AB 32 Landfill Methane Rule
2021 Annual Report
Berkeley Landfill (Facility No. 3590)

Prepared for:

City of Berkeley
Public Works Department
1947 Center St., 4th Floor
Berkeley, California 94704

For Submittal to:

Bay Area Air Quality Management District
375 Beale Street, Suite 600
San Francisco, California 94105

SCS ENGINEERS

01210112.02 Task 8 | March 2022

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Santa Rosa, CA 95403
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This AB 32 Landfill Methane Rule (LMR) Annual Report for calendar year (CY) 2021 was prepared for the Cesar Chavez Park (formerly Berkeley Landfill) in Berkeley, California. This document is dated March 2022 and was prepared and reviewed by the following:

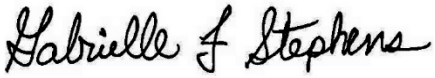
Report Preparer:

Name & Title: Anne Liu, Staff Professional

Signature:  Date: 3/10/22

Report Reviewer:

Name & Title: Gabrielle Stephens, Project Manager

Signature:  Date: 3/10/22

I CERTIFY THAT, TO THE BEST OF MY KNOWLEDGE AND BELIEF, THE INFORMATION PROVIDED IN THIS REPORT IS COMPLETE AND ACCURATE.

Landfill Responsible Official:

Name & Title: Samantha Kinstrey, Environmental Compliance Specialist, City of Berkeley

Signature:  Date: March 14, 2022

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1 INTRODUCTION

SCS Engineers (SCS), on behalf of the City of Berkeley Public Works Department (City), is submitting the calendar year (CY) 2021 Annual Report in accordance with the Title 17 California Code of Regulations (CCR) §95460 through §95476 (AB 32 Landfill Methane Rule [LMR]) and alternative compliance option (ACO), submitted November 1, 2011, for the Cesar Chavez Park (formerly Berkeley Landfill [Site]).

Please note that an amended ACO was submitted to the Bay Area Air Quality Management District (BAAQMD or District) on January 17, 2013, as requested by the District, to include the less than continuous (LTC) operation previously approved by the District for the Site. On May 28, 2015, the BAAQMD issued a letter directing re-submittal of the ACO request with the most current data available. On March 7, 2016, SCS re-submitted a revised ACO request to the BAAQMD with the requested data. A letter from the District dated June 8, 2016, in response to the March 7 ACO request, was issued by the District. Subsequent LMR compliance activities have been conducted in accordance with the June 8, 2016 District letter.

2 BACKGROUND

The Site is a closed municipal solid waste (MSW) landfill, located in Berkeley, Alameda County, California. The Site accepted waste after January 1, 1977, accepted degradable waste, currently contains more than 450,000 tons of waste-in-place, and has an active gas collection and control system (GCCS) with an existing methane destruction device. Therefore, the Site is subject to Article 4, Subarticle 6, §95464 through §95476 of 17 CCR and must comply with the GCCS operational, monitoring, record keeping, and reporting requirements contained therein, or alternatives approved in the District's June 8, 2016 letter.

Currently, the Site is developed as a City Park, known as Cesar Chavez Park, with approximately half of the 90-acre area landscaped as lawn area that is regularly maintained, and the other half designated as a natural area with native seasonal grasses and a bird nesting area.

The Landfill is a small, closed landfill, with low, declining landfill gas (LFG) production. Due to the continuing decline in gas volume and quality at the closed Landfill, the City installed a smaller flare (A-4) that commenced operation on June 9, 2016. The old A-3 flare was permanently decommissioned and removed from the site.

Furthermore, it has been the City's position that the declining gas flows have resulted in methane surface emissions less than 200 parts per million by volume (ppmv), which is also the threshold for exemption from the LMR for closed sites without a GCCS (§95463 [b][2][B]). As such, the City proposed to conduct quarterly instantaneous surface emissions monitoring (SEM) for a year to demonstrate compliance under the 200 ppmv threshold. If the four SEM events documented methane emissions below the 200 ppmv limit, or if areas above 200 ppmv can be remediated within 10 days, then SEM would be conducted annually in subsequent years as long as results continue to remain below 200 ppmv, as specified in the LMR.

The second quarter 2012 SEM results concluded four consecutive quarters with no detections of surface emissions greater than 200 ppmv. As such, the Site has reduced SEM frequency from quarterly to annual effective second quarter 2012.

As previously noted, a District response letter to the most recently submitted revised ACO request was issued on June 8, 2016. In the letter, the District denied the City's request to be exempt from integrated SEM and only conduct instantaneous SEM. As such, subsequent SEM will continue to include and report the results of both instantaneous and integrated SEM, and the LMR specified limits will apply.

3 ANNUAL REPORT CONTENT

SITE INFORMATION [§ 95470(B)(3)(A)]

Table 1. Site Information

Input	Value
Landfill Name	Berkeley Landfill
Owner	City of Berkeley
Operator	City of Berkeley
Address	Marina Boulevard at Spinnaker Way
SWIS Number	01-AC-0001 (Closed Landfill – 1983)

TOTAL LFG RECOVERY DATA [§ 95470(B)(3)(B),(C)]

The LFG GCCS was installed at the Site in 1983. LFG recovery data for the reporting period is summarized in the following table.

Table 2. Total LFG Recovery

Description	Quantity	Units
Total Volume of LFG Recovered	31,147,303	scf
Average Methane Content	34.6	% by volume
Average Carbon Dioxide Content	24.4	% by volume

CONTROL DEVICE IDENTIFICATION [§ 95470(B)(3)(D),(E),(F)]

Data used to identify the control device(s) used at the Site are provided in the following table.

Table 3. Control Devices

Device ID	Type	Installation Year	Operational Date	Rating	Fuel Type
A-4	Enclosed Flare	2016	2016	2.4 MMBtu/hour	Landfill gas

A summary of the 2019 operations data for the control device(s) is presented in the following table.

Table 4. Control Device Operations Data

Device ID	Total Combusted (scf)	Methane, CH_4 (% vol)	Carbon Dioxide, CO_2 (% vol)	CH_4 Destruction Efficiency (%)
A-4	31,147,303	34.6	24.4	99.997

SUPPLEMENTAL FUELS [§ 95470(B)(3)(G)]

Propane is used in small quantities at the Site for flare startups only. Supplemental fuels used during the reporting period are summarized in the following table.

Table 5. Supplemental Fuels

Device ID	Type	Quantity Consumed	Units
A-4	Propane	18	gallons

LFG SHIPPED OFF-SITE [§ 95470(B)(3)(H)]

No LFG was shipped off-site during the reporting period.

TOPOGRAPHIC MAP [§ 95470(B)(3)(I)]

The 90-acre Site is closed and final soil cover encompasses the entire surface. A topographic map of the site is presented as Attachment A.

ADDITIONAL DATA [§ 95470(B)(3)(J)]

Section 95470(b)(3)(J) requires the submittal of records kept throughout the year. These data are discussed throughout this report and provided, in attachments to this document, as appropriate, and are available for review upon request.

Downtime Data [§ 95470(a)(1)(A),(B)]

No downtime of the GCCS exceeding five calendar days occurred during the reporting period. There were also no individual well shutdowns during the reporting period.

A summary of all gas control system downtime in excess of one hour, the reason for the downtime, and the length of time the gas control system was shutdown is presented in **Appendix B**.

LFG Generation Model [§ 95470(a)(1)(C)]

An LFG generation model was prepared for the Landfill pursuant to Section 95471(e) to estimate the expected gas generation rate. The collected LFG flow rate for 2021 is 85 standard cubic feet per minute (scfm) at 50 percent methane, per attached Intergovernmental Panel on Climate Change (IPCC) gas model results. Collected LFG is 75% of total gas generation, per CARB/IPCC default. This model is presented as **Attachment C**.

Surface Emissions and Component Leak Monitoring [§ 95470(a)(1)(D)]

The annual SEM event was conducted on April 30, 2021. During the event, the monitoring was conducted along pathways spaced 100 feet apart. Along each pathway, the inlet of a methane detection instrument (SEM-500) was held within 3-inches of the landfill surface and exceedances, if any, of the 200 ppmv standard, measured as methane, were GPS-tagged and field marked with a stake for repair, as specified in the Rule. Cracks, holes, and other penetrations were also tested. A copy of the annual 2021 SEM report is included as **Attachment D**. This report includes a full description of the procedures as well as the SEM pathway map.

Instantaneous Surface Emissions and Integrated Surface Sampling

The annual 2021 SEM event resulted in no monitoring exceedances of 200 ppmv, measured as methane. In addition, there also were no detected exceedances of the integrated limit of 25 ppmv, measured as methane. During the instantaneous monitoring, the highest observed reading was 12.7 ppmv, measured as methane. The highest integrated reading observed was 4.34 ppmv, measured as methane.

Component Leak Monitoring

Leak testing of the portion of the GCCS under positive pressure was performed quarterly, with no exceedances of the 500 ppmv limit, measured as methane, detected.

Quarterly component leak monitoring was performed in accordance with the LMR on January 8, April 30, July 29, and October 21, 2021. Component leak monitoring performed on April 30, 2021 was completed in conjunction with the annual SEM event. SCS performed landfill gas pressurized pipe and component leak monitoring at the blower-flare station (BFS). Monitoring was performed with the detector inlet held one-half of an inch from pressurized pipe and associated components. No locations exceeding the 500 ppmv threshold were observed during the monitoring events. Therefore, all components in the BFS were in compliance at the time of the testing.

