



May 11, 2023

Sunny Becker, Site Manager
Washington State Department of Ecology
Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008-5452

RE: Everett Landfill – 2022 Landfill Gas Annual Report

Dear Sunny:

Herrera Environmental Consultants, Inc. has completed the Landfill Gas Performance Monitoring annual report for the Everett Landfill site during the 2022 calendar year.

The attached letter report presents data and results from the quarterly Landfill Gas Monitoring events and highlights several significant observations about various areas on and around the landfill site.

As you will see in the attached, the landfill site remains in compliance regarding the landfill gas exposure pathway requirements established in the CAP/CD.

If you have any comments or questions on the attached, please don't hesitate to contact me.

Sincerely,


A handwritten signature in blue ink, appearing to read 'Randy Loveless', written over a light blue horizontal line.

Randy Loveless, P.E.
Landfill Site Manager

Enclosure

Public Works

 3200 Cedar Street
Everett, WA 98201

 425.257.8800
425.257.8882 fax

 everettpw@everettwa.gov
everettwa.gov/pw

2022 Annual Report

Landfill Gas Performance Monitoring Everett Landfill Site

Prepared for
City of Everett Public Works Department

Prepared by
Herrera Environmental Consultants, Inc.

Note:

Some pages in this document have been purposely skipped or blank pages inserted so that this document will print correctly when duplexed.

2022 Annual Report

Landfill Gas Performance Monitoring Everett Landfill Site

Prepared for
City of Everett Public Works Department
3200 Cedar Street
Everett, WA 98201

Prepared by
Herrera Environmental Consultants, Inc.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206-441-9080

May 9, 2023

This page intentionally left blank

CERTIFICATE OF PROFESSIONAL ENGINEER

This document has been prepared under the supervision of a professional engineer.



05/10/2023

Tyson Wright, PE.
Name

May 10, 2023
Date

Contents

- Certificate of Professional engineer i
- Contents ii
 - Tables..... iii
 - Figures..... iii
- Introduction..... 1
- Summary 3
- LFG System Description..... 5
 - Landfill Gas Collection System 5
 - Blower System..... 6
- Landfill Gas Collection System Status 11
 - Landfill Gas Perimeter Probe Monitoring 11
 - Background 11
 - Methods..... 11
 - Results 12
 - Landfill Gas Surface Monitoring 20
 - On-Site Surface Monitoring 21
 - Off-Site Structure Monitoring 25



Tables

Table 1. List of Device Nodes and Blower Station Connections.....	7
Table 2. Quarterly Data Collection Parameters.....	12
Table 3. Perimeter Probe Monitoring Results.....	15
Table 4. Gas Monitoring Results at Off-Site Structures	27

Figures

Figure 1. Landfill Gas System Map and Blower Connections.....	9
Figure 2. LFG Monitoring Probes.....	13
Figure 3. Quarterly Serpentine Monitoring Results.....	23
Figure 4. Vicinity Map of Everett Landfill.....	26
Figure 5. 2022 Non-Zero Compliance Perimeter Probe Readings.....	29

This page intentionally left blank

INTRODUCTION

Herrera Environmental Consultants, Inc. (Herrera) is contracted by City of Everett Public Works (the City) to support in the operations and maintenance of the landfill gas (LFG) system at the Everett Landfill. This Annual Report presents LFG monitoring techniques, data and results at and around the Everett Landfill for the year 2022. This document satisfies the Gas Pathway reporting requirements of the Cleanup Action Plan (CAP) and Compliance Monitoring and Contingency Plan (CMCP) for the Everett Landfill Site.

This annual report also provides a summary of the LFG collection and control system and the chronology of installation for different sections completed in previous years and currently being developed.

This page intentionally left blank

SUMMARY

This Annual Report provides relevant information pertaining to the LFG systems at the Everett Landfill Site and results of the 2022 LFG compliance monitoring as set forth in the CMCP. Annual LFG compliance monitoring for 2022 included quarterly probe reads, and on-site and off-site methane surface monitoring. All monitoring levels were below limits set forth in the CMCP except the September reads for Probes LG-88 and LG-89, which measured methane concentrations of 12.9 percent and 5.4 percent, respectively. Although methane concentrations above the CMCP limits are reported for these wells for the September event, the measurements are not valid and do not constitute a measured exceedance since the wells were flooded with water. The LFG compliance monitoring data for 2022 demonstrates that the Everett Landfill Site remains in compliance.

This page intentionally left blank

LFG SYSTEM DESCRIPTION

The City of Everett Landfill (landfill) is a closed landfill located in the City of Everett, Washington. The landfill is approximately 70 acres in size and located in the new Riverfront section in the eastern part of the city. The landfill actively collected waste until 1974 after 50 years of operation. The landfill was sold to Riverfront Commercial Investment, LLC and is currently being redeveloped into a mixed-use area. A new roadway crossing the site (Riverfront Boulevard) was completed in 2021, and the portion of the site west of the roadway is under construction. This construction activity includes two mixed-use buildings.

In 2001, the City entered into a Consent Decree (CD) with the Washington State Department of Ecology (Ecology). The property developer subsequently signed on to the CD. The CAP incorporated into the CD defined cleanup requirements for all exposure pathways for both existing undeveloped, and future developed conditions. In the CAP, required cleanup actions for LFG for undeveloped conditions included control measures for existing on-site facilities, perimeter monitoring, and contingent installation of perimeter LFG migration controls. The CAP included the CMCP defining monitoring requirements for all exposure pathways, including LFG and its constituents of concern which were performed and described as part of this Annual Report.

Landfill Gas Collection System

The LFG system has been installed in phases beginning in 2004. Prior to being expanded to accommodate the development of the landfill site, the LFG collection system was composed of manifold (header) pipes that generally followed the outer perimeter of the 70-acre site. The expanded system includes several extensions of the header pipes throughout the landfill site. Collector (perforated) pipes within and along the landfill boundary connect into the header pipes. The header pipes are typically solid-wall, 8-inch diameter high density polyethylene (HDPE), and the collector pipes are typically 4-inch or 6-inch diameter perforated HDPE.

An LFG extraction trench (also known as a gas interception or collection trench) was constructed along most of the northern portion of the west landfill boundary and commenced operation in 2004. This trench was designed to prevent off-site migration by intercepting gas originating from the landfill. A northern extension of the perimeter gas interception trench was also constructed (in the same project) along the southern edge of the 36th Street right-of-way in 2004. In 2006, a second LFG extraction trench was installed along the northern edge of the 36th Street right-of-way, parallel to and north of the 2004 trench. The 41st Street overcrossing gas extraction system was installed in 2006. An additional perimeter gas interception trench was installed along the eastern landfill boundary, utilizing the existing leachate collector trench in 2013. A new segment of gas interceptor was completed in 2018 along the southeastern landfill boundary, as an extension of the existing gas collector along the eastern boundary, also utilizing the existing leachate collector trench. A second, separate gas extraction trench was constructed in 2019 and 2020 from the southern tip of the landfill some 480 feet northward, east of the

combined leachate collector/gas extraction trench. At present, almost the entire landfill perimeter is surrounded by active gas interception trenches.

