migration control systems but can also be used to monitor LFG monitoring wells.

If the equipment reads in PPM or percent of the LEL, conversion of those values to percent by volume in air is provided in **Attachment B**.

Before using the equipment, verify that the instrument has been calibrated in accordance with the manufacturer's recommendations. The instrument shall also be calibrated prior to operation on each day of use (i.e., bump testing). Document and keep these field calibration logs to support the monitoring results collected that day.

Other field equipment the inspector may need includes various types and sizes of tubing or hoses to connect to the sample port, tools required to access the probes, magnehelic pressure monitoring device, and auxiliary air pump (if purge times are long). Note that if an auxiliary air pump is used with flow rates exceeding 1 to 5 liters per minute, it is recommended to also bring an inline Y-fitting with shut-off valve (Y-valve) that can alternate between the instrument and auxiliary air pump to avoid air intrusion.

The inspector should also be aware of the field conditions and bring the proper personal protective equipment (PPE) for safety such as a hard hat, safety vest, safety boots, and 4-multi gas detector, if appropriate.

In addition to the field instruments and tools, the inspector should also bring with them the following:

- Site map showing Monitoring Well Locations and Probe Identification.
- Field Log, preferably pre-populated with Probe Identification and purge times filled in and calculated.
- Access key or number code to open the locks on any wells.
- Note pad for other inspection observations.

Field Monitoring Procedures

The following procedures may be used to conduct LFG monitoring. It is recommended that monitoring be conducted one probe at a time.

1. Check each probe's condition and structural integrity and suitability for monitoring. Look for the following:
    a. Is the monitoring well accessible? How is the condition of the cover?
    b. Check for odors. If an odor is present, use the field instrument to monitor around the exterior of the probes and document any readings prior to connecting to the sample port. Then connect to sample probe to monitor if conditions are safe.

c. Is the valve closed and in good condition?

d. Are the probes properly labelled with probe identifier (i.e., ID tag) and depth?

e. Is there water covering the sample port? If so, you may need to remove water to access the sampling port.

f. Are the probes filled in with sediment? This is an indication that the wells have not been properly maintained.

g. Check the monitoring well for bugs such as spiders and bees. Remove bugs as appropriate and safely. If there are dangerous spiders or bee hives, suggest it be noted for the RP to clear before it can be safely monitored.

2. Start the field instrument per manufacturer's specifications to warm-up. After warm-up is complete, pause the field instrument's pump.

3. Connect the appropriate tubing from the field instrument to the probe's sampling port, making sure the fit is secure to ensure no air intrusion. Start with the shallowest probe first, then continue to the mid-level probe, and finally to the deepest probe. This procedure will help to minimize any cross contamination or pulling the LFG from deeper probes toward the shallower probes.

4. Open the probe valve.

5. If using the LANDTEC GEM, check the probe for negative pressure generated by nearby vacuum sources (i.e., LFG or soil vapor extraction system that is near the monitoring well). A magnehelic (or similar pressure monitoring device) could also be used if the field instrument is incapable of measuring pressure such as the RKI Eagle or if there are no vacuum sources that could potentially influence the monitoring well. Document the pressure reading on the Field Log sheet. Turn on the instrument's pump. Document the start time in the Field Log sheet.

6. The pump should continue operating until the amount of time listed on the Field Log sheet is complete. This time represents the removal or purge of one probe casing volume. One probe casing volume is calculated by multiplying the probe casing inner radius squared by total length of the probe (unscreened and screened lengths) by 3.14. Record the highest methane reading observed during this purge on the Field Log sheet under "Initial CH4" column. This represents any stagnant gas that may have accumulated in the probe and may be used as additional information if there are nearby sensitive receptors such as residential houses or underground utility vaults that may act as a conduit for LFG to migrate into buildings. The inspector should note in the Field Log any nearby structures during monitoring.

    a. **Important Note**: Probes should be monitored carefully for the presence of water since water vapor can damage the instrument. Water traps should always be used and placed on the suction side of the instrument inlet tubing a minimum of 1-2 feet distant from the device to evaluate whether moisture is getting past the water trap so that the instrument pump can be shut off to not allow water to enter the instrument.

