Landfill Gas Monitoring and Contingency Plan

Go East Landfill/Alpine Estates Development

Prepared for
Century Communities®

Prepared by
Herrera Environmental Consultants, Inc.

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Landfill Gas Monitoring and Contingency Plan

Go East Landfill/Alpine Estates Development
Everett, Washington

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Note:
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1. INTRODUCTION

This Landfill Gas Monitoring and Contingency Plan (LFGMCP or "Plan") was prepared by Herrera Environmental Consultants, Inc. (Herrera) to provide updated monitoring and contingency requirements for the Go East Landfill Closure/Alpine Estates (formerly known as Bakerview) Development Project since the previous LFGMCP was prepared by Vikek Environmental Engineers, LLC (Vikek) in March 2022. This Plan, along with the anticipated Model Toxics Control Act (MTCA) Cleanup Action Plan, satisfy the requirements for post-closure plans as stated in WAC 173-350-400(11)(d). This Plan is the post-closure plan that addresses landfill gas (LFG). The previous LFGMCP specified that "this Plan will be updated accordingly" when requirements that weren't defined in the previous LFGMCP become defined and known. Specifically, this updated LFGMCP adds the details for the gas vapor barrier and gas ventilation of the Alpine Estates homes that were not defined in detail and included in the LGMCP previously. Additionally, monitoring of future homes built within 1,000 feet of the landfill (Alpine Estates homes) is specified and incorporated into the contingency plan when the methane threshold is detected at the landfill perimeter soil gas probes (perimeter probes). The LFGMCP describes the landfill gas ("LFG," "Methane Gas," or "Gas") monitoring and contingency plan and the necessary procedures to satisfy applicable permit and regulatory requirements described in Section 1.1 of this Plan. The current landfill permit (see Section III.G) requires that the permittee abide by the Landfill Gas Monitoring and Contingency Plan (Vikek 2022). The LGMCP (Vikek 2022) superseded the Landfill Closure Plan requirements (see Section 1.1 of LFGMCP (Vikek 2022)). This Plan is intended to supersede the LFGMCP (Vikek 2022).

The project site is located at 4330 108th Street Southeast, Everett, Washington, and was operated as an excavation and sand reclamation site from 1969 through 1971. Between 1972 and 1977 the landfill operator (Rekoway) accepted wood waste debris that included partially burned trees and stumps, and concrete solid material that were compacted and placed in sealed cells before the site was closed initially in 1978. After reopening in 1979 with Go East Corporation (Go East) as the Owner/Operator, the site accepted wood waste placed in enclosed cells from 1979 to 1983, after which the landfill ceased all operations. In 2009 the property was purchased by P&GE, LLC (P&GE). P&GE completed landfill closure in July 2022 in accordance with the Go East Landfill Closure Plan that was approved by Snohomish County Health Department (SCHD) under their Solid Waste Facility Permit #SW-027. The Washington State Department of Ecology (Ecology) provided a letter of consent for landfill closure to SCHD on July 25, 2022. This letter references the Construction Quality Assurance Report, including Appendix B (Approved Plans and Specifications, revised and approved June 23, 2021) and Appendix J (Landfill Gas Monitoring and Contingency Plan, Vikek 2022). This Plan updates and supersedes the LFGMCP (Vikek 2022) included as Appendix J of the approved CQA Report.

Closure involved reducing the landfill size from about 10 acres to about 6 acres by excavating the edges of the landfill and relocating the landfill material found there to the landfill area to remain. The excavated portion was designated as the "Wedge" area where the excavation would be refilled with onsite and imported material. The remaining landfill area was closed in accordance with current standards and codes in compliance with the various permits and approvals. Specific capping materials and

environmental controls installed as part of the closure are discussed throughout this LFGMCP. P&GE also put together the plans and permits associated with placing a housing community on the parcel around the closed landfill. In May 2022, another developer, Century Communities® purchased the redevelopment Project from P&GE and began installation of the utilities for the planned housing community.

Snohomish County Planning and Development Services approved the final plat for the Alpine Estates, A Plat Community[1], on October 24, 2023. The plat map identifies 96-tracts for residual development, including tracts adjacent to the landfill (see Figure 1). Tracts 988 through 992 and 995 through 999 were granted and conveyed to the Alpine Estates Owners Association. The landfill exists on Tracts 989, 992, 997, and 999. Tract 994 was granted and conveyed to Silver Lake Water and Sewer District. Century Community currently governs Alpine Estates Owners Association.

Century Communities® hired Herrera in September of 2022 to manage the environmental controls associated with development around the closed landfill. Herrera has utilized the best available site data, practices, experience, and judgment to develop this plan. However, the plan may require modifications over time to accommodate changing landfill conditions, changing receptors in areas adjacent to and around the landfill, or other conditions that cannot be fully anticipated. Uncontrolled migration of LFG (particularly methane [CH_4]) can result in, loss of life, injury, loss of property, vegetative damage, and intolerable odors. Landfill monitoring includes exposure to explosive gases. Monitoring personnel should be specifically trained in the management and response for situations such as fire or explosion and confined space entry and possess an awareness of changing conditions around the landfill.

1.1. Purpose, Applicability, and Regulatory Requirements

LFG post-closure monitoring for the landfill is governed by Washington Administrative Code (WAC) Chapter 173-350-400(11)(a)(ii) and (iv), and 173-350-400(11)(b)(ii).

The implementation of this LFGMCP will begin after the approval of landfill closure and monitoring activities by SCHD, conducted in accordance with the approved Go East Landfill Closure Plan and WAC 173-350-400(8), unless superseded by Ecology's implementation of Chapter 173-340 WAC (MTCA). The SCHD approved the Landfill Closure Plan (last updated in June 2021), which includes the post-closure Operation and Maintenance Plan in Section 10, Appendix F, and Appendix H of that Plan. The previous LFGMCP (Vikek 2022) superseded the LFG monitoring requirements in the Landfill Closure Plan. This LFGMCP supersedes all previously approved post-closure landfill gas monitoring plan(s) for this site.

[1] Alpine Estates, A Plat Community, NW1/4 of the SE1/4, TWP 28 N, RGE 5 E, W.M., Snohomish County, Washington (File No. PFN 10-101204 PSD), Stamped by professional land surveyor on September 20, 2023.

The Landfill Owner is required to retain a qualified professional (LFG Engineer) to oversee the completion of the following monitoring actions:

- **Continuous Monitoring of Gas Levels at Landfill Gas Sumps.** Continuous LFG monitoring will be completed for 3 months of the dry season and for 3 months of the wet season following closure. This monitoring could be extended at SCHD's discretion, if methane is encountered at higher levels than anticipated after landfill closure. This monitoring will occur at four sump locations along the LFG perimeter collection trench (LFG Sumps). These locations are called out on Figure 1 as Landfill Gas Sumps and are connected to the three vertical venting pipes located in the interior of the landfill (called out as Landfill Gas Vents in Figure 1). The LFG sumps and their continuous monitoring equipment cannot be removed until perimeter probe monitoring is completed as directed by Ecology (see next bullet).
- **Perimeter Soil Gas Probe Monitoring.** Methane gas measurements at the perimeter probes will be completed on a quarterly basis for 2 years. This monitoring could be extended and/or frequency can be increased at SCHD's discretion if methane is encountered at higher levels than anticipated after landfill closure. Perimeter probe locations are called out on Figure 1 as Landfill Perimeter Soil Gas Probes.
- **Home Protection.** The homebuilder (Century Communities®) will be required to provide gas migration control systems. This includes a vapor barrier beneath the homes, a passive venting system beneath the barrier, and gas detection devices within the home. The LFG Engineer is responsible for maintenance and upkeep of the detection devices in Alpine Estates homes located within 1,000 feet of the landfill.

The goal of LFG control system LFGMCP is to confirm that the landfill gas remedy is performing in a manner that protects human safety and the environment. Specifically, this requires meeting the following LFG criteria defined in WAC 173-350-400(4)(b) and (4)(f)(i)(I):

- **Onsite Structures.** Methane concentrations inside buildings and structures within the landfill boundary (excluding gas control or recovery system components) must not exceed 1.25 percent by volume, or 25 percent of the lower explosive limit (LEL). There are no onsite buildings or applicable structures within the Go East Landfill boundary.
- **Perimeter Soil Gas Probes.** Methane concentrations in soil at the landfill boundary must not exceed 5 percent by volume, the LEL for methane.
- **Offsite Structures.** The Pollution Control Hearing Board or PCHB report (2019) stated that, "any future homes built within 1,000 feet of the landfill will be required to have gas vapor barriers and gas ventilation". Methane concentrations inside Alpine Estates homes and the electrical building of the lift station, together referred to as offsite structures, or structures, must not exceed 100 parts per million by volume (ppmV).

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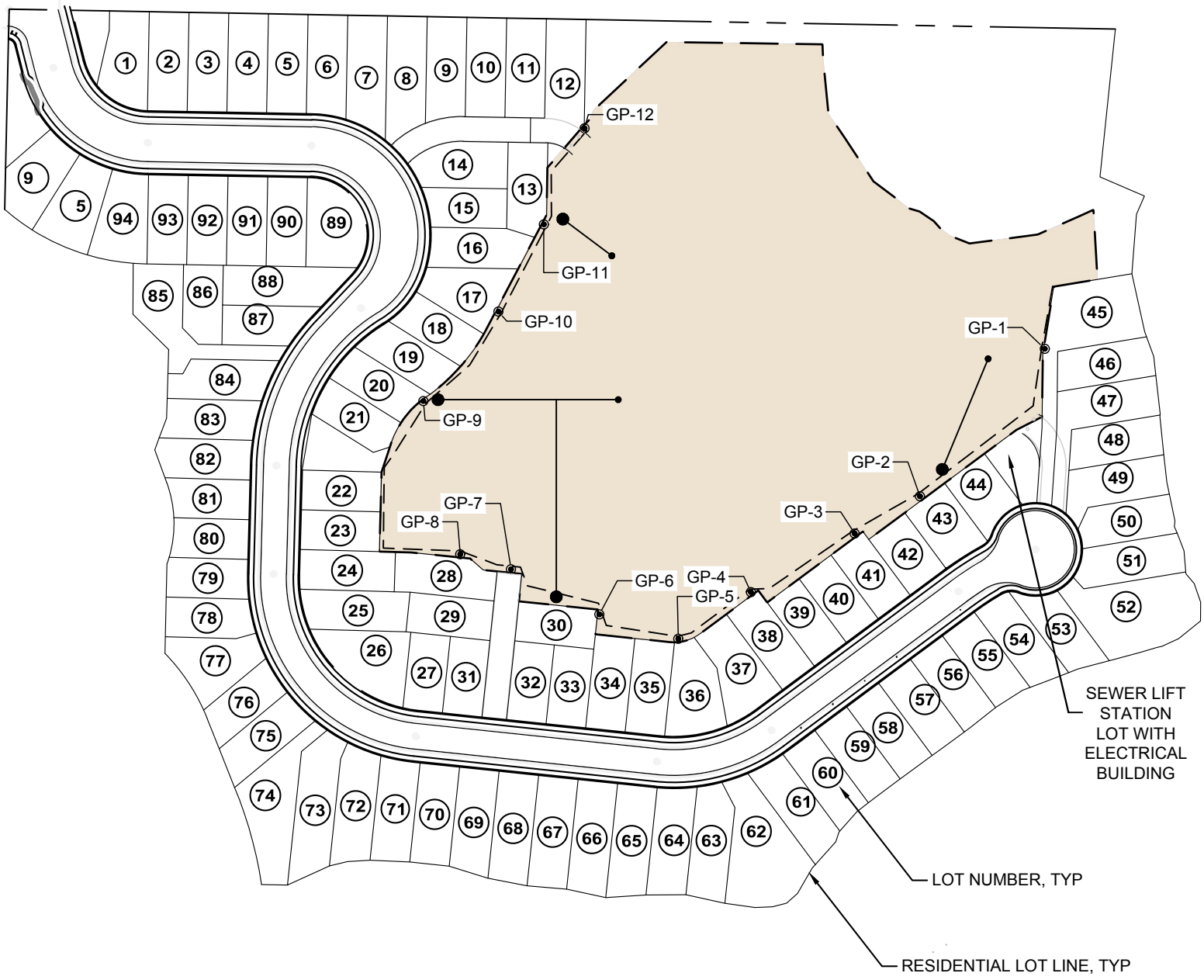
Figure 1
Landfill Gas Monitoring Locations.



LEGEND

◉ GP-#	LANDFILL PERIMETER SOIL GAS PROBE	— — — —	GRAVEL TRENCH WITH 2 IN PERF PIPE
●	LANDFILL GAS SUMP	———	GRAVEL TRENCH WITH 2 IN PIPE
•	LANDFILL GAS VENT	▭	CAPPED AND CLOSED LANDFILL AREA

1.2. Landfill Gas Control System

The LFG control system is described in the Landfill's Construction Quality Assurance Report (PACE Engineers 2022) and consists of landfill-specific solutions designed to operate separately but be compatible in how they control LFG site-wide.

The closed landfill itself, and each individual enclosed Alpine Estates home and the sewer lift station electrical building (electrical building), has a LFG control system designed to collect any LFG and convey it to a vent pipe that will release the gas a safe distance away from any receptor. The LFG control system is the most important in capturing LFG produced from the landfill and ensuring it does not migrate beyond the landfill boundary. The individual LFG control system for each Alpine Estates home and electrical building is designed as a protection insurance in case any LFG does migrate from the closed landfill.

1.2.1. Closed Landfill

The closed landfill has an engineered final cover constructed of the following layers (from the top); a minimum 12 inches of topsoil, 12 inches of onsite sand, geocomposite (200-mil [0.2 inches] GSE® Fabrinet, double-sided composite with 6-ounce nonwoven geotextile), geomembrane (40-mil GSE® UltraFlex, linear low-density polyethylene (LLDPE) double-sided textured), and a 6-inch bottom layer of onsite sand. As the gas rises, it will encounter the impenetrable surface and travel horizontally to the gravel-filled methane vent trench system located at the perimeter of the closed landfill. The trench was excavated to native soil with variable dimensions to match site conditions and filled with gravel. The trench also contains a 2-inch-diameter perforated collection pipe that conveys the gas to one of four sump-like structures for continuous gas monitoring. The gas is then conveyed from these sumps to one of three discharge pipes located over 100 feet from any buildable lot, and connected to vent pipes that discharge the gas 10 feet above grade. Twelve gas perimeter monitoring probes were installed outside the closed landfill boundary and extend into native soils (Vikek 2022).

1.2.2. Electrical Building at Sewer Lift Station

The electrical building was constructed with a gas mitigation system that includes a gas vapor impervious membrane and underlying passive ventilation system as required by the PCHB report (2019). The electrical building is uninhabited and only accessed occasionally for utility or maintenance purposes. The gas mitigation system design for the electrical building is included in Appendix A and is consistent with the Landfill Closure Plan.

20-mil PVC liner was installed as the gas vapor impervious membrane beneath the entire structural footprint of the building. Utility connections through the foundation were sealed and booted to the membrane. A 2-inch layer of sand was placed on top of vapor barrier for protection.