In 2021, the initial phase of the Riverfront Development project on the landfill was completed, including the Riverfront Boulevard and its active LFG collection system. The Riverfront Boulevard LFG collection system connects to the north blower facility. Dedication of Riverfront Boulevard occurred in July of 2021 at which time it became open for public use and the LFG collection system was officially active and under the control and monitoring of the City. Monitoring of LFG surface emissions along Riverfront Boulevard began in 2021 and is described later in this report.

Blower System

The LFG system is served by two blower facilities that apply vacuum to the header pipe network: the north blower facility is located near the intersection of 36th Street and Riverfront Boulevard, and the south blower facility is located immediately west of Riverfront Boulevard at the south end of the site, south of the 41st Street Roundabout. Both blower facilities have two blowers, however, the second blower at each blower facility is only needed for redundancy. The North Blower and South Blower facilities provide vacuum for the existing perimeter, 41st Street, Riverfront Boulevard, and West Site LFG collection system headers.

The blower facilities are also the LFG discharge points. The blower facilities vent collected LFG to atmosphere through a discharge stack that extends vertically from the blower skid. Table 1 and Figure 1 show which nodes of the LFG collection system connect to the two blower facilities. By manipulating isolation valves throughout the system, groups of nodes can be connected to the blower facility as needed, based on monitoring results and operational needs.

Gas monitoring with a Landtec GEM 5000 unit is performed monthly at the device nodes and at each blower station. In 2021, confirmational gas samples were collected from both blower facilities and were analyzed by a laboratory per the CMCP after the Riverfront Boulevard LFG collection system was brought online. No new segments of the LFG collection system became operational in 2022, so no LFG sampling was required for 2022.

Table 1. List of Device Nodes and Blower Station Connections.

Device/Node	Blower	Device/Node	Blower
BLVD0001	North	CM000027	South
BLVD0002	North	CM000028	South
BLVD0003	North	CM000029	South
BLVD0004	North	CM000030	South
BLVD0005	North	CM000031	North
BLVD0006	North	CM000032	North
BLVD0007	North	CM000033	North
BLVD0008	North	CM000034	South
BLVD0009	North	CM000035	South
BLVD0010	North	CM000036	South
BLVD0011	North	CM000037	South
BLVD0012	North	CM000038	South
CM000001	South	CM000039	South
CM000002	South	CM000040	South
CM000003	South	CM000041	South
CM000004	South	CM000042	South
CM000005	South	LFG00001	North Blower
CM000006	South	LFG00002	South Blower
CM000007	South	VL104X50	South
CM000008	South	VL106X50	South
CM000009	South	VL108X50	South
CM000010	South	VL110X50	South
CM000011	South	VL112X50	South
CM000012	South	VL114X50	South
CM000013	South	VL115X50	South
CM000014	South	VL116X75	South
CM000015	South	VL117X50	South
CM000016	South	VL118X50	South
CM000017	South	VL120X50	North
CM000018	South	VL122X50	North
CM000019	South	VL124X50	North
CM000020	South	VL126X50	North
CM000021	South	VL128X50	North
CM000022	South	VL130X00	North
CM000023	South	VL130X60	North
CM000024	South	VL131X50	North
CM000025	South	VL132X90	North
CM000026	South	VL133X25	North

device node is connected to south blower.

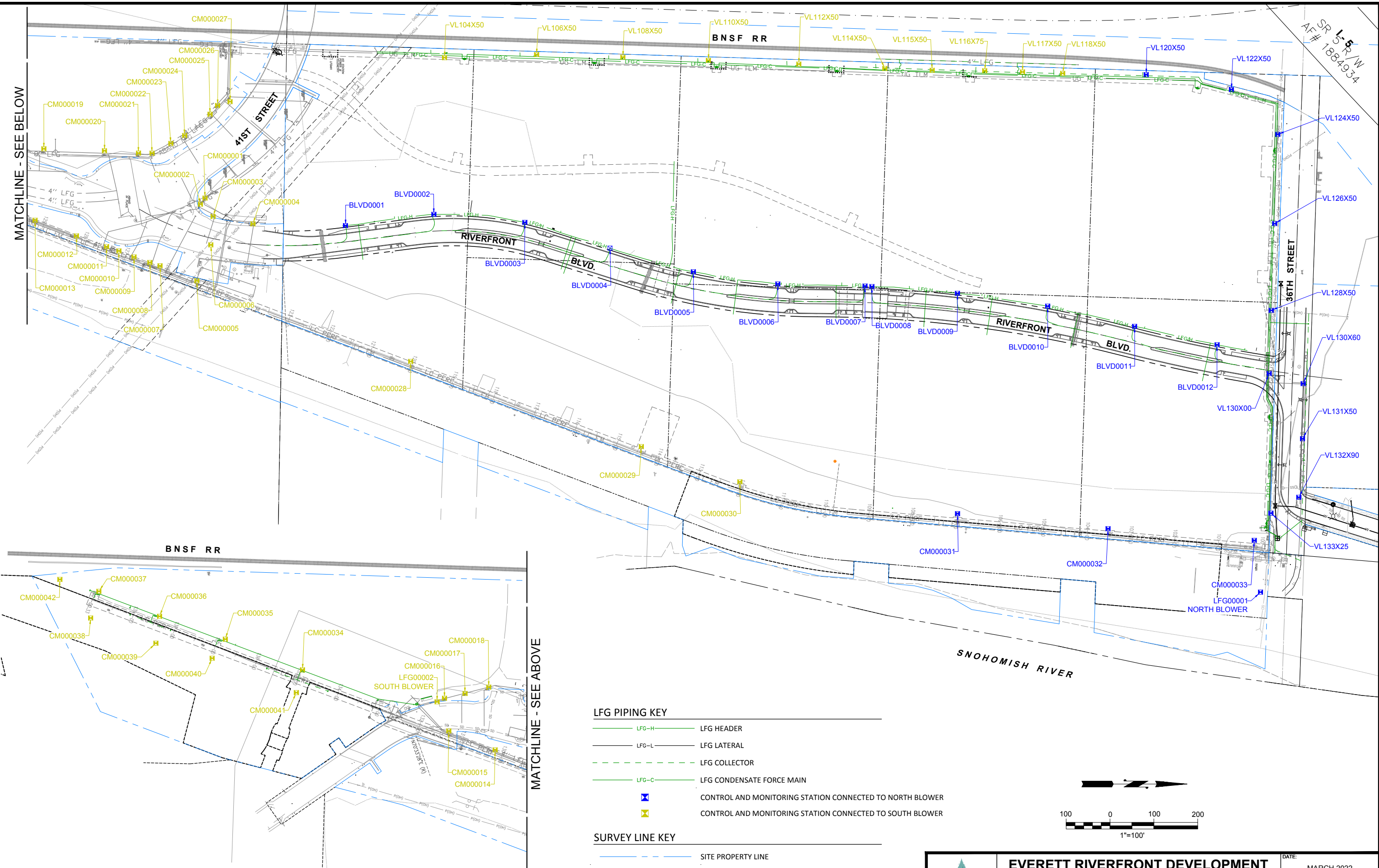
device node is connected to north blower.