Copies of the 2021 quarterly component leak monitoring results are included as **Attachment E**. Please note these results also include the component testing results as required by the BAAQMD 8-34 Rule which includes testing of all components, including components under vacuum. However, the LMR only requires testing of the landfill gas components under positive pressure; as such, the only results applicable to the LMR are the flare station results which are included on the last row of each quarterly emissions testing results table provided in **Attachment E**.

Well Monitoring Data [§ 95470(a)(1)(E)]

Monthly LFG wellhead pressure monitoring data is not required to be performed or reported per the approved June 8, 2016 ACO request approval from the District. As such, this information is not included in this report.

Waste Acceptance Data [§ 95470(a)(1)(F)]

The Site closed in 1983. At the time of closure, there were an estimated 1,539,000 tons of waste-in-place.

Source Test Results [§ 95470(a)(1)(H)]

The 2021 source testing of the Site's flare, including testing for methane destruction efficiency as specified in the LMR, was performed by Best Environmental, Inc. on July 13, 2021. The results document that the Site's flare destroys greater than 99% of the methane in the LFG, as required by the Rule. Results of this annual source test conducted pursuant to Section 95464(b)(4) are presented in **Appendix F**.

Control Device Operating Parameters [§ 95470(a)(1)(H)]

Records of equipment operating parameters specified to be monitored under Sections 95469(b)(1) and (2) as well as records for periods of operation during which the parameter boundaries established during the most recent source test are exceeded, including all 3-hour periods of operation during which the average temperature difference was more than 50 degrees Fahrenheit below the average combustion temperature during the most recent source test, are maintained; and are available for review upon request.

From January 1 through August 31, 2021, the minimum temperature above which the flare was required to operate was 1,526 °F (1,576 °F minus 50°F), based on the July 30, 2020 source test performed by Best Environmental (final report issued on September 30, 2020). From September 1, 2021 through December 31, 2021, the minimum temperature above which the flare was required to operate was 1,575 °F (1,625 °F minus 50°F), based on the July 13, 2021 source test performed by Best Environmental (final report issued on August 31, 2021). During the reporting period, the flare operated above the minimum established temperature at all times, except during periods of startup, shutdown or malfunction (SSM) with the exception of the interval noted in **Table 6**.

Table 6. 3-Hour Average Temperature Excursions

3-Hour Interval Blocks	3-Hour Average Temperature (°F)
12/29/21 18:00 – 20:59	1,558

The operations and maintenance (O&M) provider, SCS Field Services (SCSFS) was performing maintenance on the louver motors during this time, which caused the temperature excursions.

Records of flare monitoring data are maintained and can be made available upon request.

Boiler/Process Heater Data [§ 95470(a)(1)(K)]

The Landfill does not use a boiler or process heater with a design heat input capacity of 44 megawatts (MW) [150 million British thermal units per hour (MMBtu/hour)] to comply with § 95464(b)(3).

Appendix A

Topographic Map

APPROXIMATE SCALE IN FEET

250 0 250

APPROXIMATE LIMITS OF BERKELEY LANDFILL
(FACILITY NO. 01-AC-0001)

PG&E POWER (UG)

BLOWER/FLARE STATION

VERTICAL EXTRACTION WELLS (TYP.)

SUMP/ IMPINGEMENT (TYP. OF 8)

MARINA

SPINNAKER WAY

BERKELEY MARINA

LEGEND

- GAS COLLECTION HEADER/LATERALS (BELOW GRADE)
- 40 ⊙ VERTICAL LFG GAS EXTRACTION WELL
- TW-4 HORIZONTAL TRENCH WELL (MARINA PROPERTY)
- HC-1 HORIZONTAL COLLECTOR PIPE (MARINA PROPERTY)
- ⊕ Probe 5 LFG MONITORING WELL (MARINA PROPERTY)

SCS ENGINEERS
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7041 Koll Center Parkway, Suite 135
Pleasanton, California 94566
(925) 426-0080 FAX: (925) 426-0707

PROJ. NO.	DWN. BY:	ACAD FILE:
01210112.02 T12	HLG/MJE	FIG-1 LFG PLAN_061118
DSN. BY: JJM/MJE	CHK. BY: MJE	APP. BY: J. MILLER

NOTE:
ORIGINAL TOPOGRAPHY BY AERIAL METHODS 1992. BASE MAP PROVIDED BY CITY OF BERKELEY.

SHEET TITLE: LANDFILL GAS SYSTEM PLAN

PROJECT TITLE: BERKELEY LANDFILL
CITY OF BERKELEY

NO.	REVISION	DATE

DATE: 6/11/18
SCALE: AS SHOWN
FIGURE NO. 1

Appendix B

Downtime Summaries

Flare/GCCS Downtime Greater Than One Hour
Berkeley Marina Landfill, Berkeley, California
(January 1, 2021 through December 31, 2021)

Date Off line	Date On line	Down Time	Comments
1/18/2021 23:36	1/19/2021 17:25	17.82	Planned remote shutdown to reset the programmable logic controller (PLC). Flare restarted after completing maintenance.
3/6/2021 1:36	3/6/2021 8:15	6.65	PG&E Utility Outage (Breakdown Relief Request Submitted)
6/14/2021 8:37	6/14/2021 10:09	1.53	Planned shutdown to calibrate flow meter. Flare restarted after completing maintenance.
7/16/2021 16:13	7/17/2021 10:33	18.33	PG&E Utility Outage (Breakdown Relief Request Submitted)
8/11/2021 6:39	8/11/2021 10:28	3.82	Planned remote shutdown to reset the PLC. Flare restarted after completing maintenance.
9/25/2021 16:48	9/28/2021 11:17	66.48	PG&E Utility Outage; call box malfunction; air compressor malfunction. (Breakdown Relief Request Submitted)
10/10/2021 4:07	10/10/2021 11:20	7.22	Planned flame failure shutdown detected by parametric monitoring device. Flare shutdown due to low flame temperature shutdown. Flare was manually restarted.
10/25/2021 11:11	10/25/2021 13:15	2.07	Planned flame failure shutdown detected by parametric monitoring device. Flare shutdown due to low flame temperature shutdown. Flare was manually restarted.
11/8/2021 20:12	11/9/2021 11:33	15.35	PG&E Utility Outage (Breakdown Relief Request Submitted)
11/21/2021 8:22	11/22/2021 10:57	26.58	Scheduled maintenance shutdown. Flare was manually restarted.
12/14/2021 10:27	12/14/2021 11:33	1.10	Unplanned shutdown due to equipment failure. Flare was manually restarted.
12/15/2021 14:59	12/17/2021 21:33	54.57	Unplanned shutdown due to shutdown valve shutdown and thermocouple failure. Flare was manually restarted.
12/17/2021 22:11	12/19/2021 10:51	36.67	Unplanned shutdown due to thermocouple failure. Flare was manually restarted.
12/19/2021 13:18	12/19/2021 18:42	5.40	Planned remote start up for a hard reset. Flare automatically restarted.
12/19/2021 19:24	12/20/2021 10:41	15.28	Unplanned shutdown due to an analog card issue and louver malfunction. Flare was manually restarted.
12/21/2021 0:36	12/22/2021 12:12	35.60	Unplanned shutdown due to an analog card issue and louver malfunction. Flare was manually restarted.
12/22/2021 14:46	12/22/2021 18:13	3.45	Planned shutdown due to blower maintenance. Flare was manually restarted.

Flare/GCCS Downtime Greater Than One Hour
Berkeley Marina Landfill, Berkeley, California
(January 1, 2021 through December 31, 2021)

Date Off line	Date On line	Down Time	Comments
12/29/2021 22:49	12/30/2021 10:43	11.90	Unplanned shutdown due to an analog card issue and louver malfunction. Flare was manually restarted.
12/31/2021 22:41	1/1/2022 0:00	1.32	Unplanned shutdown due to blower surge. Flare was manually restarted.

Appendix C

LFG Generation Model

Data Input: Landfill Characteristics

Landfill Name:	Berkeley Landfill	**Year Opened:**	1961	Click for lists of k values	
State/Country:	CA	**If Closed, Year:**	1983	**k Value:**	0.038
City/County:	Berkeley			**M Value:**	6

Data Input: Waste Deposit History

	Waste			Daily Cover			
	Waste Deposited			Greenwaste & Compost		Sludge	
Year	Tons	% ANDOC		Tons	% ANDOC	Tons	% ANDOC
1952							
1953							
1954							
1955							
1956							
1957							
1958							
1959							
1960							
1961	45,000	9.52%					
1962	45,000	9.52%					
1963	45,000	9.52%					
1964	45,000	9.52%					
1965	45,000	9.53%					
1966	73,000	9.53%					
1967	73,000	9.53%					
1968	73,000	9.53%					
1969	73,000	9.53%					
1970	73,000	9.53%					
1971	73,000	9.53%					
1972	73,000	9.53%					
1973	73,000	9.53%					
1974	73,000	9.53%					
1975	73,000	9.59%					
1976	73,000	9.59%					
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1998							
1999							
2000							
2001							
2002							
2003							

Data Input: Landfill Characteristics

Landfill Name:	Berkeley Landfill	**Year Opened:**	1961	Click for lists of k values	
State/Country:	CA	**If Closed, Year:**	1983	**k Value:**	0.038
City/County:	Berkeley			**M Value:**	6