Beneath the impervious liner barrier is a gas ventilation system that consists of perforated horizontal pipes, gravel blankets, and a vent riser for the purpose of collecting any potential methane from the soil underneath the building and conveying it to a release point above the building.

1.2.3. Alpine Estates Homes

Each enclosed Alpine Estates home will be constructed with a gas mitigation system that includes a gas vapor impervious membrane and underlying passive ventilation system as required by the PCHB report (2019). The gas mitigation system design for the Alpine Estates homes are included in Appendix A and are consistent with the Methane Mitigation Standards established by the City of Los Angeles Department of Building and Safety (LADBS).

Per the LADBS, Alpine Estates homes will comply with the Methane Mitigation requirements for single family dwellings and will include the following:

- De-watering system
- Impervious membrane
- Perforated horizontal pipes
- Gravel blanket under impervious membrane
- Gravel surrounding perforated horizontal pipes
- Vent risers

Viaflex's Absolute Barrier[2], or approved equivalent, will be used as the gas vapor impervious membrane beneath the entire structural footprint of each home. The Absolute Barrier, available in 30-mil or 40-mil thickness, is a seven-layer, co-extruded geomembrane made of very flexible, linear low-density polyethylene (LLDPE) and a core barrier layer that provides superior resistance to gas transmission. Utility connections through the foundation will be sealed and booted to the membrane. Barriers used for methane mitigation shall be tested in accordance with the manufacturer's recommendations. Barriers shall be tested by one or a combination of one of the following methods:

- Smoke testing: High volume-low pressure pump using liquid smoke
- Spark testing: High or low voltage
- Air channel testing (ASTM 5820)
- Vacuum box testing of seams and sheet material anomalies (ASTM D-5641)

Beneath the impervious liner barrier is a house gas ventilation system that consists of perforated horizontal pipes, gravel blankets, and vent risers for the purpose of collecting any potential methane from the soil underneath the home and conveying it to a release point above the home. LFG vents will have placard signage along the length of pipe to inform that there should be no smoking or electrical equipment within 10 feet of pipe. Connected to the underlying ventilation system is a house ventilation trench monitoring station where methane levels below the home can be evaluated. The house ventilation trench monitoring station is located on the ground just beyond the footprint of the home on the property and connects to the perforated collection pipes.

[2] https://www.viaflex.com/products/absolute-barrier-y-series/

1.3. Coordination and Responsibilities

Specific area-wide LFG monitoring roles required for compliance with this LFGMCP are as follows:

1.3.1. Landfill Owner

The Landfill Owner has overall responsibility and shall retain a qualified professional (LFG Engineer) to oversee the completion of the appropriate gas monitoring actions. All correspondence and questions concerning post closure LFG monitoring at the Go East Landfill/Alpine Estates Development should be directed to the Landfill Owner listed below.

Century Communities c/o Alpine Estates Owners Association
20000 North Creek Parkway, Suite 201
Bothell, Washington 98011
Telephone: 425-775-8661

1.3.2. Landfill Gas Engineer

The LFG Engineer is hired by the Landfill Owner and is responsible for executing the LFG monitoring plan described in Section 2 of this LGMCP. Through monitoring, the LFG Engineer is responsible for verifying that people and the environment are protected by the LFG collection and ventilation system of the closed landfill and development homes. Duties of the LFG Engineer include:

- Monitoring the perimeter probes.
- Monitoring and upkeep of the continuous monitoring devices in the LFG Sumps.
- Contingency monitoring at Alpine Estates homes and the electrical building when there is a perimeter probe methane exceedance.
    - Monitoring at the house ventilation trench monitoring stations of the Alpine Estates homes.
    - Indoor air monitoring of the Alpine Estates homes and electrical building.
- Performing regular maintenance and calibration of the in-home continuous methane detectors.
- Preparing Annual Report for submittal to and review by the Landfill Owner.
- Reviewing and investigating LFG system and addressing issues to keep landfill in compliance in coordination with the Landfill Owner and SCHD.

The LFG Engineer will coordinate with the Landfill Owner and SCHD for other specific LFG control and monitoring duties not specified in this LGMCP.

1.3.3. Home Builders

Pursuant to permit and regulatory requirements in Section 1.1, Century Communities®, as the homebuilders of the site, are responsible for the requisite design and construction of home gas mitigation and monitoring systems for future homes built within 1,000 feet of the landfill. This gas mitigation system is described in Section 1.2.3 and detailed in Appendix A.

1.3.4. Homeowners

Each home built as part of the development has three continuous methane detectors installed within the home, one in the garage and two in separate rooms located on the first floor. The locations and details of these monitors are included in Appendix A and Section 2.4.1. The homeowners are responsible for notifying the LFG Engineer when an alarm goes off indicating a methane detection within the home (see Section 2.4.1).

2. LANDFILL GAS MONITORING PLAN

Monitoring LFG collection systems serves two purposes: (1) performance monitoring within the system to guide its operation and (2) post-construction compliance monitoring to confirm that the system is mitigating LFG emissions as intended by the Landfill Closure Plan. The primary goal of monitoring is to keep methane levels below regulatory limits. Non-methane volatile organic compounds (VOCs) have not been detected in the landfill as described in the Interim Action Work Plan (GeoEngineers 2020) and the Interim Action Completion Report (GeoEngineers 2021).

The two relevant LFG monitoring regulations are that perimeter probes must remain below 5 percent (50,000 ppmV), and that the indoor air of Alpine Estates homes must remain below 0.01 percent (100 ppmV). Methane concentrations in soil at the landfill boundary must not exceed 5 percent (50,000 ppmV), the LEL for methane. The LEL represents the lowest concentration (by percentage) of a gas or vapor in air that is capable of producing a flash of fire in presence of an ignition source.

Beyond regulatory requirements, monitoring will occur at the LFG sumps connected to the landfill collection trench to evaluate the composition of LFG originating from the landfill. Monitoring will also occur at the house ventilation trench monitoring stations connected to the vent systems installed beneath each home to evaluate the extent of potential LFG migration beyond the landfill containment system and towards the Alpine Estates homes.

This section discusses the four components of gas monitoring at the Go East Landfill and Alpine Estates Development and is organized from source (landfill) to potential receptor (offsite structures) including:

- Section 2.1, Landfill Gas Sump Monitoring: Continuous monitoring within landfill containment system.
- Section 2.2, Perimeter Soil Gas Probe Monitoring: Monitoring beyond the landfill containment system.
- Section 2.3, House Ventilation Trench Monitoring: Monitoring beneath Alpine Estates homes.
- Section 2.4, Indoor Air Monitoring: Monitoring first floor interior of Alpine Estates homes and electrical building.

Each monitoring component section discusses the four monitoring components, where they are located, frequency of routine monitoring, and the monitoring process and equipment used. Table 1 summarizes the landfill gas monitoring components.

Table 1. Summary of Monitoring Components.			
Monitoring Component	**Location**	**Frequency of Routine/ Initial Monitoring**	**Monitoring Process and Equipment Used**
LFG Sump	Along gas collection trench within landfill containment system.	Continuous	Automatic with RKI Instruments M2A Transmitter Units (or approved equal)
Perimeter Soil Gas Probe	Beyond landfill containment system adjacent to planned landfill property boundary.	Quarterly	Manual with GEM™ 5000 (or approved equal)
House Ventilation Trench Monitoring Station	Adjacent to each Alpine Estates home and connected to perforated collection pipe trenches positioned beneath house footprint.	Monthly for first 6 months of home being built (each home)	Manual with GEM™ 5000 (or approved equal)
Indoor Air	Interior of each Alpine Estates home and electrical building.	One-time after structure is built (each structure)	Manual with SEM™ 5000 (or approved equal)
		Continuous[a]	Automatic with Macurco™ GD-2A Model (or approved equal)

[a] Only the Alpine Estates homes are continuously monitored with installed gas detectors.

Each aspect of monitoring is to evaluate LFG conditions for operational, supplemental, or regulatory purposes. Table 2 outlines the four monitoring components; the regulatory and/or supplemental level they are evaluated at to inform how well the LFG collection and mitigation system is operating; and the contingency monitoring action that is triggered when these levels are reached (see Figure C-1 in Appendix C for flow chart of process). Only the levels of methane at the perimeter probes and the indoor air are evaluated for regulatory compliance. Supplemental monitoring trigger levels refer to results of monitoring that trigger monitoring at a different component to evaluate the extent of LFG migration. Supplemental monitoring trigger levels help to ensure methane levels across the Alpine Estates Development remain below regulatory levels.

Table 2. Summary of Monitoring Types and Levels.			
Monitoring Component	**Monitoring Type**	**Methane Level**	**Monitoring Action and Frequency**
LFG Sump	Supplemental	None	N/A
	Regulatory	None	N/A
Perimeter Soil Gas Probe	Supplemental	1 percent (10,000 ppmV)	For home lots, one-time monitoring of house ventilation trench monitoring stations after methane of greater than 1 percent is detected at perimeter probe. For electrical building, one-time monitoring of indoor air. Refer to table in Figure C-1 in Appendix C.
	Regulatory	5 percent (50,000 ppmV)	Weekly monitoring of perimeter probe for 4 weeks until control is established and then monthly monitoring until methane levels are confirmed to drop below 5 percent.
House Ventilation Trench Monitoring Station	Supplemental	0.1 percent (1,000 ppmV)	One-time monitoring of indoor air of home after methane of greater than 0.1 percent (1,000 ppmV) is detected at associated house ventilation monitoring station.
	Regulatory	None	N/A
Indoor Air	Supplemental	None	N/A
	Regulatory	0.01 percent (100 ppmV)	Daily indoor monitoring of offsite structure until methane levels are confirmed to drop below 0.01 percent (100 ppmV).

2.1. Landfill Gas Sump Monitoring

Continuous LFG monitoring will be completed using continuous monitoring equipment installed in the four LFG sumps. LFG sump monitoring represents the gas collected from the landfill within the perimeter collection trench. This collected gas is vented to the atmosphere from the three LFG vents located within the interior of the landfill (see Figure 1 for locations).

2.1.1. Routine/Initial Assessment Monitoring

LFG sump monitoring will be completed continuously for 3 months of the wet season during Winter 2024 and 3 months of the dry season during Summer 2024. The required duration of monitoring will extend longer, at SCHD's discretion, if methane is encountered at higher levels than anticipated after landfill closure. As indicated in Table 2, there is no regulatory methane level associated with the LFG sumps.

2.1.2. Supplemental Monitoring

Supplemental monitoring is not applicable for the LFG sumps. Supplemental monitoring is only applicable for monitoring components beyond the landfill extents where methane levels are regulated.

2.1.3. Continuous LFG Monitoring Equipment

M2A Transmitter units, manufactured by RKI Instruments will be used for continuous gas monitoring within the LFG sumps.

2.1.4. Continuous LFG Monitoring Equipment Calibration Procedures

Calibration will be completed as described in the M2A Transmitter Operator's Manual of March 1, 2023. Data will be viewed regularly and if abnormal measurements are observed based on operating conditions and historical data of LFG content, continuous monitoring equipment will be inspected. Equipment may require re-calibration or replacement of parts depending on condition. According to the manufacturer, frequency of calibration depends upon the type of use and the sensor type. For most applications, calibration frequencies are between 3 and 6 months but can be more often or less often based on the usage.

2.1.5. Continuous LFG Monitoring Procedures

Gas concentration data will be downloaded and system components periodically checked by the LFG Engineer. Measurement data will be checked daily in the first 2 weeks of operations; and weekly in the following weeks of operation to ensure that "drifting" is not occurring, or other anomalous condition caused by factors other than the measurement of combustible gas.

Continuous methane monitoring data recorded from each of the four M2A Transmitter units will be available and viewed via internet at https://telemetry.geotechenv.com/. The LFG Engineer and Landfill Owner have login information. Battery life, device temperature, connection level, and alarms/faults/alerts of the transmitter can also be monitored at this website. Additionally, system settings such as the sample interval and logging frequency can be adjusted.

2.2. Perimeter Soil Gas Probe Monitoring

Monitoring of the perimeter probes provides the composition of soil gas beyond the LFG containment system to evaluate whether LFG is migrating from the landfill. The locations of perimeter probes are shown on Figure 1 and are summarized in Table 3.

Table 3. Perimeter Probe Locations.

Perimeter Probe	Location[a]	Northing	Easting
GP-1	Northeast Perimeter	330692.00	1312479.49
GP-2	East Perimeter	330543.64	1312353.98
GP-3	East Perimeter	330505.98	1312288.39
GP-4	Southeast Perimeter	330447.39	1312184.50
GP-5	Southeast Perimeter	330400.16	1312110.73
GP-6	South Perimeter	330424.41	1312030.73
GP-7	Southwest Perimeter	330470.05	1311942.01
GP-8	Southwest Perimeter	330485.30	1311891.07
GP-9	West Perimeter	330639.76	1311853.74
GP-10	Northwest Perimeter	330729.69	1311928.98
GP-11	Northwest Perimeter	330817.39	1311974.87
GP-12	Northwest Perimeter	330913.46	1312013.66

[a] Adjacent Alpine Estates home lots are shown on Figure 1.

As indicated in Table 2, there is a regulatory limit for perimeter probes. Methane concentrations in soil at the landfill boundary must not exceed 5 percent, the LEL for methane. Additionally, the perimeter probes have a supplemental monitoring trigger level of 1 percent that triggers monitoring at Alpine Estates homes. This is discussed in detail in Section 2.3.

2.2.1. Routine/Initial Assessment Monitoring

Routine quarterly LFG monitoring will take place at the twelve perimeter probes positioned around the outer extents of the landfill for a minimum period of 2 years. Section 2.2.6 addresses reductions in the sampling requirements.

2.2.2. Supplemental Monitoring

If monitoring of perimeter probes indicates an exceedance of 5 percent, LFG Engineer will review and investigate the LFG system to address any issues and make adjustments as necessary to bring methane levels back below 5 percent at all perimeter probes. Monitoring of the perimeter probes will increase to weekly for 4 weeks until control is established and then will switch to monthly until methane levels are confirmed to drop below 5 percent. Control can be established by demonstrating that surface and subsurface migration of methane is not occurring (see Sections 2.3 and 2.4 for methods). SCHD and Ecology will review data to confirm monitoring is fine to return to routine quarterly monitoring.

2.2.3. Perimeter Soil Gas Probe Monitoring Times

LFG monitoring should include sampling during times when landfill gas is most likely to migrate. Scientific evidence indicates that weather and soil conditions influence the migration of landfill gas. Barometric pressure and precipitation have significant effects on landfill gas migration. As a result, landfill gas monitoring should ideally be conducted when:

- Barometric pressure is low following at least 2 hours of falling barometric pressure, with a drop of least 0.25 inch of mercury.
- Soils are saturated.
- During the winter, when the snow cover is just beginning to melt, or when the ground surface is frozen, snow- and/or ice-covered.