This page intentionally left blank

SR 1-5 R/W
AF # 1884934

MATCHLINE - SEE BELOW

MATCHLINE - SEE ABOVE

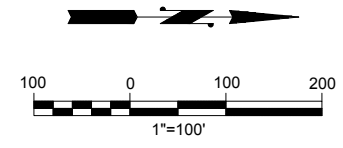


LFG PIPING KEY

- LFG-H LFG HEADER
- LFG-L LFG LATERAL
- - - LFG COLLECTOR
- LFG-C LFG CONDENSATE FORCE MAIN
- ⊠ CONTROL AND MONITORING STATION CONNECTED TO NORTH BLOWER
- ⊠ CONTROL AND MONITORING STATION CONNECTED TO SOUTH BLOWER

SURVEY LINE KEY

- - - SITE PROPERTY LINE
- OTHER PROPERTY/R.O.W. LINES
- - - EASEMENT LINE



EVERETT RIVERFRONT DEVELOPMENT

FIGURE 1 - LANDFILL GAS SYSTEM MAP AND BLOWER CONNECTIONS

DATE:	MARCH 2022
DRAWING:	
SHEET:	1 OF 1

\\herra\local\herra\proj\2018\15-0675-002\CADD\DWG\LFG-BlowerConnections\Exhibit.dwg | 3/31/2022 11:23 AM | Chuck Marston

© 2018 Herrera Environmental Consultants, Inc. All rights reserved.

This page intentionally left blank

LANDFILL GAS COLLECTION SYSTEM STATUS

Several LFG monitoring tasks were performed at the Everett Landfill in 2022 as part of compliance monitoring requirements for the gas environmental exposure pathway. Results of compliance monitoring help to evaluate how well the LFG collection system is performing to prevent migration of methane from the landfill.

Four quarterly monitoring events conducted on the following dates are discussed:

- First Quarter: March 23 and March 24, 2022
- Second Quarter: June 23, July 6, and July 7, 2022
- Third Quarter: September 28 and September 29, 2022
- Fourth Quarter: January 24, January 25, and January 26, 2023

The LFG compliance monitoring tasks performed this year include:

- Quarterly perimeter probe monitoring
- Quarterly landfill surface monitoring
- Quarterly off-site structures monitoring

Landfill Gas Perimeter Probe Monitoring

Background

A network of LFG compliance monitoring probes is established around the perimeter of the landfill site. The locations of these probes are shown in Figure 2. These probes are used to determine if LFG control systems are effective in preventing off-site migration of methane. The CAP and CMCP establish a contingency plan trigger of 5 percent methane by volume, measured at any perimeter compliance monitoring probe.

Methods

The City utilized a Landtec GEM 5000 unit for measuring gas concentrations and flows from probes surrounding the perimeter of the landfill site. Probe measurements are usually collected quarterly in March, June, September and December as per the CMCP. Some third quarter probe reads took place in early July because a different non-LFG related utility required attention by the City Public Works crew at the end of June and into July which put the second quarter LFG probe monitoring on hold. December reads took place in January 2023 because the City's GEM 5000 was in for repairs during December and into January. Ecology was notified about the delay in collecting fourth quarter reads.

Thirty-nine (39) probes are present and accessible around the perimeter of the landfill, within the boundary, and nearby, and were monitored in 2022. Thirty-six (36) of the probes were used for compliance monitoring and three were only monitored to inform operations during 2022. Monitoring probes are shown on the map in Figure 2. Compliance probes are colored green and non-compliance probes are colored orange.

The GEM 5000 samples and analyzes the methane, carbon dioxide and oxygen content of LFG with options for additional analysis. This handheld unit is portable and is manually carried by the user during the investigation. LFG readings were taken by City staff from the probes quarterly and were sent to Herrera for reporting and analysis. Table 2 describes what readings were collected from the probes by the GEM 5000 and what data is included in Table 3.

Table 2. Quarterly Data Collection Parameters.

Compound	Units	Description
CH4	Percent	Methane concentration of sampled landfill gas.
CO2	Percent	Carbon dioxide concentration of sampled landfill gas.
O2	Percent	Oxygen concentration of sampled landfill gas.

Results

All active probes were monitored and had methane levels below the contingency plan trigger of 5 percent unless otherwise discussed in the following sections. Results from quarterly probe monitoring are shown in Table 3.

Notable Areas/Probes

Landfill Interior – East Side – LG-14, LG-15, and LG-16

The three probes on the east perimeter trail – LG-14, LG-15, and LG-16 – shown in orange on Figure 2 – all had a methane reading above 5 percent at least once during 2022. These three probes are not compliance monitoring probes due to their completion in fill but have continued to be monitored to inform operations.

Figure 2. LFG Monitoring Probes.

Northern Probes



Southern Probes



Type of Probe

- NON-COMPLIANCE
- COMPLIANCE

This page intentionally left blank

Table 3. Perimeter Probe Monitoring Results.

Device ID	Date	CH4	CO2	O2
LG000014	3/24/2022	57.4	13.1	13.1
LG000014	6/23/2022	70.5	15.1	14.4
LG000014	9/29/2022	62	20.9	17.1
LG000014	1/25/2023	67.8	13.5	18.6
LG000015	3/24/2022	30.4	3.7	11.5
LG000015	6/23/2022	28.2	6.7	11.9
LG000015	9/29/2022	38.6	29.2	0.3
LG000015	1/25/2023	7.7	3.9	10.6
LG000016	3/24/2022	0	0.1	21.2
LG000016	6/23/2022	0	0	20.3
LG000016	9/29/2022	64	28.4	0.6
LG000016	1/25/2023	0.5	0.2	21.1
LG000021	3/24/2022	0	0.1	21.5
LG000021	6/23/2022	0	0	20.8
LG000021	9/29/2022	0	0	20.2
LG000021	1/26/2023	0.1	0.1	21.8
LG000023	3/24/2022	0	0.1	21.6
LG000023	6/23/2022	0	0.1	21
LG000023	9/29/2022	0	0	20.2
LG000023	1/26/2023	0.1	0.1	21.9
LG000024	3/24/2022	0	0.1	21.6
LG000024	6/23/2022	0	0.1	21.1
LG000024	9/29/2022	0	0	20.1
LG000024	1/26/2023	0.1	0.1	21.9
LG000025	3/24/2022	0	0.3	21.4
LG000025	6/23/2022	0	0.1	21.1
LG000025	9/29/2022	0	0	20.1
LG000025	1/26/2023	0.1	0.3	21.8
LG000026	3/24/2022	0	0.1	21.6
LG000026	6/23/2022	0	0.1	21.1
LG000026	9/29/2022	0	0.1	20
LG000026	1/26/2023	0	0.1	21.8
LG000027	3/24/2022	0	0.1	21.6
LG000027	6/23/2022	0	2.7	17.3
LG000027	9/29/2022	0	0	19.9
LG000027	1/26/2023	0	0.1	21.7
LG000028	3/24/2022	0	0.6	20.7
LG000028	6/23/2022	0	0	20.9
LG000028	9/29/2022	0	0.9	19.2
LG000028	1/26/2023	0	0.7	20.4
LG000030	3/24/2022	0	2.7	18.4
LG000030	6/23/2022	0	4.7	14.5