Data Input: Waste Deposit History

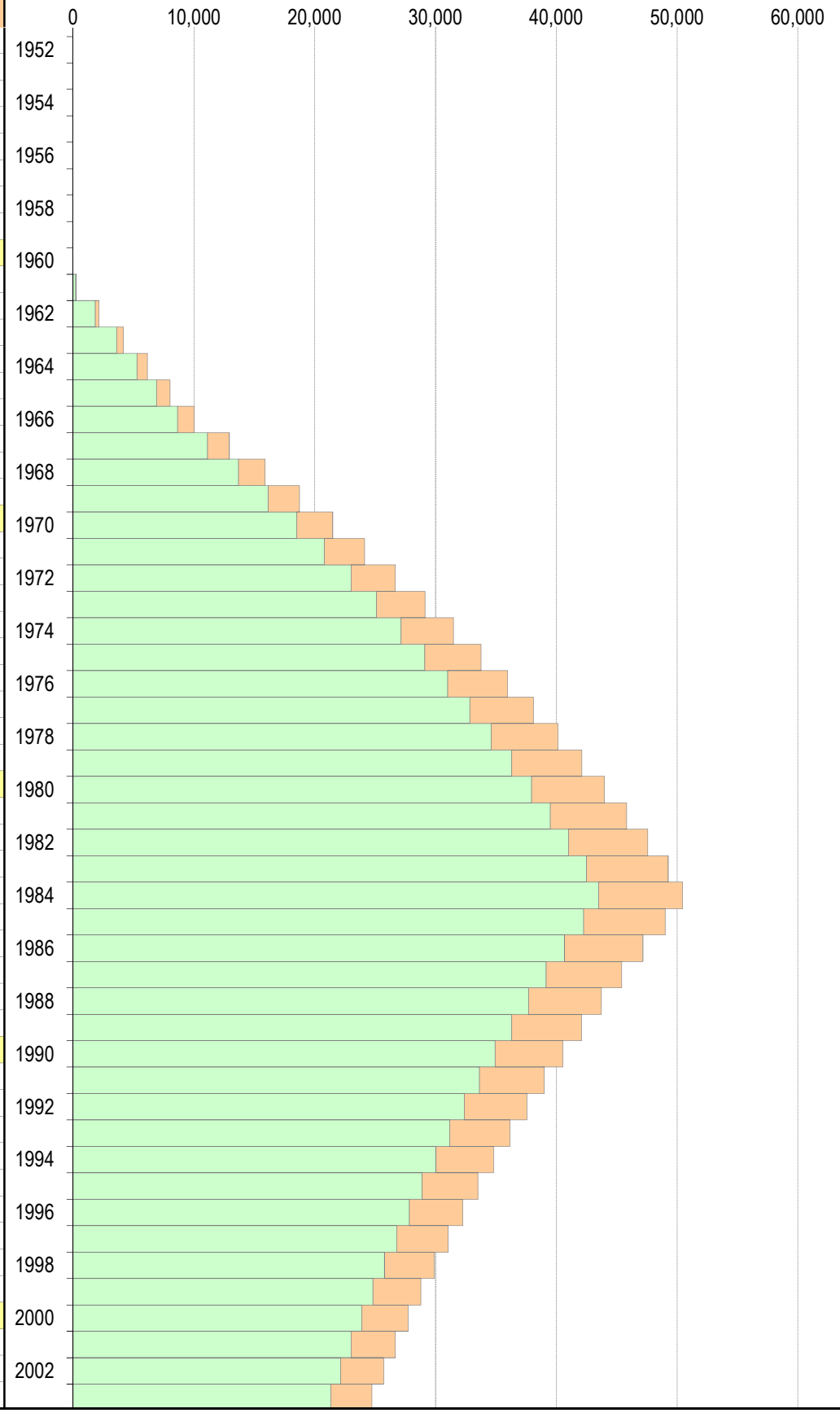
	Waste			Daily Cover			
	Waste Deposited			Greenwaste & Compost		Sludge	
Year	Tons	% ANDOC		Tons	% ANDOC	Tons	% ANDOC
2004							
2005							
2006							
2007							
2008							
2009							
2010							
2011							
2012							
2013							
2014							
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
2023							

Model Output: Landfill Characteristics

Landfill Name: Berkeley Land
State: CA
City/County: Berkeley
Year Opened: 1961
If Closed, Year: 1983
k Value: 0.038
M Value: 6

Model Output: Methane and Carbon Dioxide Emissions (metric tonnes of CO_2 equivalent)

Year	CH_4	CO_2
1952		
1953		
1954		
1955		
1956		
1957		
1958		
1959		
1960		
1961	232	37
1962	1,827	292
1963	3,589	573
1964	5,284	844
1965	6,917	1,105
1966	8,635	1,379
1967	11,143	1,780
1968	13,699	2,188
1969	16,159	2,581
1970	18,528	2,959
1971	20,808	3,323
1972	23,003	3,674
1973	25,117	4,011
1974	27,151	4,336
1975	29,112	4,649
1976	31,012	4,953
1977	32,844	5,245
1978	34,607	5,527
1979	36,305	5,798
1980	37,939	6,059
1981	39,512	6,310
1982	41,027	6,552
1983	42,485	6,785
1984	43,510	6,949
1985	42,257	6,748
1986	40,681	6,497
1987	39,164	6,254
1988	37,704	6,021
1989	36,298	5,797
1990	34,945	5,581
1991	33,642	5,373
1992	32,387	5,172
1993	31,180	4,979
1994	30,017	4,794
1995	28,898	4,615
1996	27,820	4,443
1997	26,783	4,277
1998	25,784	4,118
1999	24,823	3,964
2000	23,897	3,816
2001	23,006	3,674
2002	22,148	3,537
2003	21,322	3,405

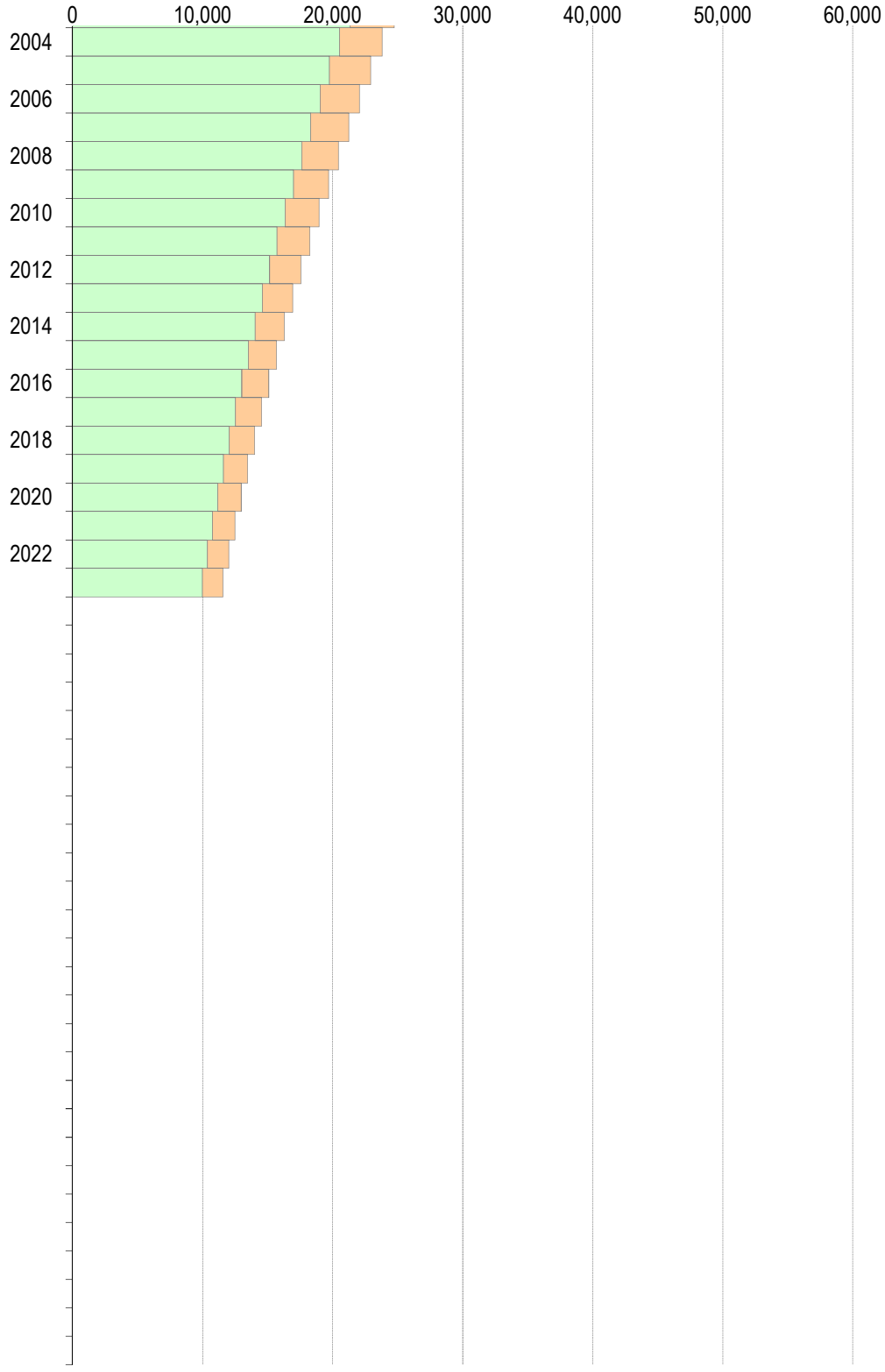


Model Output: Landfill Characteristics

Landfill Name: Berkeley Land
State: CA
City/County: Berkeley
Year Opened: 1961
If Closed, Year: 1983
k Value: 0.038
M Value: 6