Requirements for sampling frequency and other scheduling factors may not allow for LFG monitoring to occur during these ideal conditions. Notes will be included in the Monitoring Form (Appendix B) about barometric pressure, weather, and soil conditions to help evaluate the perimeter probe readings against the migration potential of LFG.

2.2.4. Landfill Gas Monitoring Instrumentation

The person using the landfill gas monitoring instrument must understand the principles of LFG control system operation and follow the manufacturer's instructions. This includes calibrating the instrument according to the manufacturer's specifications. Include the following on the top portion of the LFG Monitoring Form (see Appendix B for form):

- Facility name and address
- Permit number
- Type and serial number of gas monitoring instrument
- Full calibration date of the instrument
- Date and time of last field calibration
- Date and time of landfill gas monitoring event
- Name of sample collector
- Pump rate of instrument being used
- Ambient air temperature
- Barometric pressure (and whether it is rising or falling)
- General soil conditions
- General weather conditions

2.2.4.1. Perimeter Probe Monitoring Equipment

A LANDTEC GEM™ 5000 (GEM™ 5000) infrared portable gas analyzer (or equivalent) will be used to monitor perimeter probes.

2.2.4.2. Perimeter Probe Monitoring Equipment Calibration and Purge Procedures

The calibration procedure shown in Table 4 should be performed in accordance with the manufacturer's manual, and recorded before any perimeter probe monitoring, and again after a perimeter probe monitoring session.

Table 4. Perimeter Probe Monitoring Equipment Calibration Procedure.

General Steps	
Step	**Description**
1	Check battery status. Status should be 100 percent before calibration.
2	Set up equipment for calibration per instructions in the GEM™ 5000 operation manual. Note the importance of the order of calibration gases, zero methane, span methane, span carbon dioxide, zero oxygen, then span oxygen.
3	Record date, time. location, operator, temperature, and barometric pressure.
4	Calibrate GEM™ 5000 or equivalent meter according to the instrument's instruction manual using different gas mixture canisters, for example: ● CH_4 High: 50 percent methane/35 percent carbon dioxide ● CH_4 Low: 15 percent methane/15 percent carbon dioxide ● O2 High: 20.9 percent oxygen ● O2 Low: 4 or 11 percent oxygen.
5	Connect the meter to the perimeter probe using silicone or polyethylene tubing and filter. Each perimeter probe has a labcock or pressure fitting plug with a quick connect.
6	Measure the water level in the perimeter probe using a tape measure to confirm that the static water depth from the bottom of perimeter probe is not greater than 5 feet, the length of the perimeter probe screen. If the water level is above the perimeter probe screen, then the perimeter probe cannot be monitored accurately.
7	Purge the perimeter probe of gases until methane, carbon dioxide, and oxygen percentages stabilize, defined as when readings change by less than 10 percent for three consecutive measurements over 10-second intervals.
8	Log results of each calibration step; purge meter before each subsequent calibration step.
9	Evacuate a minimum of one perimeter probe volume before recording the final instrument readings. Refer to Table 5 for purging volumes and times of each perimeter probe.

Table 5 provides a summary of final perimeter probe construction details and purging volumes. The top of monument and ground surface elevations were surveyed using the North American Vertical Datum of 1988 (NAVD 88) after final grade was set for the Alpine Estates Development and adjustments to the tops of perimeter probes and monuments were made to align. Total length, volume of pipe, and purge time also changed slightly as a result. See Landfill Gas Probe Installation (Vikek 2022) and LGMCP (Vikek 2022) for the original perimeter probe construction details according to the landfill closure ground elevation.

Table 5. Perimeter Probe Purge Times.							
Perimeter Probe	Top of Monument Elevation (feet)	Ground Surface Elevation (feet)	Stickup (AGS) (feet)	Length of Perimeter Probe Screen (0.010-slot stainless steel) (feet)	Total Length of Pipe (feet)	Volume of Pipe (cubic feet)	Sampling Time for GEM™ 5000 One Purge Volume Time at 300 cc/min Pump (minimum)
GP-1	222.23	221.73	0.50	5	16.73	0.091	8.55
GP-2	230.01	229.92	0.09	5	13.51	0.074	6.91
GP-3	230.43	229.97	0.46	5	13.43	0.073	6.87
GP-4	230.63	230.21	0.42	5	15.63	0.085	7.99
GP-5	234.93	233.67	1.26	5	14.93	0.081	7.63
GP-6	241.06	240.68	0.38	5	25.06	0.137	12.81
GP-7	242.59	241.99	0.60	5	13.79	0.075	7.05
GP-8	243.31	242.99	0.32	5	12.31	0.067	6.29
GP-9	258.72	258.30	0.42	5	11.72	0.064	5.99
GP-10	263.02	262.40	0.62	5	20.36	0.111	10.41
GP-11	263.76	263.13	0.63	5	16.86	0.092	8.62
GP-12	260.90	260.47	0.43	5	28.90	0.158	14.78

Notes:

1-inch-diameter IPS Sch 40 = 1.049

AGS = above ground surface

Top of monument and ground surface elevations shown are consistent with final Alpine Estates Development grades and are final.

Elevations are consistent with NAVD 88.

Pump Flow Rate at 300.00 cm^3/min = 0.64 ft^3/hr.

2.2.5. Perimeter Probe Monitoring Procedure

Perimeter probe monitoring will be conducted according to the general procedures summarized in Table 6 below. Results must be recorded on the Monitoring Form included in Appendix B (electronic forms are also acceptable).

Table 6. Perimeter Probe Monitoring Procedure.		
Step	**Description**	**Comments**
1	Allow meter to warm up using time logged during calibration or 1 minute, whichever is longer.	
2	Check battery status.	Record battery status for each set of readings.
3	Read barometric pressure.	Record time, date, location, perimeter probe ID, and ambient temperature. This information should be entered into GEM™ 5000.
4	Inspect perimeter probe sampling connections for damage.	Record any damage.
5	Zero pressure transducers. Read static pressure of all completions.	Record static pressure in inches water column. Zero transducers before each perimeter probe completion reading. Open valve after connecting hose and close valve before disconnecting hose.
6	Connect GEM™ 5000 to perimeter probe sample port without removing the cap, using tubing and water trap/filter.	Observe clear tubing during sampling. Discontinue sampling procedure if water is seen in tubing, (before reaching filter if possible). Note presence of water in perimeter probe and pumping duration. Use boring log to approximate depth to water surface. If possible, measure the water level in the perimeter probe to determine the water level and to confirm that static water is not above the top of the perimeter probe screen. If the water level is above the perimeter probe screen, then the perimeter probe cannot be monitored.
7	Purge the perimeter probe until methane, carbon dioxide, and oxygen percentages stabilize, defined as when readings change by less than 10 percent for three consecutive measurements over 10-second intervals (or a stabilized concentration will not vary more than 0.5 percent by volume on the instrument's scale). Open the valve and read and record initial and stabilized methane, oxygen, and carbon dioxide concentrations.	Use last column of Table 5 to determine time to evacuate one pore volume. Time to evacuate and stabilize may be less if water is present but below top of screen. Within 30 to 45 seconds after the one pore volume a stabilized result should be available. Oxygen concentration should be at 2 percent per volume or less to indicate air is not being drawn into the system and providing false readings.
8	Close the valve and disconnect the tubing.	
9	Log results using GEM™ 5000 ID on the LFG monitoring data form. If both initial and stabilized methane concentrations are less than 20 percent of the LEL (1 percent methane), move to next perimeter probe.	Follow instructions in the operations manual. If any methane concentration is greater than 20 percent of the LEL (1 percent methane), monitoring personnel should follow the flow chart included as Figure C-1 in Appendix C, and implement the Contingency Plan (Section 3.1.1) and Reporting and Recordkeeping (Section 6).
10	Complete meter purge cycle before reading next perimeter probe completion.	

2.2.6. Criteria for Reduction of Monitoring Locations and Frequency

LFG production will continue to decline over time. A reduction of monitoring frequency may be allowed if the LFG systems are stable and perimeter monitoring results are consistently less than criteria thresholds.

As part of the Annual Report, the Landfill Owner may request reductions in sample locations and/or frequency (on a probe-by-probe basis). The request will include supporting data and rationale. The request will become effective once approved by the SCHD and Ecology. Significant changes in individual LFG systems (such as system failure, or a switch from passive to active) may warrant additional sampling as part of their operations.

2.3. House Ventilation Trench Monitoring

As described in Section 1.2.2, each Alpine Estates home will be furnished with a house ventilation trench monitoring station. This station is connected to the passive collection pipe installed below the home footprint to evaluate soil vapor conditions. The electrical building will not be equipped with a ventilation trench monitoring station as the building is uninhabited.

2.3.1. Routine/Initial Assessment Monitoring

Following completion of construction of each home, the house ventilation trench monitoring station will be monitored monthly for a period of 6 months. If methane levels stay below 1 percent at each house ventilation trench monitoring station, then initial monitoring will stop and house gas monitoring will only occur if methane above 1 percent is detected at a nearby perimeter probe. The initial monitoring will extend longer, at SCHD's discretion, if methane is detected above the supplemental monitoring trigger level.

2.3.2. Supplemental Monitoring

As indicated in Table 2, there is no regulatory limit for methane levels at the house ventilation trench monitoring stations. House ventilation trench monitoring stations will be checked when greater than 1 percent methane is observed in a perimeter probe (see table on Figure C-1 for which home lots to check for which perimeter probes and Figure 1 for map of lots). House ventilation trench monitoring provides a means of evaluating the extent of migration beyond the landfill containment system and if Alpine Estates homes are at risk when methane is observed in a perimeter probe.

2.3.3. House Ventilation Trench Monitoring Procedure

Each house ventilation trench monitoring station is equipped with a labcock or pressure fitting plug with a quick connect. The same GEM™ 5000 infrared portable gas analyzer (or equivalent) used for monitoring at the perimeter probes will be used to monitor the house ventilation trench monitoring stations. Thus, the same monitoring procedures that are defined for the perimeter probes in Sections 2.2.3 through 2.2.5 should be followed for the house monitoring.

As recommended by Ecology Publication No. 09-09-047, Revised March 2022 (Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action), house monitoring should be performed:

a) When the building is depressurized relative to the subsurface, and

b) When the source includes multiple VOCs (Go East Landfill has no history of non-methane VOCs).

2.4. Indoor Air Monitoring

Methane concentrations inside Alpine Estates homes and the electrical building must not exceed 100 ppmV. To meet this requirement, continuous gas detection devices will be installed within each home and indoor surface monitoring will occur on occasion.

2.4.1. Continuous Methane Detection System

All new homes within 1,000 feet of the closed landfill will have continuous (i.e., operate 24 hours per day, 7 days per week) methane detectors consistent with the LADBS Methane Mitigation Standards. The electrical building will not be equipped with continuous methane detectors as the building is uninhabited.

2.4.1.1. Continuous Methane Detection and Alarm Requirements

Per the LADBS, Alpine Estates homes will comply with the Methane Mitigation requirements for the lowest occupied space of single-family dwellings and will include the following:

- Gas detection system: one or more electrical devices that measure the methane gas concentration and communicate the information to the occupants with audible or visual signals.
  - Single station gas detectors with battery backup may be installed in lieu of alarm system or gas detection system.
- Alarm system and control panel: a group of interacting elements consisting of components and circuits arranged to monitor and annunciate the status of gas concentration levels or supervisory signal-initiating devices and to initiate the appropriate response to those signals (see Section 3.1.2 for appropriate response to signals).

Mechanical ventilation is not required for buildings with widths less than 50 feet and footprints smaller than a 6,000-square-foot area, which is the case for Alpine Estates homes.

2.4.1.2. Continuous Methane Detection Equipment

The GD-2A Combustible Gas Detector Model, manufactured by Macurco™, or approved equal, will be used for continuous gas monitoring within each home. Appendix D includes the data sheet and wiring diagrams for the GD-2A monitor. LADBS Methane Mitigation Standards require at least two gas detectors for homes more than 1,000 feet and up to 5,000 feet, into which category the Alpine Estates homes fall. Three continuous methane detectors will be hardwired into each home and will be connected to a

battery backup power system in case of power outages. The locations of the detectors are included in Appendix A.

The gas detector will have an alarm set point per UL 1484 (Standard for Residential Gas Detectors), at 25 percent of the LEL (1.25 percent methane, 12,500 ppmV). At normal conditions, a green LED signifies that the GD-2A is armed. If gas is detected at or above 25 percent of the LEL (1.25 percent methane, 12,500 ppmV), the red LED turns on and the alarm condition relay is activated and sent to a central alarm control panel, the DSC PowerSeries Neo, or approved equal, that activates the audible alarm and warns residents of the gas detection. At this level of detection, the residents should evacuate the home and notify the LFG Engineer immediately. Instructions and requirements for notification and evacuation will be stated on a placard next to the alarm within each home. The LFG Engineer team will be dispatched from a contracted 24-hour answering service to ensure there is always an available responder in the event of a methane detection alarm. The 24-hour phone number will be provided on the placard.

2.4.1.3. Continuous Methane Detection System Upkeep

The LFG Engineer will make sure the detectors are maintained and serviced in proper working condition and meet all requirements of the electrical and mechanical code. The testing, maintenance, and service procedure for each gas detector and alarm system shall be performed in accordance with the manufacturer's current written instructions included in Appendix D. The LFG Engineer will either perform the regular inspection and maintenance themselves or will coordinate with the manufacturer of the methane detectors to perform necessary upkeep.

2.4.2. Surface Monitoring

The continuous methane detectors installed within the homes cannot detect levels below 0.5 percent (5,000 ppmV) methane, and the electrical building is not equipped with such devices. To ensure methane concentrations inside offsite structures stay below the 0.01 percent (100 ppmV) regulatory threshold, indoor methane levels will be monitored using a surface emissions monitor that can detect methane as low as 1 ppmV (0.0001 percent). Naturally occurring methane levels in atmosphere are approximately 2 ppmV (0.0002 percent)[3]. Surface monitoring will occur as part of an initial assessment following completion of construction, and as part of a supplemental assessment when supplemental monitoring trigger level exceedances are observed both at a perimeter probe and at the house ventilation trench monitoring station in the case of Alpine Estates homes, or just at a perimeter probe in case of the electrical building.

2.4.2.1. Routine/Initial Assessment Monitoring

Following completion of construction of each structure and prior to allowing occupancy of the Alpine Estates homes, the LFG Engineer will monitor the structure interior to check that methane levels are below the regulatory threshold of 0.01 percent (100 ppmV).