Table 3 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH4	CO2	O2
LG000030	9/29/2022	0	1.7	18.7
LG000030	1/26/2023	0	1.9	19.9
LG000031	3/24/2022	0	0.2	21.6
LG000031	6/23/2022	0	0.1	20.8
LG000031	9/29/2022	0	2.6	18.1
LG000031	1/26/2023	0.1	0.2	21.5
LG000032	3/24/2022	0	4.3	15.3
LG000032	6/23/2022	0	10.5	5.6
LG000032	9/29/2022	0	5.5	15.8
LG000032	1/26/2023	0	4.5	16.7
LG000033	3/24/2022	0	0.1	21.6
LG000033	6/23/2022	0	0.3	20.4
LG000033	9/29/2022	0	0.1	20.2
LG000033	1/26/2023	0	0.1	21.4
LG000034	3/24/2022	0	1.1	19.9
LG000034	6/23/2022	0	5	13.7
LG000034	9/29/2022	0	4.1	15.4
LG000034	1/26/2023	0	0.8	20.6
LG000035	3/24/2022	0	4.9	4.1
LG000035	6/23/2022	0	9.9	0.4
LG000035	9/29/2022	0	8	14.1
LG000035	1/26/2023	0	4.1	5.8
LG000041	3/24/2022	0	0.4	20.8
LG000041	7/6/2022	0	10.6	2.7
LG-41 reads were missed during Q3 (see text in Landfill Perimeter – North End section)				
LG000041	1/25/2023	0	0.2	20.9
LG000055	3/24/2022	0	9.2	11.6
LG000055	7/7/2022	0	10.3	10.9
LG000055	9/28/2022	0	8	12.9
LG000055	1/24/2023	0	3	17.7
LG000057	3/24/2022	0	0.4	20.7
LG000057	6/23/2022	0	0.6	20.1
LG000057	9/29/2022	0	1.1	20.8
LG000057	1/25/2023	0	0.7	20.5
LG000058	3/24/2022	0	6.1	11.6
LG000058	7/7/2022	0	0	20.2
LG000058	9/29/2022	0	2.6	19.5
LG000058	1/26/2023	0	3.9	15.8
LG000059	3/24/2022	0	9.1	9.5
LG000059	7/6/2022	0	0	20.3
LG000059	9/28/2022	0	4.7	15.8
LG000059	9/28/2022	0	0.3	20.7

Table 3 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH4	CO2	O2
LG000059	1/24/2023	0	6.2	12.6
LG000062	3/24/2022	0	0.8	19.5
LG000062	7/6/2022	0	1.4	18.4
LG000062	9/28/2022	0	0.6	19.8
LG-62 reads were missed during Q4 (see text in Landfill Perimeter – North End section)				
LG000070	3/23/2022	0	5.1	9.5
LG000070	7/6/2022	0.6	9.2	0.6
LG000070	9/28/2022	0	1.2	18.6
LG000070	1/24/2023	0	1.4	16.3
LG000071	3/23/2022	0	0.9	19.5
LG000071	7/6/2022	0	0	21.2
LG000071	9/28/2022	0.8	11.3	0.2
LG000071	1/24/2023	0	2	15.2
LG000072	3/23/2022	0	0.9	19.4
LG000072	7/6/2022	0	0	21.1
LG000072	9/28/2022	0	1.8	18.1
LG000072	1/24/2023	0	0.1	20.8
LG000073	3/23/2022	0	0.2	20.4
LG000073	7/6/2022	0	1.3	19.3
LG000073	9/28/2022	0	0.3	20.5
LG000073	1/24/2023	0	0.1	20.8
LG000076	3/24/2022	0	4.6	13.9
LG000076	6/23/2022	0	0.1	20.5
LG000076	9/29/2022	0	0.4	21.1
LG000076	1/25/2023	0	4.1	14.3
LG000078	3/24/2022	0	4.6	15.3
LG000078	6/23/2022	0	0.8	19.3
LG000078	9/29/2022	0	0.1	20.8
LG000078	1/25/2023	0	2.9	18.9
LG000085	3/24/2022	0	4.6	12.1
LG000085	7/6/2022	0	9.5	7.3
LG000085	9/28/2022	0	12.9	6.6
LG000085	1/25/2023	0	4.6	14.6
LG000086	3/24/2022	0	5	13.9
LG000086	7/6/2022	0	10.5	6.1
LG000086	9/28/2022	0	14.7	5
LG000086	1/25/2023	0	5.7	15.7
LG000087	3/24/2022	0	2.4	18.8
LG000087	7/6/2022	0	4.4	12.5
LG000087	9/28/2022	0	7.3	12.4
LG000087	1/25/2023	0	0.1	20.8
LG000088	3/24/2022	0	0.1	20.8

Table 3 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH4	CO2	O2
LG000088	6/23/2022	0	0.1	20.5
LG000088	9/29/2022	12.9	1.6	18.9
LG000088	1/25/2023	0	0.1	21
LG000089	3/24/2022	0	0.1	20.9
LG000089	6/23/2022	3.7	1.3	17.5
LG000089	9/29/2022	5.4	2.1	18.2
LG000089	1/25/2023	4.7	1.2	17.9
LG000090	3/24/2022	0	1	17.2
LG000090	6/23/2022	0	0	20.8
LG000090	9/29/2022	0	1.6	20.1
LG000090	1/25/2023	0	0.2	21.3
LG000091	3/24/2022	0	4.1	16
LG000091	7/6/2022	0	6.5	12.7
LG000091	9/28/2022	0	5.5	15.6
LG000091	1/24/2023	0	3.5	16.6
LG000092	3/24/2022	0	0.3	20.6
LG000092	7/6/2022	0	0.4	19.8
LG000092	9/28/2022	0	0.1	17.5
LG000092	1/24/2023	0	0.7	20.6
LG000093	3/24/2022	0	0.3	20.1
LG000093	7/6/2022	0	0.9	19.1
LG000093	9/28/2022	0	0.3	20.3
LG000093	1/24/2023	0	0.3	21
LG000094	3/24/2022	0	1.1	19
LG000094	7/6/2022	0	0.1	20.2
LG000094	9/28/2022	0	2.1	18.7
LG000094	1/24/2023	0	0.1	21.1
LG000095	3/24/2022	3.2	20.5	0.8
LG000095	6/23/2022	0	0.1	20.4
LG000095	9/29/2022	0	0.1	20.9
LG000095	1/25/2023	0.2	4.6	15.9

Notes:

Non-compliance probe.