Model Output: Methane and Carbon Dioxide Emissions (metric tonnes of CO_2 equivalent)

Year	CH_4	CO_2
2004	20,527	3,278
2005	19,762	3,156
2006	19,025	3,038
2007	18,316	2,925
2008	17,633	2,816
2009	16,975	2,711
2010	16,342	2,610
2011	15,733	2,513
2012	15,146	2,419
2013	14,582	2,329
2014	14,038	2,242
2015	13,514	2,158
2016	13,011	2,078
2017	12,525	2,000
2018	12,058	1,926
2019	11,609	1,854
2020	11,176	1,785
2021	10,759	1,718
2022	10,358	1,654
2023	9,972	1,592

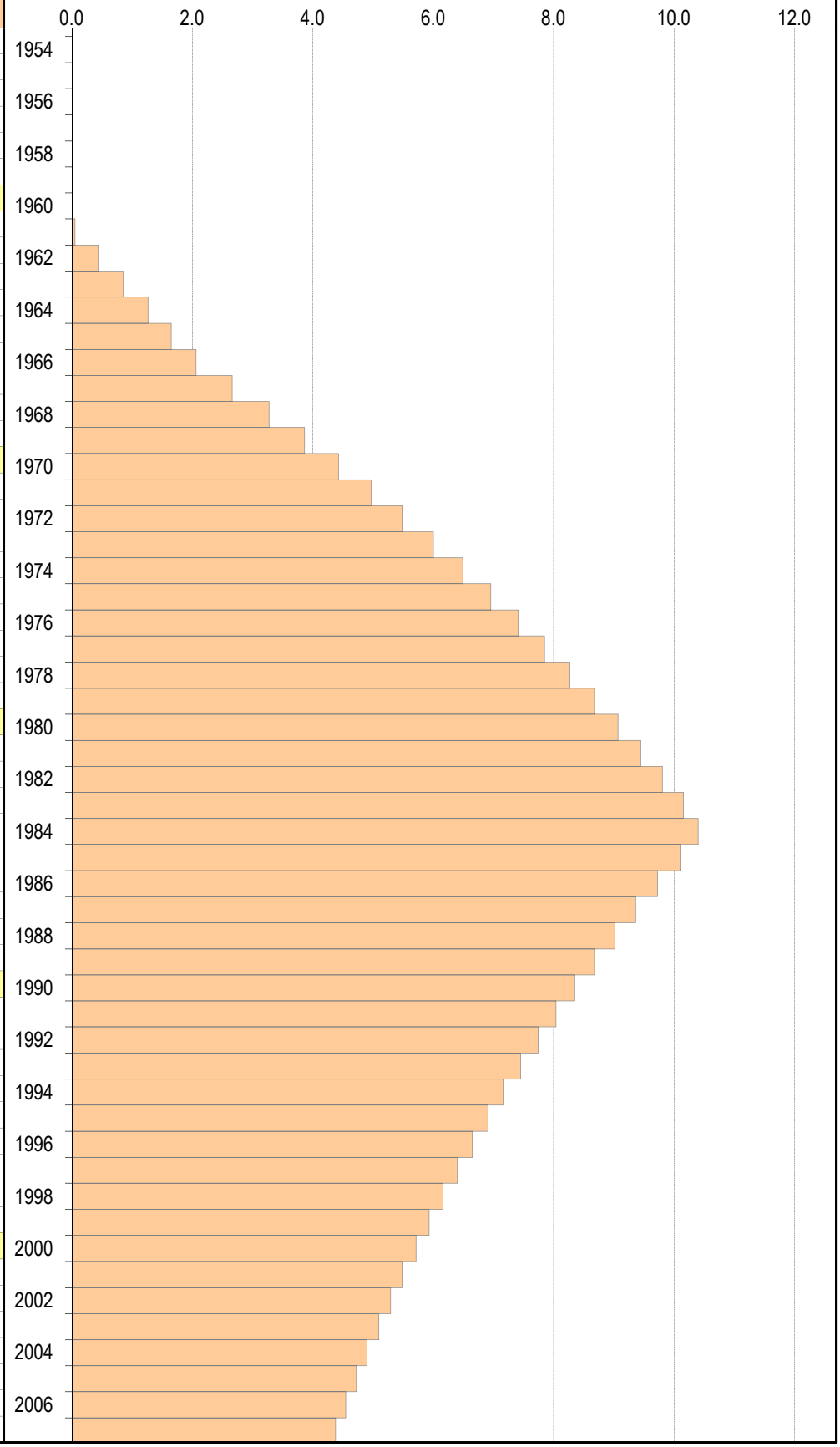


Model Output: Landfill Characteristics

Landfill Name: Berkeley Landfill
State: CA
City/County: Berkeley
Year Opened: 1961
If Closed, Year: 1983
k Value: 0.038
M Value: 6

Model Output: Landfill Gas Captured and Captured Gas Heat (graph values in MMbtu/hr)

Year	Expected Gas Recovery Flow Rate (scf/min)	Heat Input Capacity (MMbtu/hr)
1954		
1955		
1956		
1957		
1958		
1959		
1960		
1961	2	0.1
1962	14	0.4
1963	28	0.9
1964	42	1.3
1965	54	1.7
1966	68	2.1
1967	88	2.7
1968	108	3.3
1969	127	3.9
1970	146	4.4
1971	164	5.0
1972	181	5.5
1973	198	6.0
1974	214	6.5
1975	229	7.0
1976	244	7.4
1977	259	7.9
1978	273	8.3
1979	286	8.7
1980	299	9.1
1981	311	9.4
1982	323	9.8
1983	335	10.2
1984	343	10.4
1985	333	10.1
1986	320	9.7
1987	308	9.4
1988	297	9.0
1989	286	8.7
1990	275	8.4
1991	265	8.0
1992	255	7.7
1993	246	7.5
1994	236	7.2
1995	228	6.9
1996	219	6.7
1997	211	6.4
1998	203	6.2
1999	195	5.9
2000	188	5.7
2001	181	5.5
2002	174	5.3
2003	168	5.1
2004	162	4.9
2005	156	4.7
2006	150	4.5
2007	144	4.4



Model Output: Landfill Characteristics

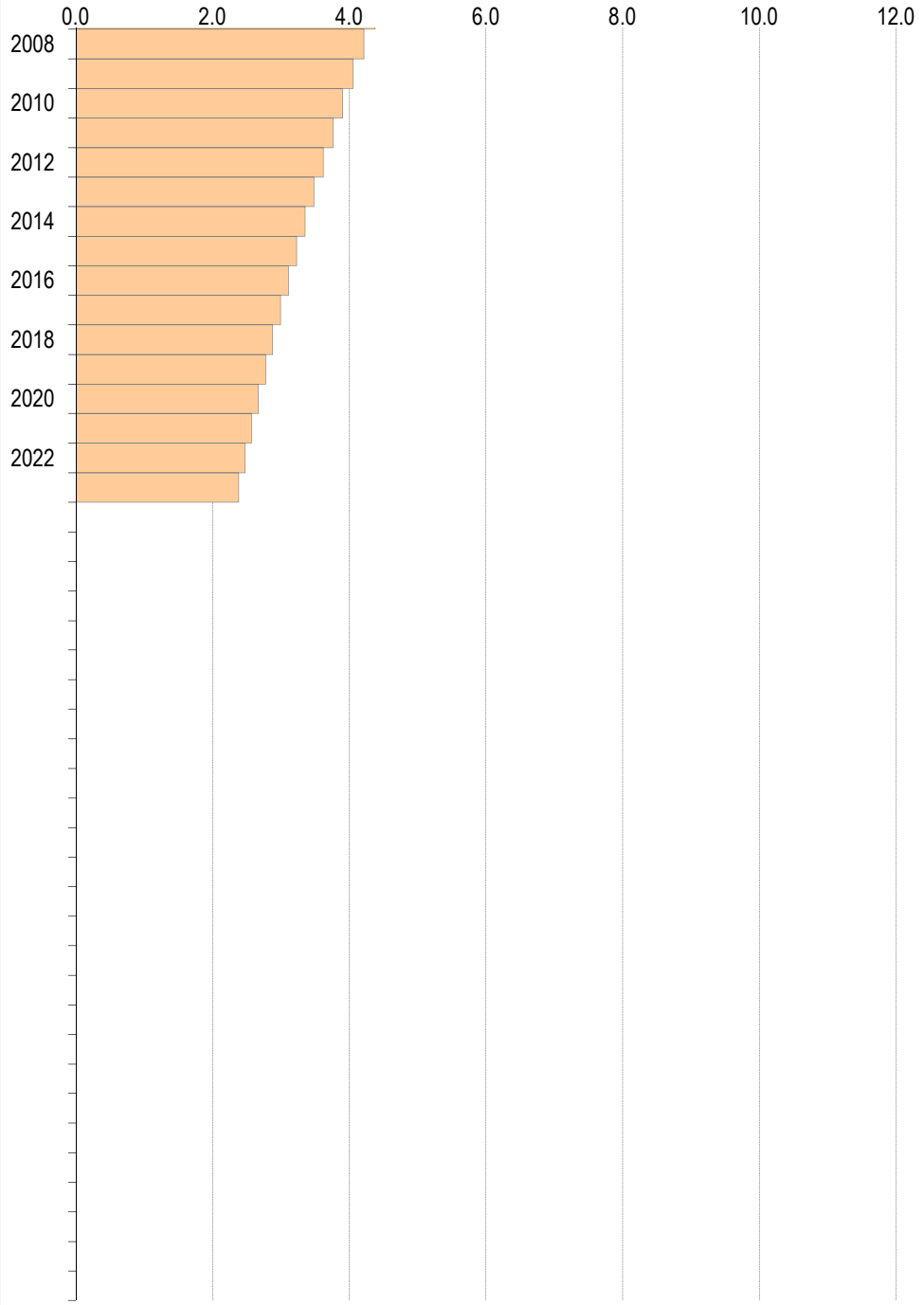
Landfill Name: Berkeley Landfill
State: CA
City/County: Berkeley