[3] https://www.thoughtco.com/chemical-composition-of-air-604288#Table%20of%20Elements%20and%20Compounds%20in%20Air

2.4.2.2. Supplemental Monitoring

For Alpine Estates homes, if methane greater than 1 percent is detected at a perimeter probe and 0.1 percent at a house ventilation trench monitoring station, the LFG Engineer will knock on door and enter the home with a surface emissions monitor unit and monitor the surface emissions within the home as Figure C-1 in Appendix C details. A SEM™ 5000 is a selective monitoring device, specifically to methane emissions from 0.5 ppmV to 100 percent concentration[4]. If there is a hit of methane at a perimeter probe and the house ventilation trench monitoring station, there is potential for there to be methane breakthrough into homes. A supplemental assessment level is set at 0.1 percent at the house ventilation trench monitoring station to trigger indoor air monitoring of Alpine Estates homes consistent with Ecology Publication No. 09-09-047, Revised March 2022 (Guidance for Evaluating Vapor Intrusion in Washington State: Investigation and Remedial Action). The Guidance indicates that crawl space sampling results are often similar to concentrations on the first floors of buildings. Indoor surface monitoring for certain homes could become periodic at SCHD's or Ecology's discretion if methane levels above the assessment level of 0.1 percent persist at the house ventilation trench monitoring station.

For the electrical building, if methane greater than 1 percent is detected at a perimeter probe, the LFG Engineer will unlock the lift station lot fence and enter the building with a SEM™ 5000 (or equal) and monitor the surface emissions within the building as Figure C-1 in Appendix C details. If there is a hit of methane at a perimeter probe, there is potential for there to be methane breakthrough into the electrical building.

2.4.2.3. Surface Monitoring Procedure

Surface Monitoring Equipment

A LANDTEC SEM™ 5000 surface emissions monitor unit (SEM™ 5000) (or equal) will be used to monitor the interior methane levels of offsite structures when required as part of initial assessments and supplemental monitoring. A SEM™ 5000 unit can be rented from Field Environmental Instruments, Inc., located at 11710 Airport Road, Suite A-300 in Everett, Washington 98204, approximately 15 minutes away from the development property.

Surface Monitoring Equipment Calibration

The field calibration procedure shown in Table 7 should be performed in accordance with the manufacturer's manual before every surface monitoring event.

[4] https://www.landtecna.com/product/sem5000-portable-methane-detector/

Table 7. Surface Emissions Monitor Equipment Calibration Procedure.	
General Steps	
Step	**Description**
1	Check battery status. Status should be at least 75 percent before calibration.
2	Check the condition of the windscreen, water trap filter, dust filter, cellulose dust filter, and sample tubing and replace as necessary. The filters should be changed at the beginning of each surface monitoring event.
3	Set up equipment for calibration per instructions in the SEM™ 5000 operation manual. Note the importance of the order of calibration gases, air, span methane, air, span methane, air, then span methane.
4	Record date, time. location, operator, temperature, and barometric pressure.
5	Calibrate SEM™ 5000 or equivalent meter according to the instrument's instruction manual switching between air and span methane (250 or 500 ppm) and finishing the calibration with an upwind and downwind test. The screen will also display instructions to start, stop and track each test.

Surface Monitoring Procedure

When surface monitoring needs to take place as part of assessment monitoring, all applicable surface gas monitoring methodologies will be conducted according to the RCW 70A.540 and forthcoming WAC 173-408, which are drawn from the U.S. Environmental Protection Agency Code of Federal Regulations (CFR) Part 60 Subpart XXX *Standards of Performance for Municipal Solid Waste Landfills*. Although these regulations do not apply to Go East Landfill, the applicable monitoring techniques presented will be implemented when surface monitoring is necessary at the Alpine Estates Development to confirm indoor levels are below the 0.01 percent (100 ppmV) regulatory threshold. The procedure listed in Table 8 should be followed whenever surface monitoring must take place. Regulatory criteria are met if methane levels are below 0.01 percent (100 ppmV) throughout the entire interior ground surface level of the structure.

Table 8. Surface Monitoring Procedures.	
General Steps	
Step	**Description**
1	Check battery status.
2	Check barometric pressure.
3	Make sure the LOG and GPS functions are enabled to record and auto save data.
4	Connect the wand that comes in the SEM™ 5000 case to the unit and adjust length so that the end of the sample probe is 3 inches or within 3 inches of the ground.
5	Move the probe along the interface periphery while observing the instrument readout. The entire ground surface level of the home should be monitored, and utility penetrations should be targeted as notable locations where LFG could enter the structure. If an increased meter reading is observed, slowly sample the interface where leakage is indicated until the maximum meter reading is obtained. Leave the probe inlet at this maximum reading location for approximately two times the instrument response time. The SEM™ 5000 response time is approximately 3 seconds.
6	Record results. If any results show an exceedance of greater than 0.01 percent (100 ppmV) methane within the structure, SCHD should be notified within 24 hours. Refer to Section 3.1.2 for additional response actions.

3. CONTINGENCY ACTIONS RELATED TO LANDFILL POST-CLOSURE MONITORING

Methane concentrations must not exceed 100 percent of the LEL (5 percent methane, 50,000 ppmV) in a perimeter probe, or 0.01 percent (100 ppmV) within an Alpine Estates home or any other structure beyond the landfill property boundary including the electrical building at the lift station. The Landfill Owner with support from the LFG Engineer will perform the urgent actions and mitigation plan described in Sections 3.1 and 3.2 below. Refer also to the monitoring flow chart for triggers and mitigation actions, included as Figure C-1 in Appendix C. All LFG monitoring, operations and maintenance personnel must understand planned mitigation actions.

3.1. Urgent Action Plan

Urgent action will be required when there is an exceedance of the regulatory levels in a perimeter probe or in the indoor air of an Alpine Estates home or the electrical building. That is, 5 percent (50,000 ppmV) methane is reached in a perimeter probe, or 0.01 percent (100 ppmV) methane is reached within an offsite structure. Exceedance of regulatory criteria requires notification to SCHD and a response action. Once occupancy has begun on the site, SCHD will be notified within 24 hours if there is a methane exceedance observed during LFG monitoring (greater than 5 percent methane at a perimeter probe or greater than 0.01 percent (100 ppmV) methane within an offsite structure). The urgent action plan pathways for the two regulatory monitoring components are detailed in Figure C-1 in Appendix C. As Figure C-1 details, response actions are also set for other methane levels detected at a perimeter probe or within an offsite structure. The different procedures for the detected methane levels are detailed in Figure C-1 and throughout this section.

3.1.1. Methane Exceedance at Perimeter Probe

Perimeter probes have a supplemental monitoring trigger level of 1 percent (10,000 ppmV) and a regulatory assessment level of 5 percent (50,000 ppmV) that require different response actions.

3.1.1.1. Methane Exceedance of 1 Percent (10,000 ppmV) at Perimeter Probe

The Landfill Owner with support from the LFG Engineer will perform the following actions for the protection of human safety in the case of a methane supplemental monitoring trigger level exceedance (greater than 1 percent) at a perimeter probe:

- Identify nearby potential receptors (Alpine Estates homes or electrical building of lift station) by referring to the table on Figure C-1 in Appendix C and the map on Figure 1.

- Perform monitoring for relevant lots near the perimeter probe with methane supplemental monitoring trigger level exceedance of 1 percent (identified on Figure C-1 and Figure 1):
    - For Alpine Estates homes, first at the house ventilation trench monitoring stations and then inside the home if methane levels at the house ventilation trench monitoring station trigger interior surface emissions monitoring (see Section 2.4.2 and Figure C-1 in Appendix C).
    - For electrical building, perform indoor surface emissions monitoring.
- Investigate and identify the potential source(s) and conduit(s) for LFG migration that may have caused the high concentration (i.e., the path that LFG may be taking to the monitoring location).
- As appropriate, begin corrective action.

3.1.1.2. Methane Exceedance of 5 Percent (50,000 ppmV) at Perimeter Probe

The Landfill Owner with support from the LFG Engineer will perform the following actions for the protection of human safety in the case of a methane regulatory level exceedance (greater than 5 percent) at a perimeter probe:

- Notify SCHD as soon as practical within 24 hours.
- Identify nearby potential receptors (Alpine Estates homes or electrical building of lift station) by referring to table on Figure C-1 in Appendix C and map on Figure 1.
- Perform monitoring for relevant lots near the perimeter probe with methane supplemental monitoring trigger level exceedance of 5 percent (identified on Figure C-1 and Figure 1):
    - For Alpine Estates homes, first at the house ventilation trench monitoring stations and then inside the home if methane levels at the house ventilation trench monitoring station trigger interior surface emissions monitoring (see Section 2.4.2 and Figure C-1 in Appendix C).
    - For electrical building, perform indoor surface emissions monitoring.
- Investigate and identify the potential source(s) and conduit(s) for LFG migration that may have caused the high concentration (i.e., the path that LFG may be taking to the monitoring location).
- As appropriate, begin corrective action.

3.1.2. Methane Exceedance Within Alpine Estates Home or Electrical Building

Alpine Estates homes and the electrical building at the lift station have a regulatory level of 0.01 percent (100 ppmV) and an emergency level of 1.25 percent (12,500 ppmV) that require different response actions.

3.1.2.1. Methane Exceedance of 0.01 Percent (100 ppmV)

The Landfill Owner with support from the LFG Engineer will perform the following actions for the protection of human safety in the case of methane greater than 0.01 percent (100 ppmV) but less than 1.25 percent (12,500 ppmV) detected within an Alpine Estates home or the electrical building:

- Notify SCHD as soon as practical within 24 hours.
- For houses, check that continuous methane detectors installed inside are on and functioning properly.
- Investigate and identify the potential source(s) and conduit(s) for LFG migration that may have caused the high concentration (i.e., the path that LFG may be taking to inside the structure).
- As appropriate, begin corrective action.

3.1.2.2. Methane Exceedance of 1.25 Percent (12,500 ppmV)

The Landfill Owner with support from the LFG Engineer will perform the following actions for the protection of human safety in the case of methane greater than 1.25 percent (12,500 ppmV) detected within an Alpine Estates home or electrical building:

- The home or building should be evacuated.
- Notify SCHD as soon as practical within 24 hours.
- Contact the Fire Department (911) and evaluate concerns.
- For houses, check that continuous methane detectors installed inside are on and functioning properly. At 1.25 percent methane (12,500 ppmV), the visual and audio warning alarm should go off within the home[5].
- Investigate and identify the potential source(s) and conduit(s) for LFG migration that may have caused the high concentration (i.e., the path that LFG may be taking to inside the structure).
- As appropriate, begin corrective action.
- Fire marshal with LFG Engineer recommendation will give go ahead to return to structure once safe.

[5] The electrical building will not be equipped with continuous methane detectors as the building is uninhabited.

3.2. Mitigation Plan

When a regulatory exceedance is detected in a perimeter probe or in the indoor air of an Alpine Estates home or the electrical building, an urgent action plan with a response action will be implemented as discussed in Section 3.1.

- If the system adjustments made as part of the response action were effective in getting methane levels below regulatory requirements, SCHD will be notified of the response action and its effectiveness for addressing the exceedance.

- If the system adjustments made as part of the response action were not effective in getting methane levels below regulatory thresholds, the LFG Engineer will notify SCHD and Ecology and coordinate with the agencies to determine and implement a plan.

- If methane levels at the perimeter probes remain consistently above the regulatory level of 5 percent methane, and monitoring results indicate no methane migration to the surface or the subsurface collection systems of Alpine Estates homes or the electrical building, SCHD and Ecology may confirm that monthly monitoring and following the urgent action plan discussed in Section 3.1 is enough.

- If conditions indicate the Alpine Estates homes and the electrical building are impacted, or as otherwise directed by SCHD and Ecology, the LFG Engineer will prepare a mitigation plan.

If required per SCHD and Ecology direction, the LFG Engineer will prepare and submit a mitigation plan that describes the nature and extent of methane migration, and proposes a remedy, as described in Figure C-1 in Appendix C. The mitigation plan will be submitted within 60 days of the regulatory methane exceedance in a perimeter probe or an Alpine Estates home or the electrical building. Prior to or upon approval, the LFG Engineer should implement the mitigation plan and place a copy of the plan in the operating record. SCHD will be notified when elements of the mitigation plan are initiated. An extension for submittal of the mitigation plan or implementation of the plan may be granted by SCHD on written request and depending on severity of the situation. Agency approval is not required to initiate mitigation measures.

4. PROPERTY ACCESS FOR MONITORING

As discussed throughout this Plan, Alpine Estates homes and the electrical building require methane compliance monitoring for as long as methane generation and potential accumulation persist. LFG monitoring stations and components include continuous monitoring LFG sumps, perimeter probes, house ventilation trench monitoring stations, indoor air monitoring, and continuous gas detectors in each home, that are situated either inside the structure, on the property, or adjacent to the property. Monitoring will require access to property lots on an as-needed basis for monitoring until decommissioning of LFG monitoring stations and facility components are approved by SCHD and Ecology. Homeowners responsible for the Alpine Estates homes and the Silver Lake Water & Sewer District responsible for the electrical building at the pump station must allow the Alpine Estates Owners Association, its designees, assignees, and agents (including the LFG Engineer) access to the property for the purpose of monitoring, operations, and maintenance of the LFG control and monitoring components established on and near each residence. No owner of a lot within the Alpine Estates Development shall alter, block, cover, disturb or otherwise prevent access to the LFG control and monitoring component within or around their property.

4.1. Indoor Air Monitoring

When monitoring personnel must enter an Alpine Estates home for indoor air monitoring or maintenance to the indoor continuous gas detectors, the personnel shall knock on the door of home and enter home when homeowner approves entry.

The electrical building at the pump station lot is enclosed by a locked fence. Monitoring personnel will have a key and approval by Silver Lake Water & Sewer District to access the electrical building at any time for indoor air monitoring of the structure.

4.2. House Ventilation Trench Monitoring Station

When monitoring personnel must access the house ventilation trench monitoring station of Alpine Estates homes, the personnel shall knock on the door of the home to notify homeowner of monitoring. If no one is home or the door is not opened by homeowner, monitoring personnel can proceed to house ventilation trench monitoring station located in fenced backyard to complete monitoring if safe to do so (pets, etc.). If not safe, personnel will wait until resident returns to home.

4.3. LFG Sump and Perimeter Probe Monitoring

Monitoring personnel do not require permission for monitoring at the LFG sumps and perimeter probes that are not located on the property of any Alpine Estates homes.

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5. HEALTH AND SAFETY PLAN (HASP)

Maintenance personnel and contractors are responsible for developing and abiding by a HASP while performing LFG post-closure monitoring or maintenance activities at the closed landfill site. The Landfill Owner shall provide contractors with pertinent information to develop the HASP.

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6. REPORTING AND RECORDKEEPING

The LFG Monitoring Form (see Appendix B) will be completed for each perimeter probe monitoring event since some information cannot be automatically logged and downloaded. Each form should include the following minimum information:

- Time*
- Date*
- Location
- Perimeter Probe ID*
- Equipment used and serial numbers
- Full name of sample collector
- Calibration sheet reference number
- Date of next full calibration
- Date of last field calibration
- Sample pump time and estimated volume
- Battery Status
- Barometric pressure* (and whether it is rising or falling)
- Ambient Temperature*
- Methane percent by volume*
- Oxygen percent by volume*
- Carbon dioxide percent by volume*
- Balance gas percent by volume*
- Static pressure*
- Physical condition of perimeter probe
- Water level or occurrence of water during sampling
- Problems encountered during sampling

(*Items with an asterisk can be logged automatically in the GEM™ 5000 or equivalent meter.)