Methane exceedance observed at non-compliance probe.

Methane exceedance observed at compliance probe.

The leachate/gas collection trench runs along the entire eastern boundary of the landfill, but some landfill waste remains east of the trench, due to access issues at the time of construction. LG-14, LG-15, and LG-16 are the only remaining probes located within the landfill footprint. All other previously monitored interior probes were decommissioned in accordance with Chapter 173-160 of Washington Administrative Code (WAC) in preparation for site development activities. Methane exceeding 5 percent by volume (which equals 100 percent of the lower explosive limit, or LEL) has been historically detected in most of the landfill interior gas probes (which were completed in or near waste), as expected. Although

LFG probes LG-14, LG-15, and LG-16 at the east edge of the landfill have historically contained methane exceeding 5 percent by volume, the presence of methane in these probes is not unexpected, and the landfill CMCP discusses that due to completion in fill, “the existing perimeter sampling locations along the eastern side of the landfill, LG-13 through LG-16, will continue to be used, but only for informational data, and not for site compliance.”

The quarterly methane, carbon dioxide and oxygen readings for the three non-compliance probes (LG-14, LG-15, and LG-16) are outlined in orange on Table 3 with readings above 5 percent highlighted orange.

Landfill Perimeter – South End – LG-88 and LG-89

Of the 39 compliance monitoring probes, only LG-88 and LG-89 had methane readings above 5 percent. Both exceedances were observed during the third quarter. For the September 2022 monitoring event, LG-88 had a reading of 12.9 percent methane and LG-89 had a reading of 5.4 percent methane. These compliance probes with a methane exceedance above 5 percent are highlighted yellow in Table 3.

While these probe readings were over the 5 percent compliance limit, it was determined the readings were not valid. During these monitoring events, both LG-88 and LG-89 pulled water into the sample collection hose within 30 seconds of the GEM 5000 pump running on the analyzer. These probes are located very close to linear saturated drainage/wetlands (part of Bigelow Creek) that run parallel to the eastern landfill boundary, part of the mapped Everett Riverfront Western Wetland Complex and as a result often get flooded. LG-88 and LG-89, along with LG-90, were installed in October 2019 west of the wetlands to monitor the potential for gas migration east of the landfill boundary. These Probes were installed as replacement compliance monitoring probes for LG-82, LG-83, and LG-84 which were installed at the southeast perimeter of the landfill at the request of Ecology in June 2015. Because LG-82, LG-83, and LG-84 are completed in landfill waste, they have not been monitored for compliance since 2020.

It is assumed that the wetlands (i.e., band of saturated ground) act as a hydraulic barrier mitigating potential soil gas migrating from the landfill after results of 2016 and 2019 bar hole surveys showed elevated methane in shallow soils near the landfill (west of the wetlands), but none east of the wetlands. The shallow aquifer in this area is saturated and comprised of silt and peat deposits known as “the aquitard,” down to depths of approximately 45 feet, below which is the deeper (fully saturated) aquifer. The gas collection trench installed in 2019-2020 is intended to intercept any potential LFG in the uppermost unsaturated soils at the southeast perimeter of the landfill.

Results from the 2020 gas monitoring showed minimal to no methane in LG-88, LG-89, and LG-90, with a single occurrence of methane detection (0.5 percent in probe LG-89 in March 2020). A few methane detections above 5 percent were observed in 2021 and 2022. Each of these instances was due to the probes being flooded with water, which means the measured methane concentrations were not indicative of actual subsurface methane at the site boundary. Thus, the results are invalid.

Both LG-88 and LG-89 had methane values below 1 percent for the other three quarters. Figure 5 shows the compliance monitoring probes with at least one non-zero read throughout 2022. The red dashed horizontal line shows the 5 percent contingency plan trigger from the CAP and CMCP for comparison.

Landfill Perimeter – North End – LG-62 and LG-41

Gas measurements for LG-62 were not collected during the fourth quarter monitoring event during 2022. LG-62 had 0 percent methane observed during the three recorded quarterly monitoring events. Prior to conducting the fourth quarter probe reads, the proprietary software for the gas analyzer experienced an error that deleted programmed identification numbers for the probes. When the probe numbers were re-entered into the program, LG-62 was inadvertently omitted from the list. Since LG-62 did not appear on the list, it was not visited during the monitoring event. The error was discovered when reviewing results from the fourth quarter, and has been resolved. LG-62 was missing for several years but was uncovered in 2020 by construction excavation in the area. The probe was found to be functional and was fitted with a new monument in March 2020, after which it continued to be monitored. Monitoring for LG-62 will continue again in 2023.

LG-41 data is not included in the third quarter monitoring results. Gas measurements were taken, but user error resulted data being inadvertently deleted during the data upload process. The missing data was not discovered until well after the monitoring event had passed. LG-41 had 0 percent methane observed during the three recorded quarterly monitoring events.

In order to prevent these sorts of errors, the City has implemented two changes to the LFG monitoring routine. First, the City's LFG technician will cross-reference a list of compliance monitoring probes during monitoring events to ensure that all available compliance probes are visited. Second, immediately following a monitoring event, the City's Landfill Site Manager will verify data has been collected for each of the compliance probes so that any data gaps can be addressed or properly documented.

Landfill Gas Surface Monitoring

City personnel used a Landtec SEM 5000 flare ionization detector to measure methane concentrations across the surface of the landfill within publicly accessible areas, and at off-site neighboring structures on a quarterly basis per CD requirements. This handheld unit is portable and is manually carried by the user during the monitoring event. The SEM 5000 unit is calibrated to the site location, and adjusts measurements based on the background methane concentrations measured upwind and downwind of the site.

LFG surface monitoring is performed on a quarterly basis per the CMCP. Surface monitoring data is collected as close in time to the quarterly LFG compliance probe reads as possible to keep surface monitoring data aligned with perimeter probe monitoring data.

Surface monitoring data was collected by City staff and sent to Herrera for reporting and analysis after each event.