Year Opened: 1961
If Closed, Year: 1983

k Value: 0.038
M Value: 6

Model Output: Landfill Gas Captured and Captured Gas Heat (graph values in MMbtu/hr)

Year	Expected Gas Recovery Flow Rate (scf/min)	Heat Input Capacity (MMbtu/hr)
2008	139	4.2
2009	134	4.1
2010	129	3.9
2011	124	3.8
2012	119	3.6
2013	115	3.5
2014	111	3.4
2015	106	3.2
2016	102	3.1
2017	99	3.0
2018	95	2.9
2019	91	2.8
2020	88	2.7
2021	85	2.6
2022	82	2.5
2023	79	2.4



Appendix D

Annual 2021 SEM Report

July 27, 2021
Project No. 01210112.01 Task 8

Mr. Reeve Battle
City of Berkeley Engineering Division
Department of Public Works
1947 Center Street, 4th Floor
Berkeley, California 94704

Subject: Closed Berkeley Marina Landfill, Berkeley, California

Annual Landfill Methane Rule (LMR) Surface Emissions Monitoring (SEM) for 2021.

Dear Mr. Battle,

SCS Field Services (SCS-FS) is pleased to provide the City of Berkeley (City), with the enclosed report summarizing the surface emissions monitoring services provided at the Closed Berkeley Marina Landfill (Site) for 2021. This report includes the results of surface scan, component emissions and blower/flare station emissions monitoring for the Site for this monitoring period.

SCS-FS appreciates the opportunity to be of assistance to the City on this project. As you review the enclosed information, please contact Art Jones at (209) 702-6228 or Whitney Stackhouse (209) 338-7990 if you have any questions or comments.

Sincerely,

Whitney M. Stackhouse
Project Professional
SCS Field Services

Arthur E. Jones Jr.
Senior Project Manager/VP
SCS Field Services

WS/AJ

cc: Enclosure Sean Bass, SCS Field Services

Closed Berkeley Marina Landfill

Landfill Methane Rule (LMR) Surface Emissions Monitoring

2021 Annual Monitoring Event

Presented to:

Mr. Reeve Battle
City of Berkeley Engineering Division
Department of Public Works
1947 Center Street, 4th Floor
Berkeley, California 94704

SCS FIELD SERVICES

File No. 01210112.01 | July 27, 2021

SCS FIELD SERVICES
4730 Enterprise Way
Modesto, CA 95356

Closed Berkeley Marina Landfill

Landfill Methane Rule (LMR) Surface Emissions Monitoring 2021 Annual Monitoring Event

INTRODUCTION

This letter provides results of the April 30, 2021, annual LMR landfill surface emissions monitoring (SEM) performed by SCS Field Services (SCS) at the subject site. All work was performed in accordance with our approved proposal dated, June 13, 2011, and LMR requirements.

SUMMARY AND CONCLUSIONS

As stipulated in the LMR, based on four consecutive years of SEM results with no regulatory exceedances, the required annual monitoring for continued compliance at the Closed Berkeley Marina Landfill was performed on a 100-foot pathway on April 30, 2021.

On April 30, 2021, the instantaneous SEM showed no exceedances of LMR instantaneous threshold limit of 500 parts per million by volume (ppmv) measure as methane. Based on these monitoring results no follow up testing was required.

During the instantaneous monitoring event, SCS performed integrated monitoring of the landfill surface. As required by the LMR, the landfill was divided into 50,000 square foot areas. The Closed Berkeley Marina Landfill surface area was therefore divided into eighty-three (83) separate grids, as shown on Figure A-1 in Attachment 1. During the monitoring event, no monitored areas were observed to exceedance the 25 ppmv threshold. Based on these monitoring results no follow up testing was required.

In addition, quarterly monitoring of the pressurized piping or components of the Gas Collection and Control System (GCCS) that are under pressure must be performed quarterly. Results of the leak testing of the landfill gas (LFG) Blower Flare Station (BFS) pressurized pipe and components indicated that all test locations were in compliance with the 500 ppmv requirements.

Further, as required under the LMR, any surface location on the landfill that has an observed instantaneous methane concentration above 200 ppmv must to be stake-marked and Global Positioning System (GPS) located on a site figure for future reference. During our monitoring no locations were observed to exceed the 200 ppmv threshold, however; if there are areas observed during upcoming monitoring events they will be GPS located on the figure in Attachment 2 for future observation and repair if needed.

As stipulated in the LMR, if no uncorrectable exceedances within the 10-day limitation are detected upon completion of four consecutive compliant monitoring events, the landfill can perform monitoring on a 100-foot pathway on an annual basis for closed landfills.

Based on the results above, no further testing is required until the end of 2022.

Finally, to help prevent potential future exceedances, SCS recommends that the landfill surface be routinely inspected and any observed surface erosion be routinely repaired.

BACKGROUND

The Berkeley Marina Landfill site is a former refuse disposal site. By way of background, organic materials buried in a landfill decompose anaerobically (in the absence of oxygen) producing combustible gas, which contains approximately 50 to 60 percent methane gas, 40 to 50 percent carbon dioxide, and trace amounts of various other gases, some of which are odorous. The Berkeley property contains a LFG collection and flare system to control the combustible gases generated in the landfill.

The gases produced in a landfill will either vent vertically to the atmosphere or migrate horizontally through subsurface soil to locations on adjacent properties. If the soil surrounding a landfill consists of permeable materials, there is a greater likelihood that the LFG will migrate to off-site locations.

SURFACE EMISSIONS MONITORING

On April 30, 2021, the instantaneous and integrated SEM was performed over the surface of the subject site. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the LMR threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring in the 50,000 square foot grids as required under the LMR. During this event, SCS performed the monitoring on 100-foot pathways in accordance with the rule as required.

In addition, the landfill cover was inspected and any areas where cover repair may be needed were identified and reported to site personnel.

EMISSIONS TESTING INSTRUMENTATION/CALIBRATION

Instruments used to perform the landfill surface emission testing consisted of the following:

- Thermo Scientific TVA 2020 portable Flame Ionization Detector (FID). This instrument measures methane in air over a range of 1 to 50,000 ppmv. The TVA 2020 meets the State of California Air Resources Board (CARB) requirements for combined instantaneous and integrated monitoring and was calibrated in accordance with United States Environmental Protection Agency (US EPA) Method 21.

- Weather Anemometer with continuous recorder for meteorological conditions in accordance with the LMR.

Instrument calibration logs and weather information are shown in Attachments 5 and 6.

SURFACE EMISSIONS MONITORING PROCEDURES

Surface emissions monitoring was conducted in accordance with the LMR. Monitoring was performed with the FID inlet held within 3-inches of the landfill surface while a technician walked a grid in parallel paths not more than 100-feet apart over the surface of the landfill. Cracks, holes and other cover penetrations in the surface were also tested. Surface emissions readings were monitored continuously and recorded every 5 seconds. Any areas in exceedance of the 200 or 500 ppmv

standard (compliance or reporting levels, respectively) were GPS tagged and stake-marked for on-site personnel to perform remediation or repairs.

The integrated average used for evaluation is based on the readings stored on the instrument which are recorded every 5 seconds. The readings are then downloaded and the averages are calculated for each grid using SCS eTools®. All readings are maintained in this secure SCS Database. The readings are not provided in the report due to the volume of readings, but can be furnished upon request.

Recorded wind speed results are shown in Attachment 6. Wind speed averages were observed to remain below the alternative requested 10 miles per hour, and no instantaneous speeds exceeded 20 miles per hour. No rainfall had occurred within 72 hours of the monitoring events. Therefore, site meteorological conditions were within the requested alternatives of the LMR requirements on the above mentioned dates.

TESTING RESULTS

During this event, SCS performed the monitoring on a 100-foot pathway in accordance with the rules as required under the LMR. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the LMR threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring. During our instantaneous monitoring, the highest observed reading was 12.7 ppmv in Grid Number 53. Results of the monitoring are shown in Attachment 3 (Table 1).

Additionally, during the integrated monitoring no exceedance of the 25 ppmv requirement was observed in any grid location tested. The highest integrated reading observed was in Grid Number 53, with an average methane concentration of 4.34 ppmv, which is shown in Attachment 4 (Table 2). Calibration logs for the monitoring equipment are provided in Attachment 5.

PRESSURIZED PIPE AND COMPONENT LEAK MONITORING

On April 30, 2021, quarterly leak monitoring was performed in accordance with the LMR. SCS performed landfill gas pressurized pipe and component leak monitoring at the flare station. Monitoring was performed with the detector inlet held one half of an inch from pressurized pipe and associated components. No locations exceeding the 500 ppmv threshold were observed during our monitoring event. The maximum reading, which was well below the regulatory threshold, was 2.2 ppmv (see Table 1 for component results). Therefore, all pressurized pipe and associated components in the LFG BFS were in compliance at the time of our testing.