The M2A gas transmitters will continuously be logging methane data that will be stored on the Geotech website (see Section 2.2.3). Data will be reviewed and downloaded frequently.

The results of the LFG monitoring will be reported annually to SCHD by April 1, either concurrently or in coordination with groundwater and surface water monitoring reporting, pursuant to WAC 173-350-500(5)(c). The Landfill Owner is responsible for complying with the necessary monitoring documentation and submittal of the related Annual Report. All records, reports, documents, and underlying data relevant to the implementation of this LFGMCP shall be maintained by the Landfill Owner for a period consistent with the landfill post closure care requirements.

7. REFERENCES

GeoEngineers. 2020. Interim Action Work Plan.

GeoEngineers. 2021. Final Interim Action Completion Report – Go East Landfill Corp Site.

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M2A Transmitter Operator's Manual. 2021. Part Number: 71-0305RK, Revision: S, Released: July 1, 2021. RKI Instruments, Inc. <www.rkiinstruments.com>.

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APPENDIX A

Landfill Gas Mitigation Design and Monitoring Schematic

HERRERA
Science + Planning + Design

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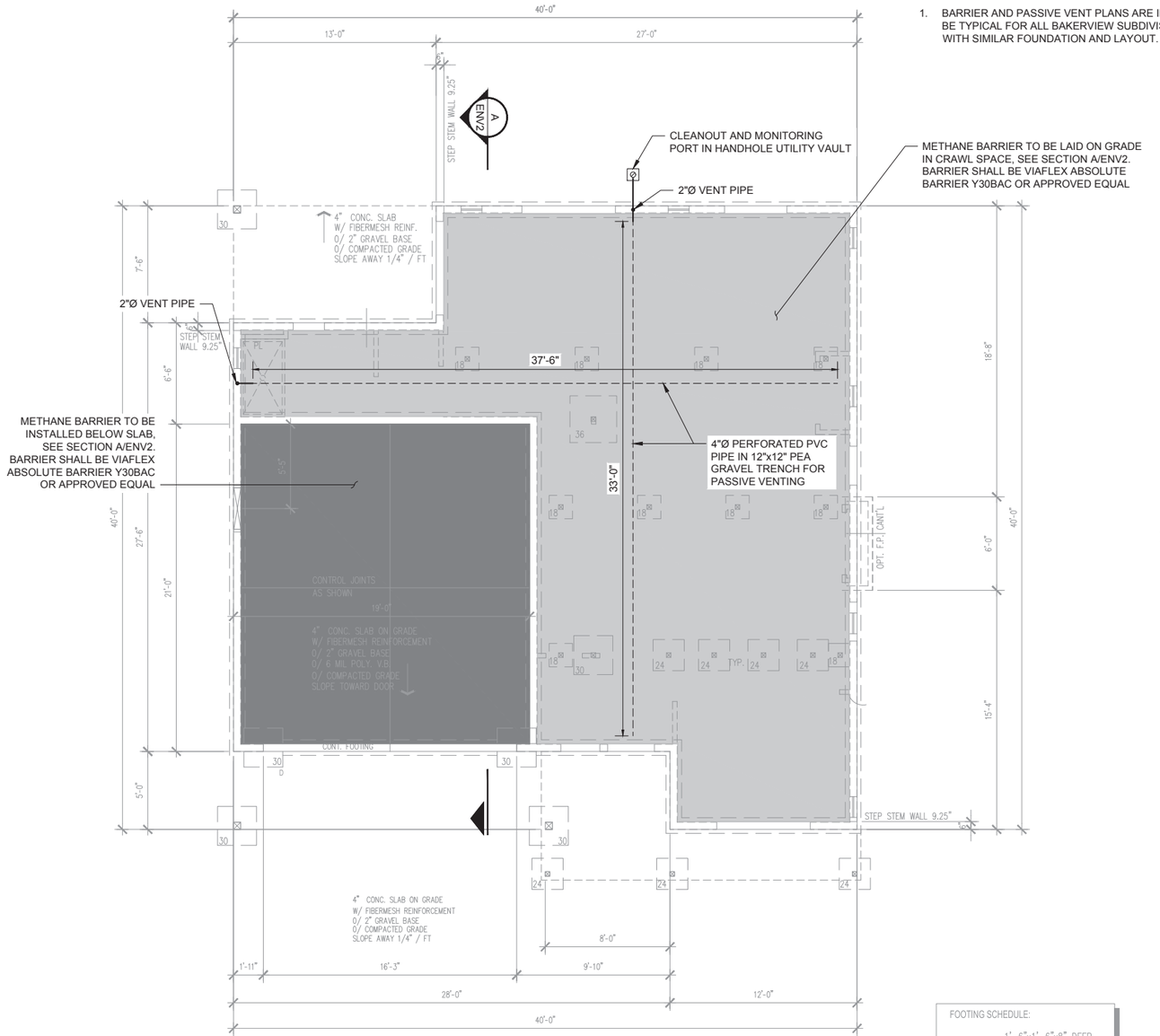
GENERAL NOTES:

1. BARRIER AND PASSIVE VENT PLANS ARE INTENDED TO BE TYPICAL FOR ALL BAKERVIEW SUBDIVISION HOMES WITH SIMILAR FOUNDATION AND LAYOUT.

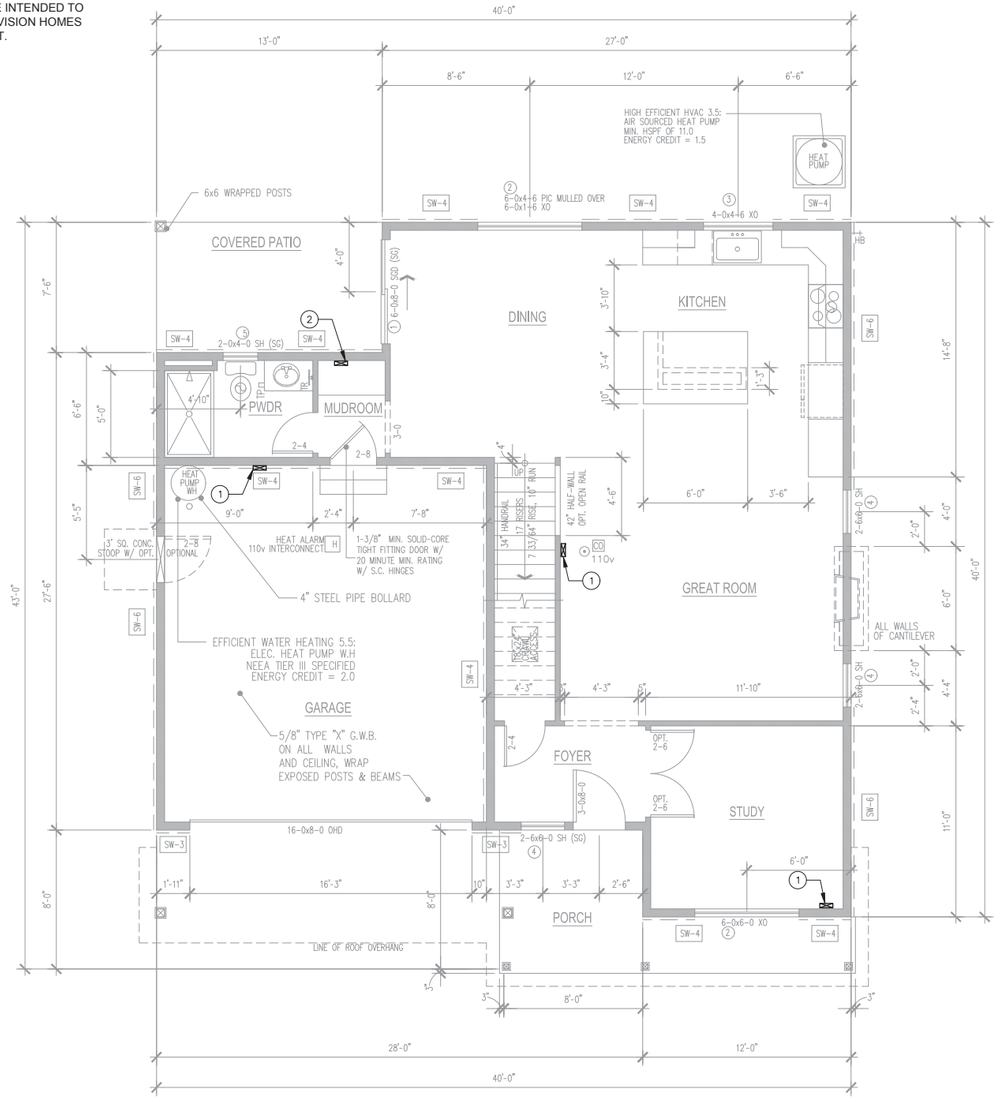


FOUNDATION / MAIN LEVEL ENVIRONMENTAL CONTROL PLAN

VENTILATION: R408.2 WITH WA. STATE AMMENDMENT
PROVIDE 1 SQFT. VENTILATION PER 300 SQFT. UNDER FLOOR AREA
864 SQFT UNDERFLOOR AREA / 300 = 3.22 SQFT. VENTILATION REQUIRED
3.22 SQ FT VENTING REQUIRED / .50 SQ FT PER VENT = 6.44 TOTAL NUMBER OF 16"x8" PLASTIC VENTS REQUIRED
PROVIDE A MINIMUM OF (7) 16"x8" FND VENTS
(NET VENTING AREA = 73 SQ IN OR .50 SQFT)

FOOTING SCHEDULE:

18	1'-6"x1'-6"x8" DEEP CONC. FOOTING W/ (3)#4 EACH WAY, TYP.
24	2'-0"x2'-0"x8" DEEP CONC. FOOTING W/ (3)#4 EACH WAY, TYP.
30	2'-6"x2'-6"x8" DEEP CONC. FOOTING W/ (4)#4 EACH WAY, TYP.
36	3'-0"x3'-0"x12" DEEP CONC. FOOTING W/ (5)#4 EACH WAY, TYP.
48	4'-0"x4'-0"x12" DEEP CONC. FOOTING W/ (7)#4 EACH WAY, TYP.



METHANE MONITORING PLAN

○ KEYNOTES

1. MACURCO (TM) COMBUSTIBLE GAS DETECTOR MODEL GD-2A CAPABLE OF DETECTION AT OR BELOW 25% OF THE LEL FOR METHANE (5% BY VOLUME) OR APPROVED EQUAL. GAS DETECTOR SHALL BE CONNECTED TO ALARM SYSTEM (SEE KEYNOTE 2). GAS DETECTOR SHALL BE WIRED INTO AC POWER AND HAVE A BATTERY BACKUP. THE GD-2A USES A SELF-PURGING SEMI-CONDUCTOR SENSOR THAT HAS A LONG LIFE EXPECTANCY AND DOES NOT REQUIRE REGULAR MAINTENANCE. ALL SERVICE AND REPAIR OF THE GD-2A ARE TO BE PERFORMED BY MACURCO. MACURCO WARRANTS THE GD-2A GAS DETECTOR WILL BE FREE FROM DEFECTIVE MATERIALS AND WORKMANSHIP FOR A PERIOD OF TWO (2) YEARS FROM THE DATE OF MANUFACTURE, PROVIDED IT IS MAINTAINED AND USED IN ACCORDANCE WITH MACURCO INSTRUCTIONS AND/OR RECOMMENDATIONS.
2. DSC POWERSERIES NEO CONTROL PANEL, OR APPROVED EQUAL, CONNECTED TO GAS DETECTORS FOR VISUAL AND AUDIO ALARMING AT DETECTION AT OR BELOW 25% OF THE LEL FOR METHANE (5% BY VOLUME). CONTROL PANEL SHOULD BE PROGRAMMED TO NOTIFY ENVIRONMENTAL ENGINEER AT DETECTION AT OR BELOW 25% OF THE LEL FOR METHANE (5% BY VOLUME). ALARM SHALL BE WIRED INTO AC POWER AND HAVE A BATTERY BACKUP. THE DSC POWERSERIES NEO CONTROL PANEL BATTERY CONDITION SHOULD BE CHECKED ACCORDING TO MANUFACTURER TESTING INSTRUCTIONS. STANDBY BATTERIES SHOULD BE REPLACED EVERY 3-5 YEARS.

DETECTOR AND ALARM SYSTEM CONSTRUCTION QUALITY ASSURANCE

1. PRODUCT DATA: MANUFACTURER'S PRINTED TECHNICAL DATA, PHYSICAL AND PERFORMANCE PROPERTIES, INSTRUCTIONS FOR OPERATING AND MAINTAINING, AND INSTALLATION INSTRUCTIONS WILL BE REVIEWED BY THE ENVIRONMENTAL ENGINEER.
2. BUMP TEST: AFTER GAS DETECTORS AND ALARM HAVE BEEN INSTALLED ACCORDING TO MANUFACTURER'S INSTALLATION INSTRUCTIONS, THE ENVIRONMENTAL ENGINEER WILL EXPOSE EACH DETECTOR FOR 25% LEL GAS (ALARM SET POINT PER UL 1484) AND ENSURE DETECTORS ACTIVATE ALARM AS DESIGNED.

TYSON M. WRAGGE
STATE OF WASHINGTON
44408
REGISTERED
PROFESSIONAL ENGINEER

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BAKERVIEW SUBDIVISION
SNOHOMISH COUNTY, WA
LANDFILL ENVIRONMENTAL CONTROL PLAN

CENTURY COMMUNITIES
16108 ASH WAY SUITE 201 LYNWOOD WA 98087

REVISED

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DATE

Bakerview - Foundations
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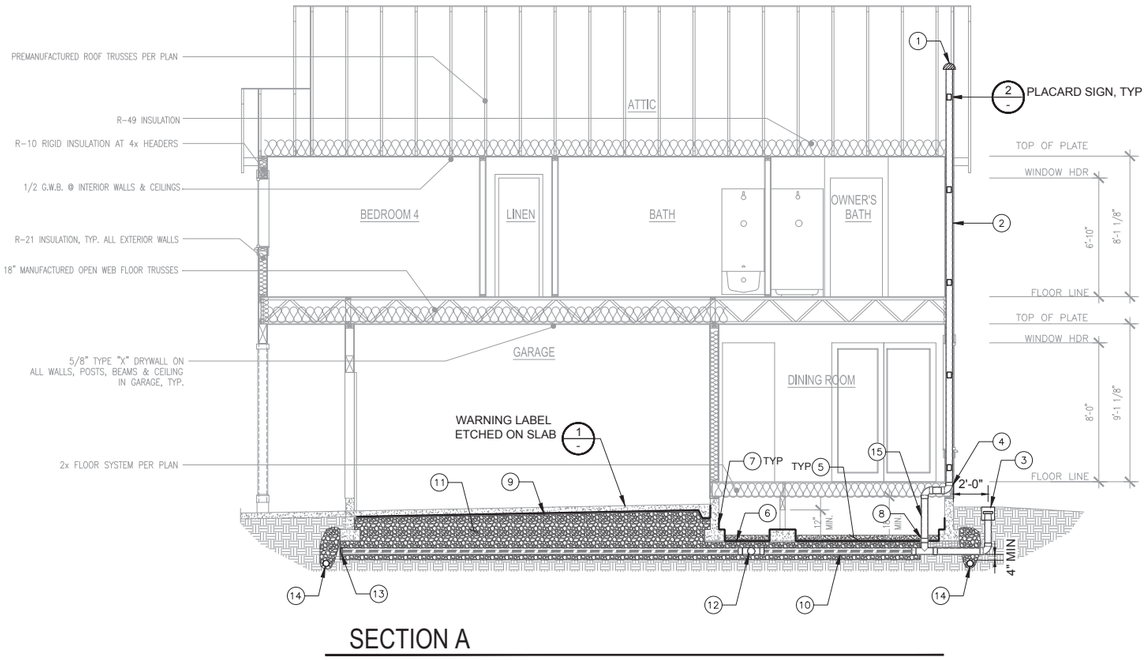

SECTION A

GENERAL NOTES:

1. BARRIER AND PASSIVE VENT SECTION IS INTENDED TO BE TYPICAL FOR ALL BAKERVIEW SUBDIVISION HOMES WITH SIMILAR FOUNDATION AND LAYOUT.