On-Site Surface Monitoring

Background

As part of CD requirements, the landfill surface is required to be monitored for methane emissions to evaluate the performance of the landfill collection and management system. In 2022, this involved monitoring the gravel path south of the south blower station, the paved east perimeter/riverside trail, the west Riverfront Boulevard sidewalk, and the east Riverfront Boulevard sidewalk.

Two buildings are currently under construction on the landfill site, in the southern part of the area to the west of Riverfront Boulevard. These buildings (currently referred to as Buildings A and B) are six-story tall mixed-use buildings. Building B is scheduled for occupancy in the second half of 2023. Both buildings have active LFG collection systems constructed beneath the buildings, along with other protective engineered systems required by the CD (methane alarms, barriers, etc.). LFG monitoring will be performed at these buildings during occupancy according to the requirements of the CAP and CMCP and LFG system O&M plan.

Four additional buildings are planned for the western portion of the site, but construction has not yet begun on these. Additional development on the eastern portion of the site is expected to occur in coming years.

Several buildings were formerly on the landfill site but have since been closed, including the Snohomish County Transfer Station (closed in January 2004) the Everett Animal Shelter (vacated in April 2009 and demolished in June 2009). LFG monitoring was previously performed at these buildings and was terminated once building occupancy ceased.

Methods and Results

City personnel used a Landtec SEM 5000 unit and walked the extents of the landfill to record surface methane concentrations. For the on-site surface monitoring, the SEM 5000 unit was calibrated to record the methane concentration and the corresponding GPS points where the methane concentration was read continuously at the ground surface of the four monitoring path sections: the gravel path south of the south blower station, the paved east perimeter/riverside trail, the west Riverfront Boulevard sidewalk, and the east Riverfront Boulevard sidewalk.

The landfill monitoring path began at the southernmost point of the Everett Landfill. The personnel walked past the south blower station and then turned southeast on Riverfront Boulevard towards the entrance for the Riverside Trail representing the eastern side of the landfill. The entire Riverside Trail was walked from south to north until its end at the north blower station after which the personnel walked west to the north end of Riverfront Boulevard. The personnel walked south on the east Riverfront Boulevard sidewalk until reaching the 41st roundabout. At the roundabout the personnel crossed the street to the west Riverfront Boulevard sidewalk and walked back north until reaching the north end of Riverfront Boulevard and the extents of the landfill once again.

The same walking and monitoring method was used for each of the four surface monitoring walking path sections. Every five seconds, a data point was logged showing the methane concentration reading and latitude and longitude. City personnel had the probe of the SEM 5000 positioned between five to ten centimeters above the ground surface and walked in a back and forth, "Serpentine," path that involved walking on one side of the trail for five steps and then crossing to the other side of the trail in a forward diagonal route. Then five more steps were taken on the opposite side of the trail and the trail would be crossed again in a forward diagonal route to get to the original side. The SEM 5000 operator walked slow enough to collect enough data points in a variety of positions across the trail. The probe was also positioned over the ground based on visual observations, e.g., distressed vegetation, cracks, or seeps in the ground. The term 'trail' used in the walking technique can be replaced with path, or sidewalk to encapsulate the method used for each of the four landfill surface monitoring sections. All surface gas monitoring procedures were conducted following the Environmental Protection Agency (EPA) Code of Federal Regulations (CFR) Part 60 Subpart WWW *Standards of Performance for Municipal Solid Waste Landfills*.

The threshold for the on-site monitoring identified in the CAP is 100 ppm inside buildings and 500 ppm for exterior areas. None of the quarterly monitoring events that took place during 2022 exceeded these thresholds. As shown in Figure 3, the maximum methane concentration measured for exterior areas for 2022 was 146.6 ppm, well below the 500 ppm threshold. There were no onsite structures to be monitored in 2022.

Figure 3. Quarterly Serpentine Monitoring Results

**CITY OF EVERETT LANDFILL
OPERATIONS AND ENVIRONMENTAL COMPLIANCE**



SURFACE EMISSIONS MONITORING

Surface emissions monitoring recording methane concentrations (in parts per million) are collected quarterly with a Landtec SEM 5000 at these three locations:

- 1) Riverside Trail
- 2) Riverfront Boulevard
- 3) Four private buildings to the west of the landfill

The SEM 5000 unit is calibrated to the site location and continuously reads methane concentrations. Every five seconds, a data point is logged showing the methane concentration reading and latitude and longitude.

REGULATORY THRESHOLDS

These following regulatory thresholds apply to each of the three monitoring elements:

- 1) Riverside Trail: No methane exceedances over 500 ppm
- 2) Riverfront Boulevard: No methane exceedances over 500 ppm
- 3) Four private buildings to the west of the landfill: No methane exceedances over 100 ppm

2022 DATA COLLECTION SUMMARY

Serpentine monitoring was conducted on these following dates:

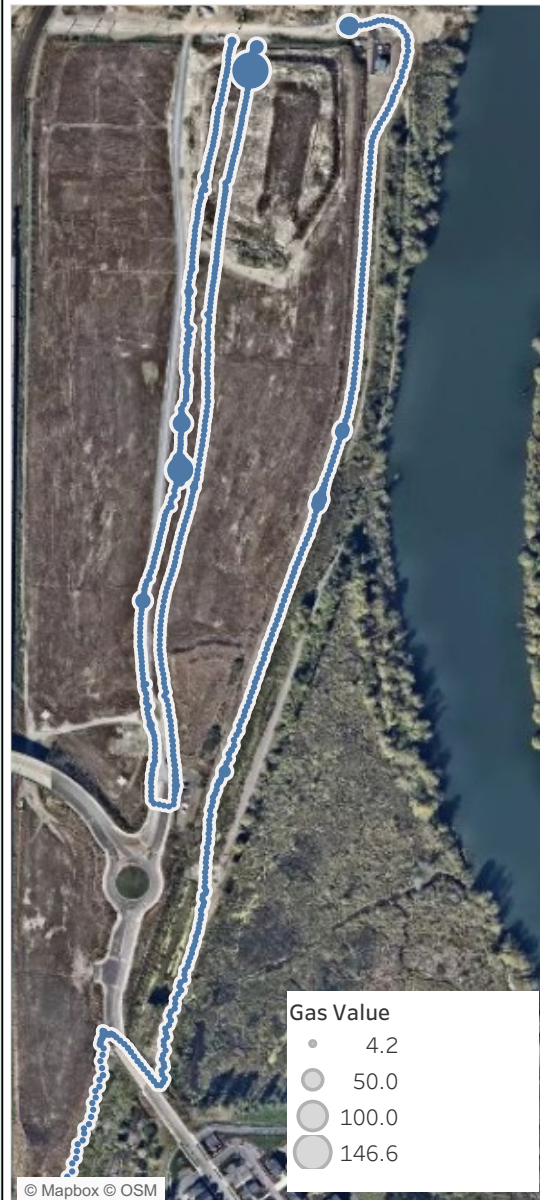
March 23, 2022: No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

July 8, 2022 (June 2022): No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

September 27, 2022: No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

January 26, 2023 (December 2022): No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

March 23, 2022



July 8, 2022



September 27, 2022



January 26, 2023



This page intentionally left blank

Off-Site Structure Monitoring

Background

As part of CD requirements, specific nearby off-site structures are required to be monitored for methane emissions to evaluate the performance of the landfill collection and management system.