PROJECT SCHEDULE

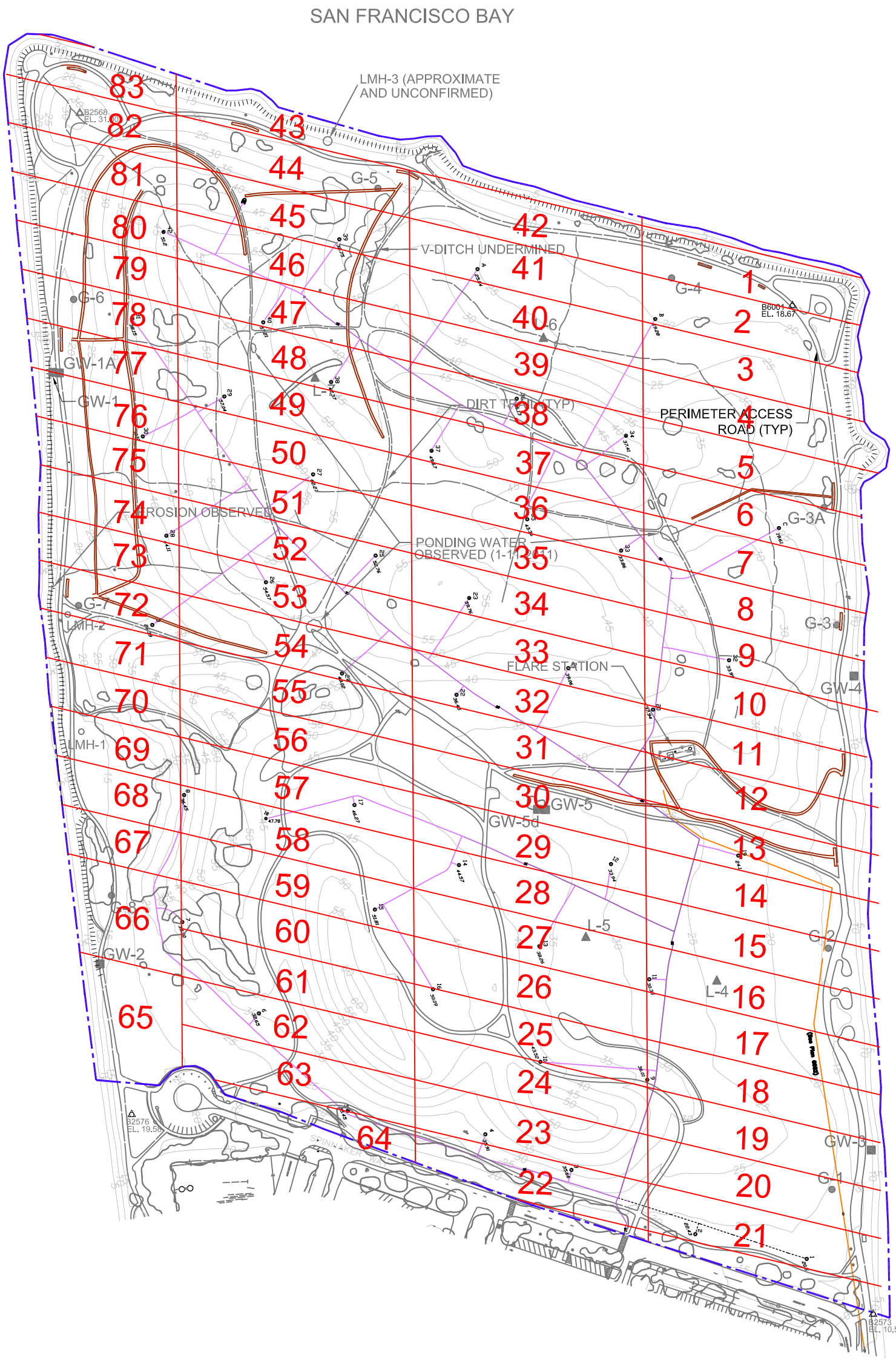
In accordance with our approved Work Scope, the next LMR monitoring event will need to be performed prior to the end of 2022. Since the landfill is closed and has remained in compliance for multiple years, the monitoring is only required annually.

STANDARD PROVISIONS

This report addresses conditions of the subject site during the testing dates only. Accordingly, we assume no responsibility for any changes that may occur subsequent to our testing which could affect the surface or component emissions at the subject site or adjacent properties.

Attachment 1

Landfill Grid



LEGEND

- GROUNDWATER MONITORING WELL
- LEACHATE MONITORING WELL
- LEVEE SEEPAGE WELL
- LMH-2 LIQUID COLLECTION SUMP
- RIP RAP WALL
- CONCRETE DRAINAGE DITCH (V-ditch)
- SITE BOUNDARY

APPROXIMATE SCALE IN FEET

250 0 250

SCS ENGINEERS

ENVIRONMENTAL CONSULTANTS & CONTRACTORS

6601 KOLL CENTER PARKWAY, SUITE 140
PLEASANTON, CALIFORNIA 94566
PH. (925) 426-0080 FAX. (925) 426-0707

PROJ. NO.	DWN. BY:	ACAD FILE:
01210112.00 TSK 3	ATV	FIGURE A-1
DSN. BY: ATV	CHK. BY: AAM	APP. BY: AAM

NOTE:
ORIGINAL TOPOGRAPHY BY AERIAL METHODS 2010. BASE PROVIDED BY HJW GEOSPATIAL.

AERIAL PROVIDED BY HJW GEOSPATIAL.

SHEET TITLE: SURFACE EMISSIONS PLAN

DATE: 7/26/11

PROJECT TITLE:
BERKELEY LANDFILL
CITY OF BERKELEY, CALIFORNIA

SCALE: AS SHOWN

FIGURE NO. A-1

Attachment 2

Surface Pathway

2021 Annual
LMR Surface Emission Monitoring Pathway
Berkeley Marina Landfill, Berkeley, California

Attachment 3

Instantaneous and Component Emissions Monitoring Results

2021 Annual Event

Table 1. Instantaneous Surface Emissions and Component Monitoring Results

Berkeley Marina Landfill, Berkeley, California

Instantaneous Data Report for April 30, 2021

Location	Date	Time	Concentration (ppmv)
53	4/30/2021	11:19	12.7

Pressurized Pipe and Component Results

Location	Date	Time	Concentration (ppmv)
BFS	4/30/2021	14:06	2.2

No Exceedances of the 500 ppm threshold were observed during the monitoring performed on April 30, 2021. The highest reading observed was 12.7 ppmv.

Component Emissions Monitoring Results
Berkeley Marina Landfill, Berkeley, California

Field Technician and Weather Conditions						
Technician	**Date**	**Ambient Temp**	**Barometric Pressure (in - Hg)**	**General Weather**	**Wind Speed**	**Wind Direction**
R.Haslam/H.Ott	04/30/2021	64	29.9	Overcast	4	North
Name	**Date**	**Well Vault (ppm)**	**Valve Vault (ppm)**	**Area Scan (ppm)**	**Re-Testing**	**Comments**
EW-01	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-02	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-03	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-04	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-05	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-07	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-09	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-10	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-13	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-15	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-16	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-17	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-18	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-19	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-20	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-21	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-22	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-24	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-25	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-26	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-27	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-28	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-30	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-31	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-32	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-33	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-34	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-36	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-37	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-38	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-39	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-40	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-41	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-42	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-1	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-2	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-01	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-02	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-03	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-04	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-05	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-06	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-07	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-08	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-09	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-10	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-11	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-12	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-13	04/30/2021				None	Blocked
TW-14	04/30/2021				None	Blocked
		Valves	Piping	Flex hoses		
Flare	04/30/2021	3	3	3	None	

Attachment 4

Integrated Monitoring Results

2021 Annual Event

Table 2. Integrated Surface Emissions Monitoring Results

Berkeley Marina Landfill, Berkeley, California

Point Name	Record Date	FID Concentration (ppm)	Comments
1	4/30/2021	3.04	
2	4/30/2021	3.07	
3	4/30/2021	2.93	
4	4/30/2021	3.02	
5	4/30/2021	1.95	
6	4/30/2021	3.03	
7	4/30/2021	2.32	
8	4/30/2021	3.23	
9	4/30/2021	1.82	
10	4/30/2021	2.91	
11	4/30/2021	1.96	
12	4/30/2021	3.03	
13	4/30/2021	1.71	
14	4/30/2021	2.90	
15	4/30/2021	1.72	
17	4/30/2021	1.66	
18	4/30/2021	2.90	
19	4/30/2021	1.92	
20	4/30/2021	2.88	
21	4/30/2021	1.97	
22	4/30/2021	2.03	
23	4/30/2021	2.89	
24	4/30/2021	1.98	
25	4/30/2021	2.90	
26	4/30/2021	1.69	
27	4/30/2021	2.90	
28	4/30/2021	1.72	
29	4/30/2021	2.90	
30	4/30/2021	1.82	
31	4/30/2021	2.91	
32	4/30/2021	1.90	
33	4/30/2021	2.94	
34	4/30/2021	1.89	
35	4/30/2021	3.32	
36	4/30/2021	2.24	
37	4/30/2021	3.12	
38	4/30/2021	1.92	
39	4/30/2021	3.08	
40	4/30/2021	2.95	
41	4/30/2021	3.04	
42	4/30/2021	3.00	