○ KEYNOTES

1. TERMINATE PIPES MIN 12" ABOVE ROOF IN A LOCATION AT LEAST 10' FROM ANY WINDOW OR OTHER OPENING. VENT PIPE SHALL TERMINATE WITH RAIN CAP.
2. TWO 2" GALVANIZED OR CAST IRON VENT PIPES IN EXTERIOR WALL.
3. LFG MONITORING STATION AND CLEANOUT WITHIN 5 FEET OF VENT PIPE: 4" PVC CAP WITH THREADED PLUG IN HANDHOLE UTILITY VAULT.
4. TRANSITION FROM 4" PVC TO 2" GALVANIZED OR CAST IRON PIPE FOR VERTICAL VENT PIPE. PIPE FITTINGS AS NEEDED TO TRANSITION FROM CRAWL SPACE TO EXTERIOR WALL. VENT PIPE SHALL BE PRESSURE AND/OR HYDROSTATIC LEAK TESTED FROM THIS POINT UP THROUGH TOP OF VENT ABOVE ROOF. PIPE SHALL BE CAPABLE OF HOLDING 4 PSI OF AIR PRESSURE FOR 1 HOUR WITHOUT LOSING PRESSURE AND/OR HOLDING WATER FOR 24 HOURS WITH NO LEAKAGE.
5. 3" OF BEDDING SAND OR 6-OZ NON-WOVEN GEOTEXTILE FOR PROTECTION OF BARRIER.
6. VIAFLEX ABSOLUTE BARRIER Y30BAC OR EQUAL SHALL BE INSTALLED IN CRAWL SPACE. SEE ABSOLUTE BARRIER INSTALLATION INSTRUCTIONS FOR SEAMING AND TESTING. ENVIRONMENTAL ENGINEER SHALL INSPECT SUBGRADE PRIOR TO PLACEMENT OF BARRIER AND BE PRESENT FOR SEAM TESTING. DRAPE BARRIER OVER PAD FOOTINGS. ANY PENETRATION THROUGH BARRIER FOR POST FASTENING TO BE SEALED WITH ELASTOMERIC POLYURETHANE SEALANT. SEE GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE INSTRUCTIONS THIS SHEET.
7. FASTEN BARRIER TO CONCRETE WITH BATTEN STRIP PER ABSOLUTE BARRIER INSTALLATION INSTRUCTIONS.
8. BOOT VENT PIPE AND ALL UTILITY PENETRATIONS THROUGH BARRIER PER ABSOLUTE BARRIER INSTALLATION INSTRUCTIONS.
9. VIAFLEX ABSOLUTE BARRIER Y30BAC OR EQUAL SHALL BE PLACED BENEATH SLAB. 6 MIL POLYPROPYLENE SHALL BE PLACED ON TOP OF BARRIER. SEE ABSOLUTE BARRIER INSTALLATION INSTRUCTIONS FOR SEAMING AND TESTING. ENVIRONMENTAL ENGINEER SHALL INSPECT SUBGRADE PRIOR TO PLACEMENT OF BARRIER AND BE PRESENT FOR SEAM TESTING. SEE GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE INSTRUCTIONS THIS SHEET.
10. 4" PERFORATED SCH 40 PVC VENT PIPE INSTALLED IN MIDDLE OF 12"x12" PASSIVE VENT TRENCH WITH PEA GRAVEL BACKFILL.
11. PASSIVE VENT TRENCH: PEA GRAVEL TRENCH, PERFORATED PIPE.
12. 4" PVC SCH 40 CROSS FITTING. EXACT LOCATION WILL VARY DEPENDING ON LOCATION OF STRUCTURAL FOOTINGS.
13. 4" PIPE CAP AT END OF PASSIVE VENT TRENCHES.
14. 4" PERFORATED PERIMETER DRAIN PIPE WITH FILTER FABRIC COVER AND PEA GRAVEL BACKFILL. CONNECT TO STORM SYSTEM. PERIMETER DRAIN SHALL BE LOWER IN ELEVATION THAN PASSIVE VENT TRENCHES.
15. IF REQUIRED IN THE FUTURE, INSTALL INTRINSICALLY SAFE FAN FOR ACTIVE METHANE MITIGATION. ELECTRICAL JUNCTION BOX FOR FAN SHALL BE INSTALLED IN CRAWL SPACE DURING HOME CONSTRUCTION AND SHALL BE 120 VOLT, 20 AMP. JUNCTION BOX SHALL BE INSTALLED A MINIMUM OF 10 FEET FROM EACH VENT PIPE.

WARNING

THIS BUILDING IS PROTECTED WITH A METHANE GAS CONTROL BARRIER. ANY PROPOSED PENETRATION OR ALTERATION OF FLOOR SLAB REQUIRES NOTIFICATION OF THE BUILDING OFFICIAL

NOTES:

1. THIS NOTIFICATION IS TO BE PERMANENTLY STAMPED OR ETCHED IN THE SURFACE OF THE GARAGE SLAB OR OTHER LOCATION APPROVED BY THE BUILDING INSPECTOR AT THE TIME OF CONSTRUCTION.
2. ALL LETTERS 1/2" MIN IN HEIGHT.
3. AT LEAST ONE REQUIRED PER BUILDING.

DETAIL - WARNING LABEL 1/-

SCALE: NTS

CAUTION

METHANE GAS IN PIPE NO SMOKING OR ELECTRICAL EQUIPMENT WITHIN 10' OF TOP OF VENT

NOTES:

1. PLACE SIGN AT 5' INTERVALS. MINIMUM OF ONE PLACARD SHALL BE ABOVE ROOF.
2. SIGN TO BE 3" HIGH x 4" WIDE PLASTIC WITH ADHESIVE BACKING AND 1/4" HIGH BLACK LETTERS ON WHITE BACKGROUND.
3. GALVANIZED PIPE TO HAVE THREADED JOINTS. NO SMOKING OR ELECTRICAL EQUIPMENT WITHIN 3' OF JOINTS THAT WILL BE INSIDE OF WALL.

DETAIL - PLACARD SIGN 2/-

SCALE: NTS

GEOMEMBRANE CONSTRUCTION QUALITY ASSURANCE

1. INSTALLER QUALIFICATIONS: THE WELDING CERTIFICATIONS OF INSTALLER WILL BE COLLECTED AND REVIEWED BY THE ENVIRONMENTAL ENGINEER PRIOR TO LINER INSTALLATION. INSTALLATION CONTRACTOR WILL RUN AN AUTHORIZED APPLICATOR RECOGNIZED BY THE MANUFACTURER WHO IS TRAINED TO PERFORM WORK THAT IS IN ACCORDANCE WITH MANUFACTURER STANDARDS AND POLICIES.
2. PRODUCT DATA: MANUFACTURER'S PRINTED TECHNICAL DATA, PHYSICAL AND PERFORMANCE PROPERTIES, INSTRUCTIONS FOR EVALUATING, PREPARING, AND TREATING SUBSTRATES, AND INSTALLATION INSTRUCTIONS WILL BE REVIEWED BY THE ENVIRONMENTAL ENGINEER PRIOR TO LINER INSTALLATION.
3. SHOP DRAWINGS: PROJECT SPECIFIC DRAWINGS SHOWING LINER PANEL AND WELD LOCATIONS, AND EXTENT OF VAPOR BARRIER SYSTEM, DETAILS FOR OVERLAPS, PENETRATIONS, TRANSITIONS, AND TERMINATION CONDITIONS FOR EACH HOUSE WILL BE SUBMITTED BY INSTALLER AND REVIEWED BY ENVIRONMENTAL ENGINEER.
4. LABORATORY ANALYSIS: AN APPROXIMATELY 3 FOOT BY 3 FOOT SECTION OF EACH ROLL OF GEOMEMBRANE WILL BE COLLECTED AS PARENT MATERIAL SAMPLE FOR LABORATORY ANALYSIS AND WILL BE COMPARED TO PHYSICAL, MECHANICAL, AND ENDURANCE PROPERTIES PROVIDED BY THE MANUFACTURER AND THE GEOSYNTHETIC RESEARCH INSTITUTE (GRI).

GM17 STANDARD SPECIFICATIONS

PROPERTIES	TEST METHOD	TEXT VALUE FOR 30 MILS	TESTING FREQUENCY (MIN)
THICKNESS (MIN AVG) MILS LOWEST INDIVIDUAL OF 10 VALUES - %	D 5199	NOM. -10	PER ROLL
FORMULATED DENSITY (MAX) - G/CC	D 1505/D 792	0.939	20,000 LB
TENSILE PROPERTIES (L) (MIN AVG) BREAK STRENGTH - LB/IN BREAK ELONGATION - %	D 6693 TYPE IV	 114 500*	20,000 LB
2% MODULUS (MAX) - LB/IN	D 5323	1800	PER FORMULATION
TEAR RESISTANCE (MIN AVG) - LB	D 1004	16	45,000 LB
PUNCTURE RESISTANCE (MIN AVG) - LB	D 4833	42	45,000 LB
CARBON BLACK CONTENT (RANGE) - %	D 4218 *(2)*	2.0-3.0	45,000 LB
NOTES: VALUES FROM GRI GM17 STANDARD SPECIFICATION FOR TEST METHODS, TEST PROPERTIES, AND TESTING FREQUENCY FOR LINEAR LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANES (GRI GM17) (TABLE 1(a)) * MINIMUM BREAK ELONGATION OF ABSOLUTE BARRIER Y30BAC FROM MANUFACTURER			

5. FIELD SAMPLES: AN APPROXIMATELY 1 FOOT BY 1 FOOT SECTION OF MEMBRANE CONTAINING A WELDED SEAM WILL BE COLLECTED FROM EACH WELDING MACHINE ON EACH DAY MATERIAL IS WELDED. THE SECTION WILL BE FIELD TESTED FOR PEEL AND SHEAR STRENGTH USING A TENSIOMETER. AFTER TESTING IS COMPLETE, THE RESULTS WILL BE COMPARED TO GRI GM19a AND THE SAMPLE WILL BE RETAINED FOR RECORDS.

   IF THE INSTALLER DOES NOT HAVE A TENSIOMETER ON SITE, THEN AN APPROXIMATELY 1 FOOT BY 2 FOOT SECTION OF MEMBRANE WILL BE COLLECTED AND DIVIDED INTO TWO APPROXIMATELY 1 FOOT BY 1 FOOT SECTIONS. ONE SECTION WILL BE SUBMITTED TO THE LABORATORY FOR STRENGTH TEST RESULTS. THE RESULTS WILL BE COMPARED TO GRI GM19a, AND THE OTHER SECTION WILL BE RETAINED FOR RECORDS.

GEOMEMBRANE NOMINAL THICKNESS	30 MILS
HOT WEDGE SEAMS SHEAR STRENGTH, LB/IN PEEL STRENGTH, LB/IN PEEL SEPARATION, %	 45 38 25
EXTRUSION FILLET SEAMS SHEAR STRENGTH, LB/IN PEEL STRENGTH, LB/IN PEEL SEPARATION, &	 45 34 25
NOTES: PROPERTIES FROM GRI GM19a STANDARD SPECIFICATION FOR SEAM STRENGTH AND RELATED PROPERTIES OF THERMALLY BONDED SMOOTH AND TEXTURED LINEAR LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANES (TABLE 2(a))	

6. VISUAL INSPECTIONS:
   - GEOMEMBRANE SUBGRADE: THE GEOMEMBRANE SUBGRADE WILL BE INSPECTED AND APPROVED BY INSTALLER, CONSTRUCTION MANAGER, AND ENVIRONMENTAL ENGINEER PRIOR TO LINER INSTALLATION. SUBGRADE MUST BE UNIFORMLY COMPACTED AND FREE FROM PROTRUSIONS AND DEBRIS THAT MAY COMPROMISE THE MEMBRANE SYSTEM.
   - INSTALLED GEOMEMBRANE: AT EACH LOCATION WHERE LINER IS INSTALLED, THE GEOMEMBRANE WILL BE SWEPT AND VISUALLY INSPECTED TO ASSESS FOR COMPROMISED INTEGRITY BY TEARS, PUNCTURES, ABNORMAL LINER DEFORMATION, OR SEAM SEPARATION.
   - SMOKE TEST: TWO SMOKE TESTS WILL BE CONDUCTED ON THE INSTALLED GEOMEMBRANE SYSTEM FOR EACH HOME AT THE FOLLOWING TIMES:
     A. AFTER INITIAL INSTALLATION IS COMPLETED
     B. AFTER CONSTRUCTION OF THE CRAWL SPACE IS COMPLETED AND CONTRACTORS ARE FINISHED WORKING IN THE CRAWL SPACE

   ALL DEFICIENT AREAS WILL BE IMMEDIATELY NOTED AND REPAIRED. THE REPAIR WILL BE VERIFIED WITH SMOKE TEST.

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SNOHOMISH COUNTY, WA
LANDFILL ENVIRONMENTAL CONTROL SECTION

CENTURY COMMUNITIES
16108 ASH WAY SUITE 201 LYNWOOD WA 98087

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APPENDIX B

Monitoring Form

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LFG MONITORING FORM

Facility Name:	**Facility Address:**	
Permit Number:	**Time of Sampling: Start _____ Finish _____**	
Date of Sampling:	**Date of Next Full Calibration:**	
Gas Meter Type and Serial Number:	**Last Field Calibration Date:**	
	Weather:	**Barometric Pressure (inches or mm Hg):**
Monitoring Personnel:		**Mean Temperature:**
		Weather/Soil Conditions:
Gas Meter Sample Pump Rate:	**Sample Pump Time (sec or min):**	**Pore Volume (cc):**

Results:

Perimeter Probe No.	Initial Percent LEL	Stabilized Percent LEL	Percent CH_4 (volume)	Percent O_2 (volume)	Percent CO_2 (volume)	H_2S (ppmV)	NOTES
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Note: If needed, attach additional data forms.