GTS Drywall Supply Co., north of the landfill, was not monitored after November 2002, when the building was vacated. The GTS building was then demolished in 2007. The Diversified Recycling facility north of the landfill was closed in April 2014 and the south building subsequently demolished. The north building was demolished in early 2016.

In 2021, Royell Manufacturing Inc. became the tenant of the former Sno Valley Process Solutions building and was included in the list of off-site structure monitoring in 2022.

Methods and Results

City personnel used a Landtec SEM 5000 unit and measured the surface methane concentrations at five off-site buildings that neighbor the Everett Landfill to the west. The five off-site buildings are called out on the map in Figure 4.

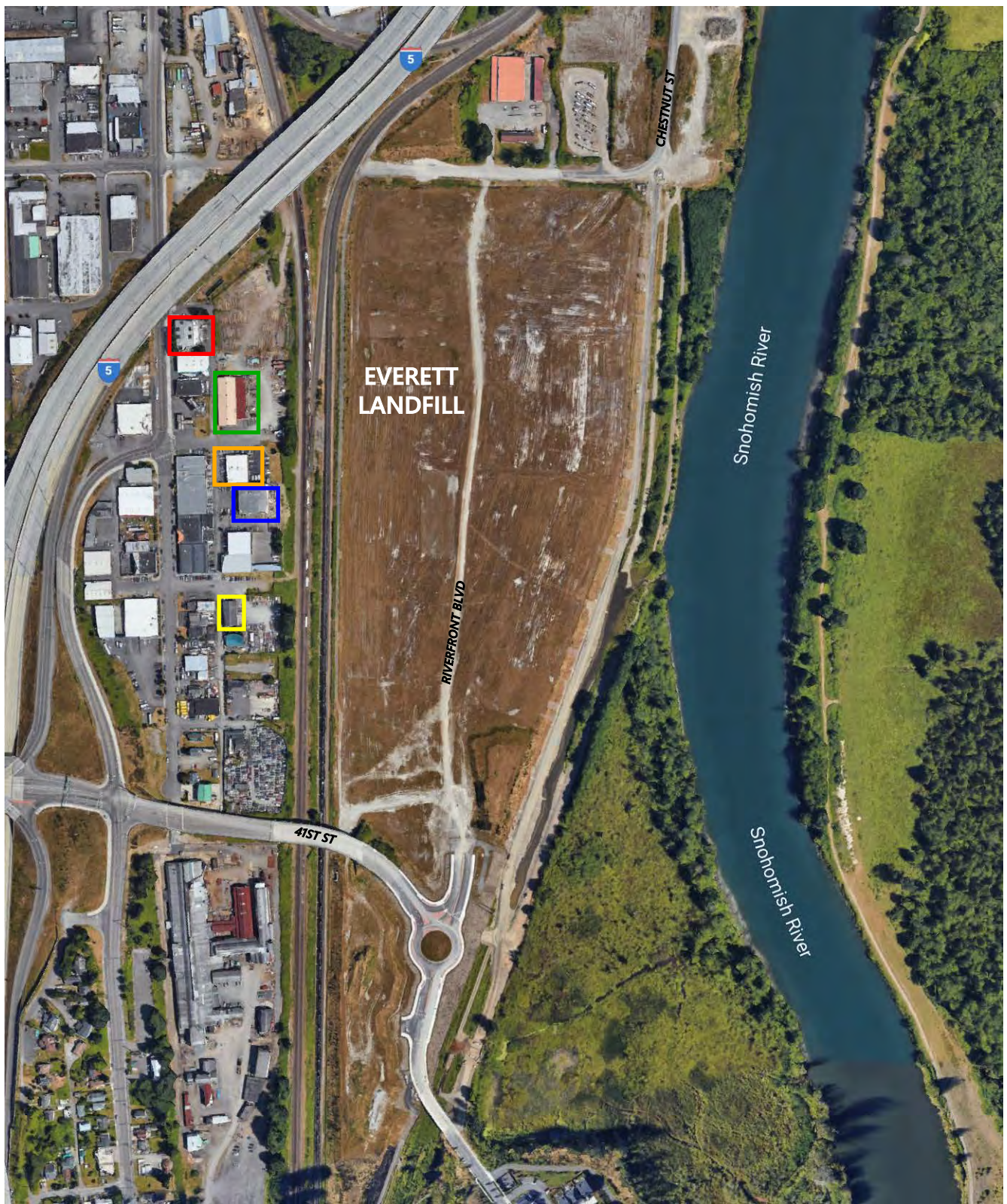
Existing off-site structures monitored in 2022 included:

- Everett Gospel Mission, 3711 Smith Avenue
- H&R Mechanical Systems Inc., 2407 38th Street
- Cascade Wholesale, 2410 38th Street
- Royell Manufacturing Inc. (formerly Sno Valley Process Solutions), 2420 38th Street
- Ron May Towing, 2406 39th Street

City personnel walked around and inside each building and recorded the SEM 5000 methane readings by hand. The SEM 5000 was positioned near observed slab cracks, drains, utility penetrations, elevator pits, and other notable locations where LFG could enter the building.

The threshold identified in the CAP and CMCP for the off-site structures is 100 ppm. Table 4 shows the surface monitoring results at the off-site structures. Of the off-site buildings, the highest methane concentrations were consistently found in the boiler room of the Everett Gospel Mission near the ceiling ventilation fan. The highest measured methane concentration for 2022 was 9 ppm. No exceedances of CAP/CMCP thresholds for offsite structures occurred during 2022.

Off-site surface monitoring will discontinue beginning 2023. Off-site monitoring was reinstated in 2020 after a methane exceedance of 5 percent was detected in LG-77 (now decommissioned). Per the CMCP, "off-site monitoring will be discontinued after three years if there is no confirmed LFG detection in any monitored off-site building." Quarterly monitoring for off-site structures has been completed for three consecutive years (2020 through 2022) with no exceedances observed since the last possible compliance issue (12.9 percent methane at LG-77 in October 2019).



Legend

- Everett Gospel Mission
- H&R Mechanical Systems Inc.
- Cascade Wholesale
- Royell Manufacturing Inc.
- Ron May Towing



Figure 4.
Vicinity Map of Everett Landfill
Off-Site Monitoring Locations



Snohomish County, Aerial (2017)

K:\Projects\Y2017\17-06595-000\Project\Report\Fig1_VicinityMap_Letter.mxd

Table 4. Gas Monitoring Results at Off-Site Structures.