2021 Annual Event

Table 2. Integrated Surface Emissions Monitoring Results

Berkeley Marina Landfill, Berkeley, California

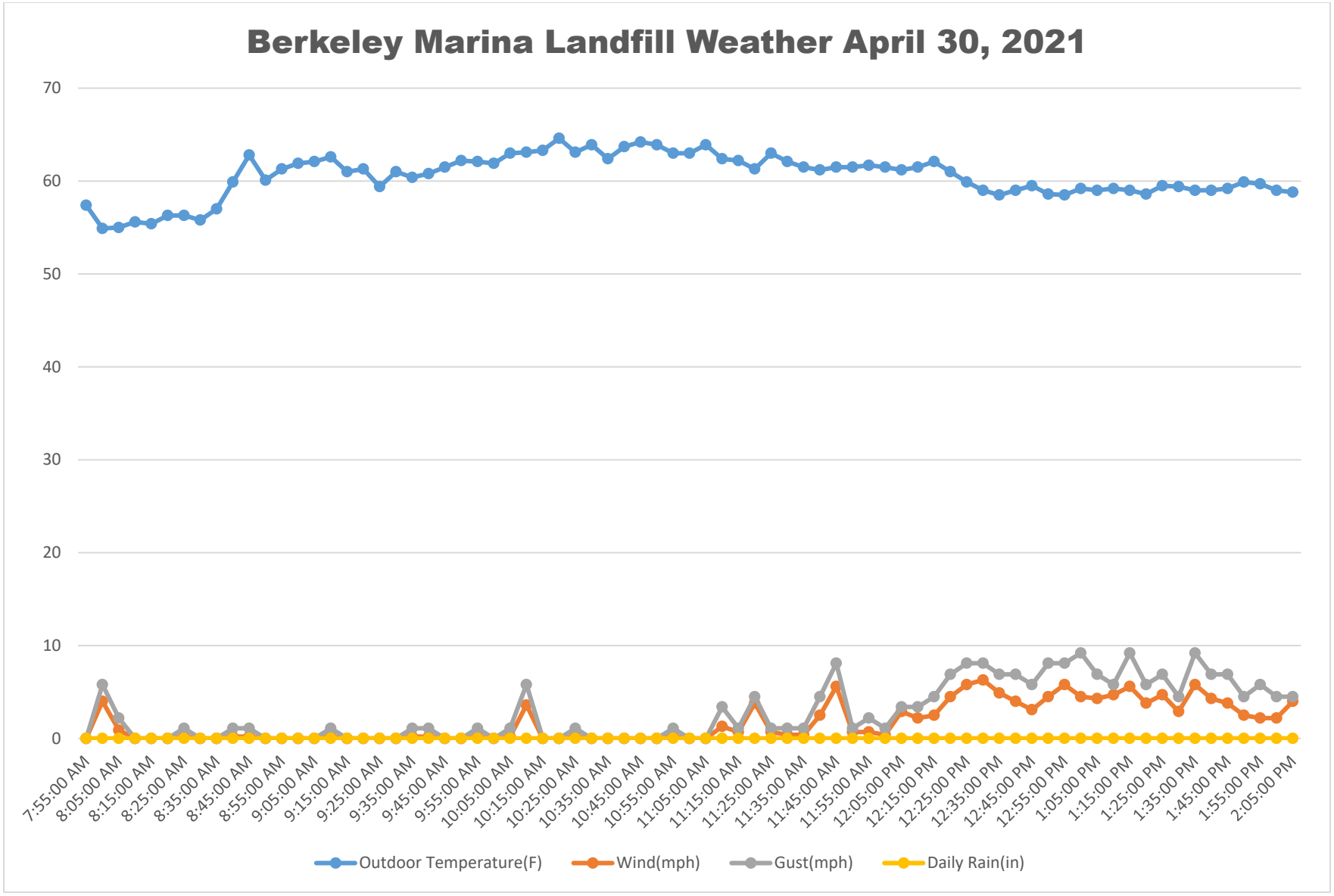
Point Name	Record Date	FID Concentration (ppm)	Comments
43	4/30/2021	3.01	
44	4/30/2021	2.91	
45	4/30/2021	3.12	
46	4/30/2021	2.89	
47	4/30/2021	3.10	
48	4/30/2021	1.96	
49	4/30/2021	3.00	
50	4/30/2021	2.17	
51	4/30/2021	2.99	
52	4/30/2021	1.77	
53	4/30/2021	4.34	
54	4/30/2021	2.09	
55	4/30/2021	3.02	
56	4/30/2021	1.78	
57	4/30/2021	2.91	
58	4/30/2021	1.86	
60	4/30/2021	1.82	
61	4/30/2021	2.90	
62	4/30/2021	1.92	
63	4/30/2021	2.88	
64	4/30/2021	2.03	
65	4/30/2021	2.48	
66	4/30/2021	2.89	
67	4/30/2021	2.91	
68	4/30/2021	1.91	
69	4/30/2021	2.94	
70	4/30/2021	1.80	
71	4/30/2021	3.03	
72	4/30/2021	1.77	
73	4/30/2021	2.98	
74	4/30/2021	1.71	
75	4/30/2021	3.22	
76	4/30/2021	1.90	
77	4/30/2021	3.02	
78	4/30/2021	1.84	
79	4/30/2021	3.07	
80	4/30/2021	2.94	
81	4/30/2021	3.13	
82	4/30/2021	2.90	
83	4/30/2021	3.04	

Attachment 5

Calibration Logs

Attachment 6

Weather Data


Berkeley Marina Landfill Weather April 30, 2021
70
60
50
40
30
20
10
0
7:55:00 AM
8:05:00 AM
8:15:00 AM
8:25:00 AM
8:35:00 AM
8:45:00 AM
8:55:00 AM
9:05:00 AM
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12:45:00 PM
12:55:00 PM
1:05:00 PM
1:15:00 PM
1:25:00 PM
1:35:00 PM
1:45:00 PM
1:55:00 PM
2:05:00 PM
Outdoor Temperature(F)
Wind(mph)
Gust(mph)
Daily Rain(in)

Appendix E

2021 Quarterly Component Leak Monitoring Results

Component Emissions Monitoring Results
Berkeley Marina Landfill, Berkeley, California

Field Technician and Weather Conditions						
Technician	**Date**	**Ambient Temp**	**Barometric Pressure (in - Hg)**	**General Weather**	**Wind Speed**	**Wind Direction**
D.Gibson	01/08/2021	54	30.1	cloudy	2	ses

Name	**Date**	**Well Vault (ppm)**	**Valve Vault (ppm)**	**Area Scan (ppm)**	**Re-Testing**	**Comments**
EW-01	01/08/2021	3.2 ppm	2.6 ppm	3.4 ppm	None	
EW-02	01/08/2021	3.3 ppm	2.9ppm	3.0 ppm	None	
EW-03	01/08/2021	3.1 ppm	3.0 ppm	3.3 ppm	None	
EW-04	01/08/2021	3.2 ppm	3.0 ppm	3.3 ppm	None	
EW-05	01/08/2021	3.7 ppm	3.0 ppm	3.0 ppm	None	
EW-07	01/08/2021	3.3 ppm	3.0 ppm	3.1 ppm	None	
EW-09	01/08/2021	3.3 ppm	2.9 ppm	3.0 ppm	None	
EW-10	01/08/2021	3.2 ppm	2.9 ppm	3.0 ppm	None	
EW-13	01/08/2021	3.3 ppm	2.9 ppm	3.1 ppm	None	
EW-15	01/08/2021	3.3 ppm	3.0 ppm	3.0 ppm	None	
EW-16	01/08/2021	3.1 ppm	2.9 ppm	2.9 ppm	None	
EW-17	01/08/2021	3.2 ppm	2.9 ppm	3.0ppm	None	
EW-18	01/08/2021	3.2 ppm	3.0 ppm	3.1 ppm	None	
EW-19	01/08/2021	3.1 ppm	3.0 ppm	3.3 ppm	None	
EW-20	01/08/2021	3.2 ppm	3.0 ppm	3.0 ppm	None	
EW-21	01/08/2021	3.2 ppm	3.1 ppm	3.1 ppm	None	
EW-22	01/08/2021	3.1 ppm	3.0 ppm	3.0 ppm	None	
EW-24	01/08/2021	3.3 ppm	3.0 ppm	3.2 ppm	None	
EW-25	01/08/2021	3.3 ppm	3.1 ppm	3.3 ppm	None	
EW-26	01/08/2021	3.1 ppm	3.0 ppm	3.0 ppm	None	
EW-27	01/08/2021	3.3 ppm	3.1 ppm	3.0 ppm	None	
EW-28	01/08/2021	3.2 ppm	3.2 ppm	3.1 ppm	None	
EW-30	01/08/2021	3.2 ppm	3.0 ppm	3.1 ppm	None	
EW-31	01/08/2021	3.3 ppm	3.0 ppm	3.1 ppm	None	
EW-32	01/08/2021	3.3 ppm	3.1 ppm	3.2 ppm	None	
EW-33	01/08/2021	3.2 ppm	3.3 ppm	3.0 ppm	None	
EW-34	01/08/2021	3.2 ppm	3.0 ppm	3.2 ppm	None	
EW-36	01/08/2021	3.3 ppm	2.9 ppm	3.0 ppm	None	
EW-37	01/08/2021	3.0 ppm	3.0 ppm	3.2 ppm	None	
EW-38	01/08/2021	3.3 ppm	3.2 ppm	3.3 ppm	None	
EW-39	01/08/2021	3.2 ppm	3.2 ppm	3.2 ppm	None	
EW-40	01/08/2021	3.2 ppm	2.9 ppm	3.1 ppm	None	
EW-41	01/08/2021	3.3 ppm	3.0 ppm	3.1 ppm	None	
EW-42	01/08/2021	3.2 ppm	2.9 ppm	3.1 ppm	None	
HC-1	01/08/2021	3.3 ppm	3.0 ppm	3.1 ppm	None	
HC-2	01/08/2021	3.2 ppm	2.9 ppm	3.1 ppm	None	
TW-01	01/08/2021	3.2 ppm	3.2 ppm	3.1 ppm	None	
TW-02	01/08/2021	3.3 ppm	2.9 ppm	2.9 ppm	None	
TW-03	01/08/2021	3.2 ppm	2.9 ppm	3.1 ppm	None	
TW-04	01/08/2021	3.2 ppm	3.0 ppm	3.1 ppm	None	
TW-05	01/08/2021	3.3 ppm	3.1 ppm	3.0 ppm	None	
TW-06	01/08/2021	3.2 ppm	2.8 ppm	2.9 ppm	None	
TW-07	01/08/2021	3.1 ppm	3.0 ppm	3.2 ppm	None	
TW-08	01/08/2021	3.2 ppm	3.1 ppm	3.2 ppm	None	
TW-09	01/08/2021	3.2 ppm	3.1 ppm	3.2 ppm	None	
TW-10	01/08/2021	3.2 ppm	3.1 ppm	3.3 ppm	None	
TW-11	01/08/2021	3.3 ppm	2.9 ppm	3.1 ppm	None	
TW-12	01/08/2021	3.3 ppm	3.0 ppm	2.9 ppm	None	
TW-13	01/08/2021				--	Blocked
TW-14	01/08/2021				--	Blocked