7. After the one probe casing volume has been removed, continue operating the pump until a steady reading is achieved (meaning that the reading does not change for 10 to 30 seconds). Once a steady gas reading is achieved, record the readings on the Field Log under the appropriate columns, stop the pump, and record the end time.
8. Close the probe valve and disconnect the tubing.
9. Turn on the field instrument's pump until all readings have cleared out and readings represent atmospheric conditions.
10. If using an auxiliary air pump for deeper probes, record the make, model, and flow rate in the Field Log. The flow rate can be entered into the Field Log to calculate the purge time needed using that specific auxiliary air pump. We suggest the maximum flow rate used be less than 3 liters per minute or 0.1 cubic feet per minute to avoid excessive air removal which may shock the system, draw in fines through the slotted sections, artificially induce a vacuum from surrounding subsurface, avoid possibility of ambient air entering the subsurface, and depending on probe casing material, may collapse or damage the casing. Then do the following:
    a. Connect the probe to the auxiliary air pump and field instrument using a Y-valve where the probe is connected to the base of the Y, the field instrument to one arm, and the auxiliary air pump to the other arm so that the shut-off valve can move between the field instrument and auxiliary air pump.
    b. Open the probe and turn the valve to the field instrument to obtain an initial pressure reading. Record this in the Field Observations column in the Field Log.
    c. Turn on the field instrument to obtain an initial reading for no longer than 30 seconds to measure any stagnant air. Record this value in the Initial CH4 column of the Field Log.
    d. Turn off the field instrument, move the valve to the air auxiliary pump, turn on the pump and record start time.
    e. Once purge time is complete, stop the auxiliary pump, turn the valve to the field instrument, wait approximately the same amount of time used to purge to allow the probe to equilibrate, and turn on the field instrument. Continue operating the field instrument until a steady reading is achieved (meaning that the reading does not change for 10 to 30 seconds). Once a steady gas reading is achieved, record the readings on the Field Log, stop the field instrument, and record the end time.
    f. Close the probe valve and disconnect the tubing. Turn the field instrument on until all readings have cleared out and reading represents atmospheric conditions.

Evaluating the Results

If any detected methane concentration in the probes is over 5% by volume in air, it is an indication of an exceedance and further investigation is warranted. Note that if there is a deviation to these procedures such as the instrument was not calibrated in accordance with the manufacturer's specifications or the daily bump test was not performed, the data may be used to note a potential "Area of Concern" on the inspection report

and the RP should be required to test and report the results to the LEA. If the inspector used these procedures, then the reading may be considered a "Violation." If it is a "Violation," the inspector should inform the RP to follow-up in accordance with 27 CCR section 20937 – Reporting and Control of Excessive Gas Concentrations. The inspector should check their Enforcement Program Plan for additional procedures as well.

The LFG monitoring performed by the inspector should be included in the inspection report. Documents should include, at a minimum, the Field Log, calibration documentation, and field observations.

Version Information

Date	Author
October 31, 2025	Stephanie Young, PE Closed, Illegal and Abandoned Sites Section
September 28, 2026	Stephanie Young, PE Closed, Illegal and Abandoned Sites Section

ATTACHMENT A

DOWNLOAD EXAMPLE FIELD MONITORING LOG

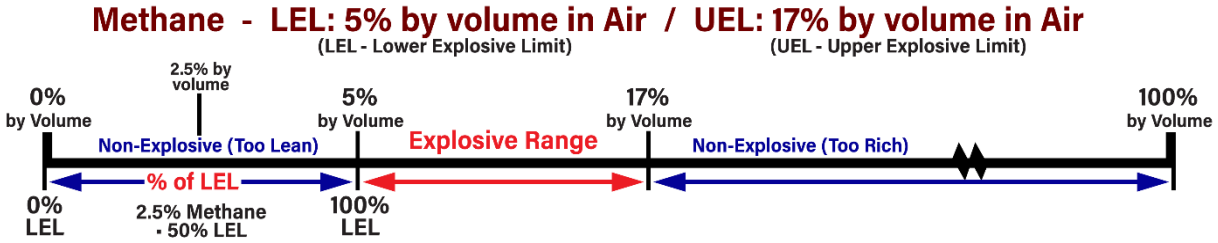
ATTACHMENT B

UNIT CONVERSIONS FOR METHANE

METHANE CONVERSIONS
Lower Explosive Limit (LEL) to Volume in Air to Parts per Million (PPM)

(LEL)	Percent by Volume in Air	PPM
100% LEL	5.00%	50,000
75% LEL	3.75%	37,500
50% LEL	2.50%	25,000
25% LEL	1.25%	12,500
20% LEL	1.00%	10,000
10% LEL	0.50%	5,000

VISUAL REPRESENTATION OF METHANE SCALES



visual example to show where on the scale % of LEL is measured