Structure/Address	March	June ^a	September	December ^b
Sample Location	Methane (ppm)			
Everett Gospel Mission – 3711 Smith Avenue				
Basement Floor and Flood Storage Area Floor Cracks	2.2	2.3	2.4	2.5-2.6
Elevator Shaft	2.2	2.2	2.4	2.4
Boiler Room Floor Drain	2.3	3.1	3.3	2.7
Boiler Room Ceiling Near Ventilation Fan	3.4	8.4-9	5.0	3.2
Bathroom Floor Drain	2.3	2.3	2.4	2.4
Roof Drains West Side of Building	2.1	2.1	2.3	2.4
Irrigation Control Vault North Side of Building	2.2	2.1	2.3	2.5
Cascade Wholesale – 2410 38th Street				
Basement Bathroom Floor and Ceiling	2.4	3.8-4.4	2.8-3.2	2.4
Basement Floor Cracks (multiple)	2.3-2.5	2.4-2.6	2.4-2.6	2.4-2.5
Basement Floor Drain	2.4	2.4	2.4	2.5
Roof Drains	2.2	2.3	2.2	2.5
Water Meter Vault East Site of Building	2.3	2.4	2.2	2.5
H&R Mechanical Systems Inc. – 2407 38th Street				
Floor Cracks (multiple)	2.0-2.1	2.1-2.2	2.1-2.2	2.4
Roof Drains East Side of Building	2.1	1.9-2.1	2.2	2.5
Driveway Cracks	2.0	2.0	2.2	2.4
Royell Manufacturing Inc. (Formerly Sno Valley Process Solutions) – 2420 38th Street				
Floor Cracks (multiple)	2.4-2.5	2.6	2.6-2.7	2.3-2.4
Fireline Penetration Inside Building	2.3	2.7	2.6	2.3
Floor Drain	2.2	2.7	2.7	2.4
Roof Drains East Side of Building	2.2	2.4	2.4	2.3
Cracks in All Garage Door Entries	2.2	2.4	2.4	2.3-2.4
Water Meter Vault East Side of Building	2.2	2.6	2.5	2.3
Ron May Towing – 2406 39th Street				
Men’s Bathroom Floor Drain	2.5	2.7	2.4	2.4
Men’s Bathroom Ceiling	2.5	2.6	2.4	2.4
Women’s Bathroom Crack	-	-	-	2.4
Crack Between Sidewalk and Asphalt	2.2	2.7	2.5	2.4
Abandoned Fence Post Cut at Grade NE Site of Building	-	2.7	2.5	2.4

Notes:

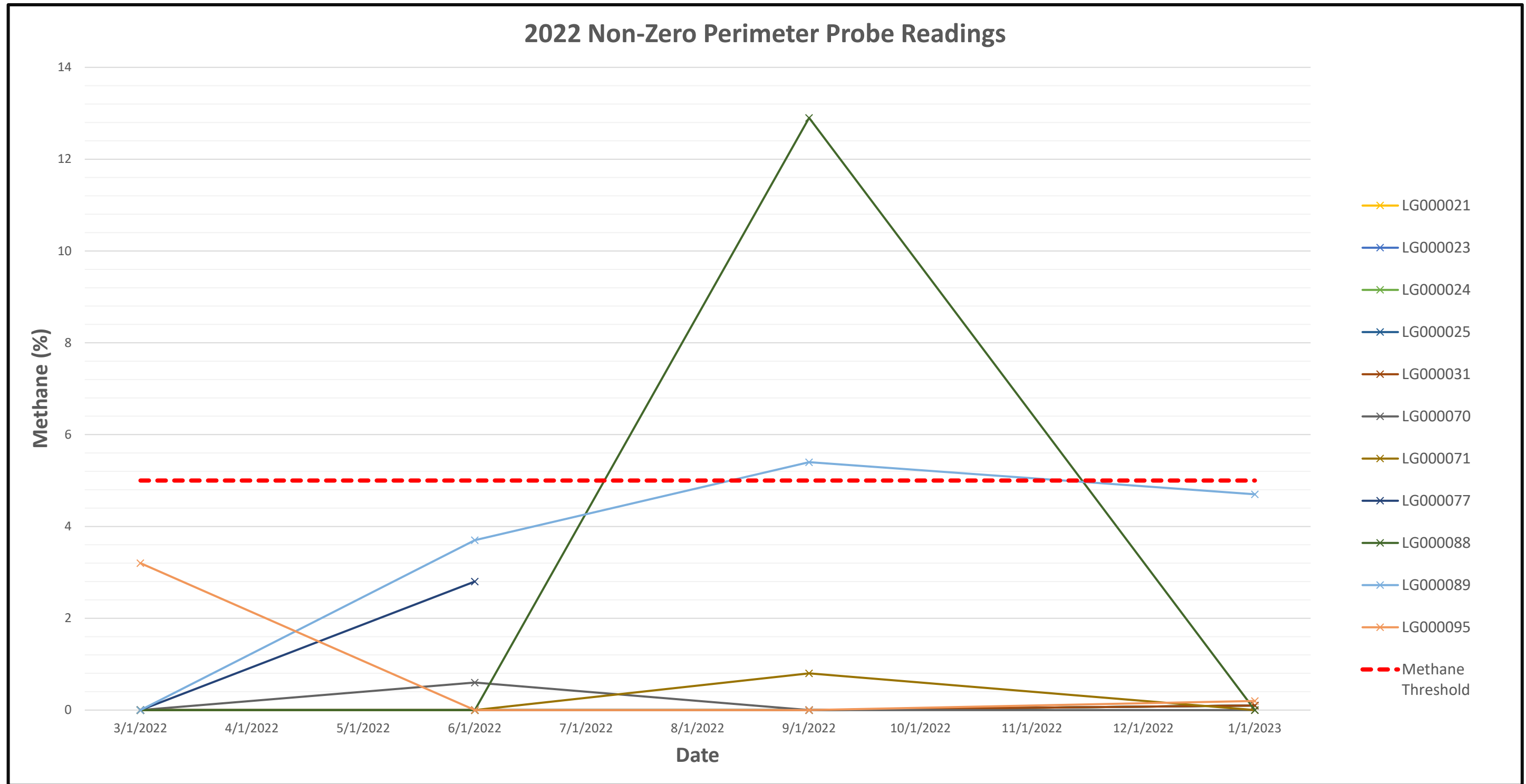
^a Second quarter 2022 reads were collected in July 2022.

^b Fourth quarter 2022 reads were collected in January 2023.

- Unavailable

This page intentionally left blank

Figure 5. 2022 Non-Zero Compliance Perimeter Probe Readings.



This page intentionally left blank