General Comments:

Certification:

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. I am aware that there are significant penalties for making any false statement, representation, or certification.

SIGNATURE:	**TITLE:**

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APPENDIX C

Monitoring Contingency Plan

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START: Measure LFG concentrations at Perimeter Probes

Is the methane concentration less than 1% by volume (20% of LEL)?

Yes

Record results and return to routine monitoring program.

No

Is the methane concentration less than 5% by volume (100% of LEL)?

Yes, methane concentration is between 1% and 5% by volume at the probe.

See table below for which lots to check according to which probe has an exceedance (see Figure 1 in Plan for map of lots).

For electrical building, check the interior methane levels with a calibrated SEM™ 5000 unit (or approved equal). Were all measured concentrations of methane below 0.01% (100 ppmV) in the building?

Yes

Yes, methane level at house ventilation trench monitoring station is below 0.1% (1,000 ppmV) and historical data has shown the level to maintain below 0.01% (100 ppmV) within the house.

For residential lots, check house ventilation trench monitoring stations of adjacent homes. Is the methane concentration less than 0.1% (1,000 ppmV) at the house ventilation trench monitoring station? Has the methane level been shown to be normal with historical data and protective of keeping methane levels at less than 0.01% (100 ppmV) within the interior of the house?

No, methane level at house ventilation trench monitoring station is above 0.1% (1,000 ppmV), and there is not enough historical data that shows the level to maintain below 0.01% (100 ppmV) within the house.

No

Check monitoring ports of lots on the other side of the street. Consult LFG Engineer for which additional lots to check.

LFG personnel shall knock on door of house and check the interior methane levels with a calibrated SEM™ 5000 unit (or approved equal). Were all measured concentrations of methane below 0.01% (100 ppmV) in the house?

Yes

Verified methane levels within house are protective with level above 0.1% beneath house. Record results and return to routine monitoring program.

No

Are the indoor methane levels below 1.25%?

No

1. Evacuate house or electrical building until issue can be resolved.
2. Notify the fire department, SCHD, and affected perimeter property owners.
3. LFG personnel shall identify the area/source of methane inside and around perimeter of house or electrical building and coordinate with fire department about concerns.
4. For houses, make sure continuous methane detectors are on, working, and calibrated.
5. Fire marshal with LFG Engineer recommendation will give go ahead for occupants to return to home or electrical building once safe.
6. LFG Engineer will review/investigate LFG system to address any issues, and continue daily monitoring until methane levels are confirmed to drop below 0.01% (100 ppmV) inside structure. For houses, an intrinsically safe fan can be installed on collection vent pipe in crawl space and plugged into the electrical junction box to create active methane mitigation system below house. For electrical building, a wind turbine vent cap can be installed on vent pipe to create negative pressure and draw LFG out of the collection trench.
7. Report exceedances and actions to SCHD within 14 days of the incident.

Yes, methane levels within structure are between 0.01% to 1.25%.

1. Notify SCHD.
2. LFG personnel shall identify the area/source of methane inside and around perimeter of house or electrical building.
3. For houses, make sure continuous methane detectors are on, working, and calibrated.
4. LFG Engineer will review/investigate LFG system to address any issues and continue daily monitoring until methane levels are confirmed to drop below 0.01% (100 ppmV) inside structure. For houses, an intrinsically safe fan can be installed on collection vent pipe in crawl space and plugged into the electrical junction box to create active methane mitigation system below house. For electrical building, a wind turbine vent cap can be installed on vent pipe to create negative pressure and draw LFG out of the collection trench.
5. Report exceedances and actions in quarterly reports to SCHD.

1. Notify SCHD.
2. LFG Engineer will review/investigate LFG system to address any issues, and continue weekly monitoring for 4 weeks; if no change, then switch to monthly until methane levels are confirmed to drop below 5%. Frequency of monitoring should be done according to Ecology/SCHD direction.
3. Report exceedances and actions in quarterly reports to SCHD.

Were system adjustments effective in getting methane levels under control (below 5% at perimeter probes and below 0.01% (100 ppmV) within house)?

Yes

LFG Engineer notifies SCHD of the actions taken and their effectiveness. Record results and return to routine monitoring program.

No

1. LFG Engineer prepares and submits mitigation plan for approval to SCHD within 60 days of the detection of a high methane concentration.
2. Implement plan with regular monitoring until methane levels are confirmed to drop below methane threshold for 4 consecutive days. Continue monitoring weekly for 4 consecutive weeks. Frequency of monitoring should be done according to Ecology/SCHD direction.
3. Report exceedances and actions in quarterly reports to SCHD.

Probe Number with Exceedance of 1% Methane	Neighboring Lots To Be Checked (lot number; see Figure 1 for map)
1	45, 46, 47, 48, Electrical Building, 44
2	42, 43, 44, Electrical Building
3	39, 40, 41, 42
4	37, 38, 39, 40
5	34, 35, 36, 37
6	30, 32, 33, 34, 35
7	28, 29, 27, 31, 30, 32, 33
8	28, 29, 27, 31, 26, 25, 24, 23, 22
9	21, 20, 19, 18
10	19, 18, 17, 16
11	16, 15, 14, 13
12	10,11, 12, 13, 14, 15

Figure C-1.
Flow Chart for Triggers and Contingent Actions for Perimeter Probe Monitoring.

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APPENDIX D

Home Methane Detector Product Sheets

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Macurco™ Combustible Gas Detector

GD-2A

For use with alarm control panels

SIGNALING UL LISTED

Methane and Propane Gas Detection

The GD-2A is a low voltage electronic detector of combustible, heating type gases. The GD-2A is designed for connection to UL Listed Fire Alarm/Burglary Control Panels. Alarm control panels that work on 12 or 24 VDC can provide battery backup to the GD-2A detectors. This product is for use in ordinary indoor locations of family living units and office workspaces. The GD-2A is intended for installation in buildings in non-hazardous locations such as residences, retail stores, office buildings, and institutional buildings. This combustible gas detector has been evaluated by UL for methane (natural gas) and propane (LP) gas. It is NOT designed to detect smoke, fire or carbon monoxide.

Easy Operation

A green LED signifies that the GD-2A is armed. If gas is detected, the Red LED turns on and the alarm condition relay is activated.

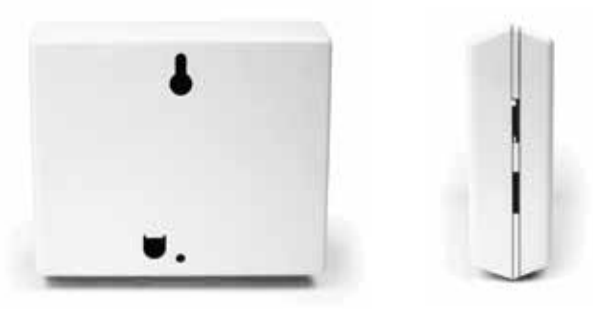
Features

- Supervised Sensor
- Simple installation and operation
- SPDT Alarm and N.C. Trouble Relay
- Can be self-restoring or latching
- California State Fire Marshal Listed
- Solid State Electronic sensors: no maintenance or recalibration
- Sensitivity tested based on UL 1484 Standard for Residential Gas Detectors
- Listed to UL Standard 2075 for the Standard for Safety for Gas and Vapor Detector and Sensors

Manufactured by Aerionics, Inc. Sioux Falls, SD – Phone: 1-877-367-7891 – Email: info@aerionicsinc.com – www.macurco.com

GD-2A Specifications

- Size: 4 ½ x 5 x 1 5/8 inches
- Shipping Weight: 0.54 pound
- Voltage: 12 to 24 VAC or VDC
- Current (non-alarm): 45 mA @ 12 VDC, 22 mA @ 24 VDC, 65 mA @ 12 VAC, 45 mA @ 24 VAC
- Current (in alarm): 70 mA @ 12 VDC, 35 mA @ 24 VDC, 100 mA @ 12 VAC, 65 mA @ 24 VAC
- Color: white
- Sensor Maintenance: not required
- Alarm Relay Rating: 0.125 A, 40 V, 3 VA
- Trouble Relay: 0.250 A, 40 V, 10 VA
- Operating Temperature Range: 32° to 120° F
- Alarm Set Point: Per UL 1484, 25% LEL



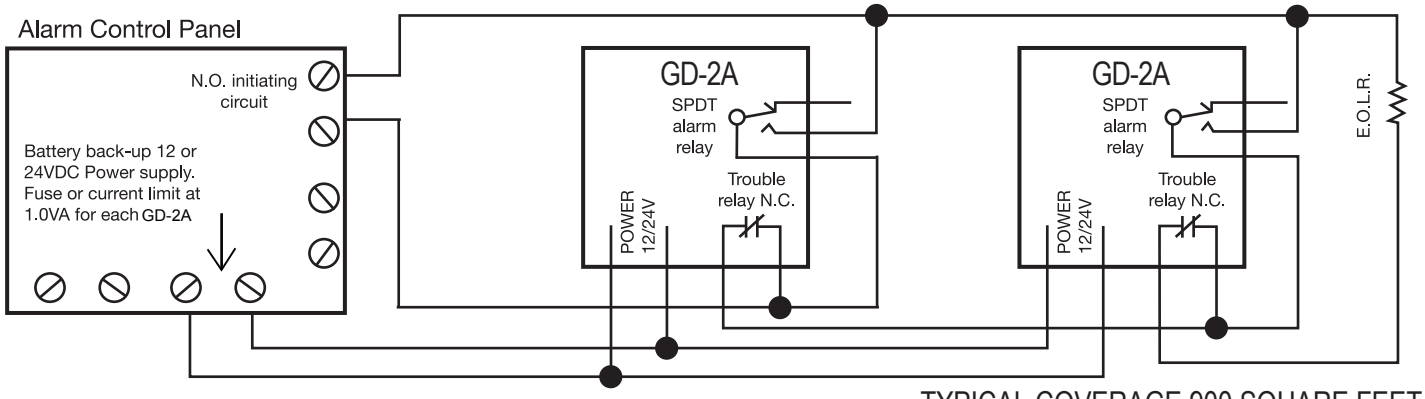
Installation

The three part plastic case allows the GD-2A to be either surface mounted or installed over a four-inch square or double gang electrical box, providing a near flush mount.

Location

A GD-2A is usually located in each room (except kitchens or bathrooms) where there are gas appliances or through which gas pipes pass. Do NOT mount the GD-2A in a corner. Do NOT mount the GD-2A in kitchens or bathrooms - alcohol's, ammonia, cleaning solvents, paint thinner, gasoline vapors, and aerosol propellants (aerosol cans such as hair spray usually contain a combustible gas) may cause alarms. Do NOT mount the GD-2A where the normal ambient temperature is below 32° F (0° C) or exceeds 120° F (50° C). If the gas used is natural gas (methane) mount the GD-2A on a wall about one foot down from the ceiling. If the gas used is propane (LP), mount the GD-2A on a wall or column one foot above the floor. Use the same spacing as for smoke detectors- 30-foot centers, 900 square feet per detector.

TYPICAL CONNECTION OF TWO GD-2A TO AN ALARM CONTROL PANEL



TYPICAL COVERAGE 900 SQUARE FEET

Made in the USA

Made in the U.S.A. with US and imported materials

MACURCO
Gas Detection Experts

Macurco™ GD-2A

Combustible Gas Detector
Installation & Operation Manual

IMPORTANT: These User Instructions are to be provided to the homeowner/end user upon product installation. Each person installing or using this equipment must read and understand the information in these User Instructions before use. Installation of this equipment by untrained or unqualified persons, or use that is not in accordance with these User Instructions may adversely affect product performance and result in sickness or death. For proper use see User Instructions or call Macurco Technical Service.

www.macurco.com 1-877-367-7891 info@macurco.com 1504 W 51st St. Sioux Falls, SD 57105

1 General Safety Information

1.1 List of warnings

⚠WARNING
Each person using this equipment must read and understand the information in these User Instructions before use. Use of this equipment by untrained or unqualified persons or use that is not in accordance with these User Instructions, may adversely affect product performance and **result in sickness or death**.
Use only for monitoring the gas which the sensor and detector are designed to monitor. Failure to do so may result in exposures to gases not detectable and **cause sickness or death**. For proper use, see supervisor or User Instructions, or call Macurco Technical Service.
GD-2A may not function effectively below 32 °F or above 120°F. Using the detector outside of this temperature range may adversely affect product performance and **result in sickness or death**.
This detector helps monitor for the presence and concentration level of certain specified airborne gases. Misuse may produce an inaccurate reading, which means that higher levels of the gas being monitored may be present and could result in overexposure and **cause sickness or death.** For proper use, see supervisor or User Instructions, or call Macurco Technical Service.
This product is intended for use in ordinary indoor locations of family living units and office workspaces. The GD-2A is not designed to measure compliance with Occupational Safety and Health Administration (OSHA) commercial or industrial standards.
When the unit is powered up it performs a self-test during which the green LED light will blink for a period of one and one half to two minutes. Afterward, the green LED light will turn on continuously to indicate the unit is in normal operation (ARMED). If the self-test fails or the green LED light does not turn on continuously do not use. Failure to do so may adversely affect product performance and **result in sickness or death**.
Immediately exit the environment if there is an alarm condition on the detector. **Failure to do so may result in sickness or death**.
This detector will only indicate the presence of combustible gas at the sensor. Combustible gas may be present in other areas. Accommodation spaces should be well ventilated when household cleaning supplies or similar contaminants are used.
Do not cover or obstruct visual alarm LED. Doing so may adversely affect product performance and **result in sickness or death**.
Do not disassemble unit or attempt to repair or modify any component of this detector. This detector contains no user serviceable parts, and substitution of components may adversely affect product performance and **result in sickness or death**.
CAUTION
Avoid the use of harsh cleaning materials, abrasives and other organic solvents. Such materials may permanently scratch the surfaces, damage the sensor, labels or instrument housing.
If you have any doubts about the applicability of the equipment to your job situation, consult an industrial hygienist or call Macurco Technical Service.

www.macurco.com 1-877-367-7891 info@macurco.com 1504 W 51st St. Sioux Falls, SD 57105

2 Use Instructions and Limitations

The GD-2A is a low voltage (12-24 VAC or VDC) electronic detector of combustible, heating type gases, that has been evaluated by ETL for methane (natural gas) and propane (LP) gas. The GD-2A is designed for connection to Fire Alarm/Burglary Control Panels. The GD-2A has a SPDT Alarm relay, for connection to control panels or other devices. The GD-2A does NOT detect carbon monoxide. The GD-2A does not have an internal audible sounder.

⚠WARNING

Each person using this equipment must read and understand the information in these User Instructions before use. Use of this equipment by untrained or unqualified persons or use that is not in accordance with these User Instructions, may adversely affect product performance and **result in sickness or death**.

2.1 Use For

The GD-2A is an electronic detector of combustible, heating type gases (natural gas and propane), designed for connection to alarm control panels. It can operate on 12 to 24 VDC power from standby or interruptible panel power or be powered separately. The GD-2A is intended for installation in buildings in non-hazardous locations such as residences, retail stores, office buildings, and institutional buildings.

⚠WARNING

Use only for monitoring the gas which the sensor and detector are designed to monitor. Failure to do so may result in exposures to gases not detectable and **cause sickness or death**. For proper use, see supervisor or User Instructions, or call Macurco Technical Service.

2.2 Do NOT use for

The GD-2A is NOT intended for use in industrial applications such as refineries, chemical plants, etc. The GD-2A does NOT detect carbon monoxide. Do NOT mount the GD-2A in a corner. The GD-2A is designed for connection to Fire Alarm/Burglary Control Panels. Do not connect the GD-2A to Fire Alarm Circuits, or Burglar Alarm or other signals. The Alarm Control Panel must be dedicated to gas detection or have alarm devices that provide a distinctive alarm for gas detection. Do NOT mount the GD-2A in kitchens or bathrooms - alcohol's, ammonia, cleaning solvents, paint thinner, gasoline vapors, and aerosol propellants (aerosol cans such as hair spray usually contain a combustible gas) may cause nuisance alarms.

⚠WARNING

GD-2A may not function effectively below 32 °F or above 120°F. Using the detector outside of this temperature range may adversely affect product performance and **result in sickness or death.**

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2.3 Features

- Listed to UL standard 2075 for the standard for safety for gas and vapor detectors and sensors
- Sensitivity tested based on UL 1484 standard for residential gas detectors
- Detects heating gases: propane (LP) and natural gas (methane)
- SPDT alarm and N.C. trouble relays
- Can be self-restoring or latching
- Electronic sensors: no maintenance or recalibration
- Temperature compensated
- Simple installation and operation
- Supervised sensor

2.4 Specifications

- Size: 4 ½ X 5 X 1 5/8 inches
- Shipping weight: 0.54 pound
- VOLTAGE: 12 to 24 VAC or VDC
- Current (non-alarm): 45 mA @ 12 VDC, 22 mA @ 24 VDC, 65 mA @ 12 VAC, 45 mA @ 24VAC
- Current (in alarm): 70 mA @ 12 VDC, 35 mA @ 24 VDC, 100 mA @ 12 VAC, 65 mA @ 24 VAC
- Color: White
- Sensor maintenance: Not required
- Alarm relay rating: 0.125 AMPS, 40V, 3VA
- Trouble relay: 0.250 AMPS, 40V, 10VA
- Operating temperature range: 32° to 120° F
- Alarm set point: Per UL 1484 (25% LEL)

3 Installation and Operating Instructions

The following instructions are intended to serve as a guideline for the use of the Macurco GD-2A Combustible Gas Detector. It is not to be considered all-inclusive, nor is it intended to replace the policy and procedures for each facility.

⚠WARNING

This detector helps monitor for the presence and concentration level of certain specified airborne gases. Misuse may produce an inaccurate reading, which means that higher levels of the gas being monitored may be present and could result in overexposure and **cause sickness or death**. For proper use, see supervisor or User Instructions, or call Macurco Technical Service.

3.1 Location

A GD-2A is usually located in each room (except kitchens or bathrooms) where there is gas appliances or through which gas pipes pass. Do NOT mount the GD-2A in a corner. Do NOT mount the GD-2A in kitchens or bathrooms - alcohols, ammonia, cleaning solvents, paint thinner, gasoline vapors, and aerosol propellants (aerosol cans such as hair spray usually contain a combustible gas) may cause alarms. Do NOT mount the GD-2A where the normal ambient

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temperature is below 32° F (0° C) or exceeds 120° F (50° C).

⚠WARNING
This product is intended for use in ordinary indoor locations of family living units and office workspaces. The GD-2B is not designed to measure compliance with Occupational Safety and Health Administration (OSHA) commercial or industrial standards.

3.2 Installation

1. If the gas used is natural gas (methane) mount the GD-2A on a wall about one foot down from the ceiling. If the gas used is propane (LP), mount the GD-2A on a wall or column one foot above the floor. Use the same spacing as for smoke detectors- 30-foot centers, 900 square feet per detector.
2. The three-part plastic case allows the GD-2A to be either surface mounted or installed over a four-inch square or double gang electrical box, providing a near flush mount. The GD-2A snap on front cover will need to be removed before installation. To remove it, lightly pry the front cover off of the mounting plate (middle section) with a coin or flat screwdriver inserted into the vent at the bottom. The cover will snap off exposing the electronics and mounting plate.
3. For flush mount, remove the 2 screws and rear cover from the mounting plate and use the appropriate hole-pattern for installation. The four holes toward the center of the mounting plate match the hole- pattern of a double gang electrical box. The four holes near the corners match the pattern of a four-inch square box. Mount the GD-2A so the "TOP" marked side of the mounting plate is at the highest side. Snap the front cover back on when finished, making sure that the lights line up with the access holes.
4. When using the GD-2A with normally closed initiating circuits, use the Com. and N.C. alarm relay connections.
5. See wiring diagram and information below for connections of the GD-2A.

- UL 2075 Requirements - 12.4.1 Power supply leads provided for field connection shall not be less than 6 inches (152 mm) long, provided with strain relief, and shall be no smaller than 18 AWG (0.82 mm2). The insulation, when thermoplastic, shall not be less than 1/32 inch (0.8mm) thick.
- Exception No. 1: A lead is not prohibited from being less than 6 inches long when it is evident that the use of a longer lead results in damage to the insulation.
- Exception No. 2: Solid copper leads as small as 26 AWG (0.13 mm2) are not prohibited from use when:
    - The current does not exceed 1 ampere for lengths up to 2 feet (61 cm) and the current does not exceed 0.4 ampere for lengths from 2 feet up to 10 feet (3.05 m);
    - There are two or more conductors, and they are covered by a common jacket, or the equivalent; and
    - The assembled conductors comply with the requirements of the Strain Relief Tests, Section 18.

6. The GD-2A uses a full wave bridge rectifier at its power input, so that it is independent of the polarity of the input power. It can operate on DC or AC voltages between 12 and 24 volts.
7. A switching regulator is used to efficiently match the wide input voltage range to the fixed, internal power system. As a result, the power consumption is fairly constant at about 0.75 watts in normal operation, and 1.0 watt in alarm.
8. The alarm control panel zone inputs must be terminated with end of line resistors (E.O.L.R.), which are provided with the panel. The GD-2A does not have an internal audible sounder and must be connected to a Fire Alarm/Burglary Control Panel with an audible device that provides at least 85 dB sound output.

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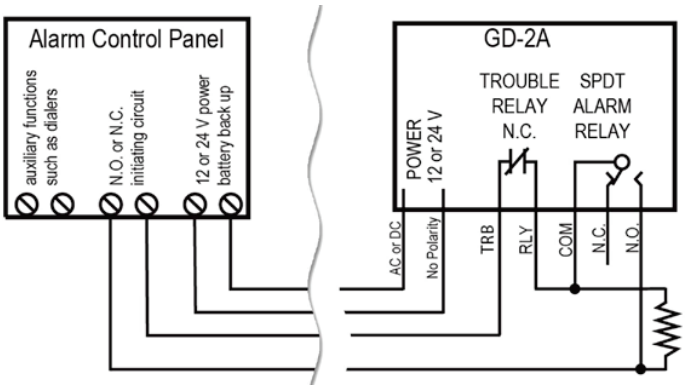

Figure 3-1 – Connection of a single GD-2A to an alarm control panel

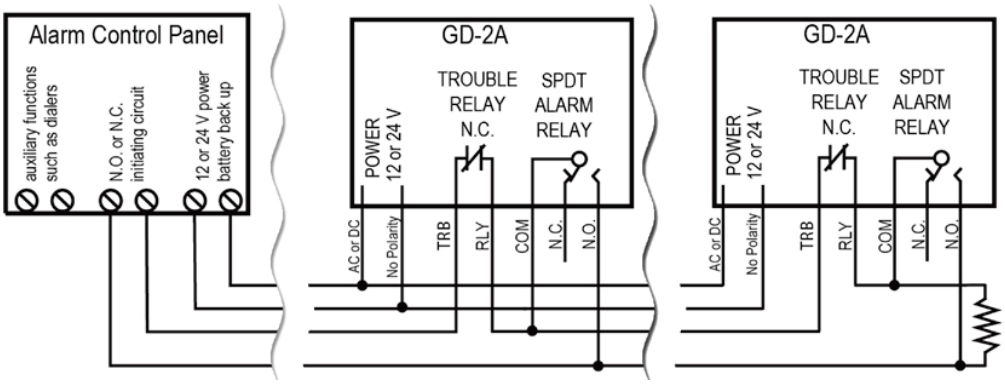

Figure 3-2 – Connection of multiple GD-2A to an alarm control panel

4 Operation

⚠WARNING

When the unit is powered up it performs a self-test during which the green LED light blinks for a period of one and one half to two minutes. Afterwards, the green LED light will turn on continuously to indicate the unit is in normal operation (ARMED). If the self-test fails or the green LED light does not turn on continuously do not use. Failure to do so may adversely affect product performance and **result in sickness or death**.

4.1 Power Up

When power is first applied to the detector, it will go through a warm-up period of two and one-half minutes, during which alarms are inhibited. The green LED light will turn on and off during the delay period. The green light will turn

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1. Once the GD-2A is operational (ARMED) the green light will be on continuously. If gas is detected the red LED (ALARM) turns on and the SPDT alarm relay activates to indicate the alarm condition.
2. In the configuration, as shipped from the factory, the GD-2A is self-restoring. When the air clears of gas, the red light turns off and the relay switches to its normal state. A jumper wire on the circuit board can be clipped to allow the unit to latch in upon alarm. Once latched in, power will need to be interrupted to un-latch the alarm condition.
3. The GD-2A can be modified, either before or after installation, to have a latching output. Pull off the cover and locate the jumper wire labeled "CLIP FOR LATCH IN" on the printed circuit board in the upper right-hand side. Clip or cut this jumper wire and separate the wire ends. Now the unit will stay in alarm (once gas has exceeded the pre-set threshold) until the power is interrupted. When replacing the cover, make sure the lights line up with their access holes.
4. The GD-2A has a supervisory circuit of critical functions. A trouble condition, due to failure of a non-reliable component, results in both lights switching on and off and the normally closed trouble relay opening. A power failure also causes the trouble relay to open.

4.2 Alarms

⚠WARNING
Immediately exit any environment if there is an alarm condition on the detector. Failure to do so may result in sickness or death.

The final alarm is determined by the configuration of the control panel, with the GD-2A only switching its relay to actuate the panel. Do not connect the GD-2A to Fire Alarm Circuits, or Burglar Alarm or other signals. The illumination of the red (ALARM) light on the GD-2A indicates the alarm condition. When an alarm occurs immediately evacuate the premises and seek assistance.

⚠WARNING
This detector will only indicate the presence of combustible gas at the sensor. Combustible gas may be present in other areas. Accommodation spaces should be well ventilated when household cleaning supplies or similar contaminants are used.

In addition to the methane (natural gas) and propane (LP) gas that it is designed to detect, the GD-2A can also be affected by a broad range of combustible gases. Some of these that may cause an alarm are

- alcohol,
- ammonia,
- cleaning solvents,
- paint thinner,
- gasoline vapors,
- aerosol propellants.
- Aerosol cans such as hair spray usually contain a combustible gas.

Always make sure that there is adequate ventilation when you use these products. Proper location, not in kitchens or bathrooms, will minimize alarms due to normal use of household products.

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4.3 Trouble Indicator

The trouble signal is determined mostly by the configuration of the alarm panel, with the GD-2A trouble relay only providing an open circuit for actuation. A failure of the gas-sensing element will result in both lights turning on and off and the trouble relay opening. Failure of power supplies in the GD-2A or a lack of power to the detector will result in the trouble relay opening. The most common expected trouble would be a break in the wiring between the panel and the GD-2A. When a trouble signal occurs call the alarm panel installer for assistance.

⚠WARNING
Do not cover or obstruct visual alarm LED. Doing so may adversely affect product performance and **result in sickness or death**.

4.4 End-Of-Life Indicator

5 years after the GD-2A is installed the end-of-life signal will be activated indicating that the GD-2A has reached the end of its service life and needs to be replaced. The end-of-life signal will cause an open circuit in the normally close (NC) Trouble Relay to provide actuation of the signal circuits. The green LED will remain steady and red LED will flash every second to indicate end-of-life signal. End-of-life signal can be silenced for 48 hours by resetting power of GD-2A. End-of-life signal also resets the Trouble Relay to the Normally Closed (NC) position and LED will also be reset. The silence function will continue to be available for 29 days after the GD-2A initiates an end-of-life signal. After this 29-day period, the GD-2A can no longer be silenced and must be replaced.

5 Maintenance

The GD-2A does not require regular maintenance. The unit uses a self-purging semi-conductor sensor that has a long-life expectancy. All service and repair of the GD-2A are to be performed by Macurco. Macurco does not sanction any third-party repair facilities.

⚠WARNING
Do not disassemble unit or attempt to repair or modify any component of this instrument. This instrument contains no user serviceable parts, and substitution of components may impair intrinsic safety which may adversely affect product performance and **result in sickness or death.**

5.1 Cleaning

The GD-2A should be cleaned using the soft brush attachment of your vacuum cleaner. The GD-2A should be tested after cleaning to ensure the unit is operating normally.

5.2 Sensor Poisons

Once the unit is fully operational (the green light is on steady), test the unit by directing gas from an unlighted butane cigarette lighter into the detector near the left-hand side through one of the vent holes. It will be necessary to hold the lighter valve open for several seconds. The red light (ALARM) will turn on, the alarm relay switches, and any devices connected should activate. The detector should be tested regularly by using gas from an unlit cigarette lighter, as detailed above.

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6 Testing

Once the unit is fully operational (the green light is on steady), test the unit by directing gas from an unlighted butane cigarette lighter into the detector near the left-hand side through one of the vent holes. It will be necessary to hold the lighter valve open for several seconds. The red light (ALARM) will turn on, the alarm relay switches, and any devices connected should activate. The detector should be tested regularly by using gas from an unlit cigarette lighter, as detailed above.

7 Macurco Gas Detection Product limited warranty

Macurco warrants the GD-2A gas detector will be free from defective materials and workmanship for a period of two (2) years from the date of manufacture (indicated on inside cover of the GD-2A), provided it is maintained and used in accordance with Macurco instructions and/or recommendations. If any component becomes defective during the warranty period, it will be replaced or repaired free of charge, if the unit is returned in accordance with the instructions below. This warranty does not apply to units that have been altered or had repair attempted, or that have been subjected to abuse, accidental or otherwise. The above warranty is in lieu of all other express warranties, obligations or liabilities. THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE ARE LIMITED TO A PERIOD OF TWO (2) YEARS FROM THE PURCHASE DATE. Macurco shall not be liable for any incidental or consequential damages for breach of this or any other warranty, express or implied, arising out of or related to the use of said gas detector. The manufacturer or its agent's liability shall be limited to replacement or repair as set forth above. Buyer's sole and exclusive remedies are the return of the goods and repayment of the price, or repair and replacement of non-conforming goods or parts.

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Macurco Gas Detection

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