					Re-Testing
flare	01/08/2021	**Valves**	**Piping**	**Flex hoses**	none
		3.8	4.8	4.2	

Component Emissions Monitoring Results
Berkeley Marina Landfill, Berkeley, California

Field Technician and Weather Conditions						
Technician	**Date**	**Ambient Temp**	**Barometric Pressure (in - Hg)**	**General Weather**	**Wind Speed**	**Wind Direction**
R.Haslam/H.Ott	04/30/2021	64	29.9	Overcast	4	North
Name	**Date**	**Well Vault (ppm)**	**Valve Vault (ppm)**	**Area Scan (ppm)**	**Re-Testing**	**Comments**
EW-01	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-02	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-03	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-04	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-05	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-07	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-09	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-10	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-13	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-15	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-16	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-17	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-18	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-19	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-20	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-21	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-22	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-24	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-25	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-26	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-27	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-28	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-30	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-31	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-32	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-33	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-34	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-36	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-37	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-38	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-39	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-40	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-41	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-42	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-1	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-2	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-01	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-02	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-03	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-04	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-05	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-06	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-07	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-08	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-09	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-10	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-11	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-12	04/30/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-13	04/30/2021				None	Blocked
TW-14	04/30/2021				None	Blocked
		Valves	Piping	Flex hoses		
Flare	04/30/2021	3	3	3	None	

Component Emissions Monitoring Results
Berkeley Marina Landfill, Berkeley, California

Field Technician and Weather Conditions						
Technician	**Date**	**Ambient Temp**	**Barometric Pressure (in - Hg)**	**General Weather**	**Wind Speed**	**Wind Direction**
McGinn/Mmorris/Priver	07/29/2021	64	29.9	Overcast	4	North
Name	**Date**	**Well Vault (ppm)**	**Valve Vault (ppm)**	**Area Scan (ppm)**	**Re-Testing**	**Comments**
EW-01	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-02	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-03	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-04	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-05	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-07	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-09	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-10	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-13	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-15	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-16	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-17	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-18	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-19	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-20	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-21	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-22	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-24	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-25	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-26	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-27	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-28	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-30	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-31	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-32	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-33	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-34	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-36	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-37	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-38	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-39	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-40	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-41	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-42	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-1	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-2	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-01	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-02	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-03	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-04	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-05	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-06	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-07	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-08	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-09	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-10	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-11	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-12	07/29/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-13	07/29/2021				None	Blocked
TW-14	07/29/2021				None	Blocked
		Valves	Piping	Flex hoses		
Flare	07/29/2021	7	3	4	None	

Component Emissions Monitoring Results
Berkeley Marina Landfill, Berkeley, California

Field Technician and Weather Conditions						
Technician	**Date**	**Ambient Temp**	**Barometric Pressure (in - Hg)**	**General Weather**	**Wind Speed**	**Wind Direction**
McGinn/Mmorris/Priver	10/21/2021	64	29.9	Overcast	4	North
Name	**Date**	**Well Vault (ppm)**	**Valve Vault (ppm)**	**Area Scan (ppm)**	**Re-Testing**	**Comments**
EW-01	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-02	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-03	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-04	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-05	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-07	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-09	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-10	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-13	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-15	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-16	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-17	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-18	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-19	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-20	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-21	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-22	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-24	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-25	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-26	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-27	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-28	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-30	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-31	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-32	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-33	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-34	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-36	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-37	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-38	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-39	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-40	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-41	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
EW-42	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-1	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
HC-2	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-01	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-02	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-03	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-04	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-05	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-06	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-07	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-08	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-09	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-10	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-11	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-12	10/21/2021	1-3ppm	1-3ppm	1-3ppm	None	
TW-13	10/21/2021				None	Blocked
TW-14	10/21/2021				None	Blocked
		Valves	Piping	Flex hoses		
Flare	10/21/2021	7	3	4	None	

Appendix F

Source Test Results

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

375 Beale Street, Suite 600
San Francisco, California 94105
(415) 771-6000

Contractor Source Test Supplemental Form

Site name: City of Berkeley Marina Landfill

NST number: 6595

Testing company: BEST ENVIRONMETAL

Test purpose:

- [x] Routine compliance testing
- [ ] Compliance test required after previous source test failure
- [ ] Start-up test
- [ ] Other, ex: trial testing for permit changes, engineering studies

  Please explain:
- [ ] Revised report with corrections noted

  Revision number:

Preliminary test results:

- [x] **Values within range set by rule or regulation**
- [ ] **Values outside of range set by rule or regulation**
- [ ] N/A
- [ ] Please explain:

Source Test Report

CITY OF BERKELEY MARINA LANDFILL
Berkeley, CA

Landfill Gas Fired Flare (A-4)
Emission Results & Landfill Gas Characterization
Facility # A3590, Condition # 1826
NST-6595

Test Date: July 13, 2021
Report Date: August 31, 2021

Performed and Reported by:

BEST ENVIRONMENTAL
339 Stealth Court
Livermore, CA 94551
Phone: (925) 455-9474
Fax: (925) 455-9479

Prepared For:

SCS Field Services
4730 Enterprise Way
Modesto, Ca 95956
Attn: Mr. Stephen Harquail

For Submittal To:

Bay Area Air Quality Management District
375 Beale Street, STE 600
San Francisco, CA 94185

REVIEW AND CERTIFICATION

Team Leader:

The work performed herein was conducted under my supervision, and I certify that the details and results contained within this report are to the best of my knowledge an authentic and accurate representation of the test program. If this report is submitted for compliance purposes it should only be reproduced in its entirety. If there are any questions concerning this report, please call the Team Leader or Reviewer at (925) 455-9474.

Shaun Irwin
Project Manager

Reviewer:

I have reviewed this report for presentation and accuracy of content, and hereby certify that to the best of my knowledge the information is complete and correct.

Basim (Bobby) Asfour
Principal

Source Test Information

Source Owner:	City of Berkeley/Engineering Division/Public Works 1947 Center St., 4th Fl Berkeley, CA 94704
Source Location:	Berkeley Marina Landfill Cesar Chaves Park (Berkeley Marina) Berkeley, California 94704
Engineering Firm:	SCS Field Services
Contact:	Stephen Harquail, (530) 867-2369
Source Description:	Landfill Gas Flare
PTO Number:	Plant #3590 (S-1/A-4)

Test Parameters & Limits:		**Average Result**
NOx:	**0.06 lbs/MMBtu**	**0.02 lbs/MMBtu**
CO:	**0.2 lbs/MMBtu**	**< 0.002 lbs/MMBtu**
NMOC:	**30 ppm @ 3% O_2 as methane**	**< 2.3 ppm @ 3% O_2**
CH_4:	**99% DRE**	**> 99.997% DRE**
Fuel Sulfur:	**300 ppm as H_2S**	**10.5 ppm as H_2S**

Source Testing Firm:	BEST ENVIRONMENTAL 339 Stealth Court Livermore, CA 94551 Phone (925) 455-9474 Fax (925) 455-9479
Contact:	Bobby Asfour
Test Date:	July 13, 2021
NST Number:	6595
Analytical Laboratories:	Atmospheric Analysis & Consultants (NMOC, Speciated VOC, TRS, Fixed gases,) 1534 Eastman Avenue, Ste. A Ventura, CA 93003 Attn: Eric Grossjean Phone: (805) 650-1642 BEST ENVIRONMENTAL (CH_4, NMOC, H_2S, HHV& F factor) 339 Stealth Court Livermore, CA 94551

TABLE of CONTENTS

SECTION 1. INTRODUCTION

1.1. Test Purpose

Best Environmental (BE) was contracted by SCS Field Services to perform emissions testing on one landfill gas flare (A-4) to comply with Bay Area Air Quality Management District (BAAQMD) Regulation 8 Rule 34 Sections 301.3 & 412 as well as condition # 1826 of the permit. A copy of the Permit is included in the appendices.

1.2. Test Location

The testing was conducted on the flare located at the City of Berkeley, Ceasar Chavez Park, Berkeley Marina, CA 94704. (Facility #3590).

1.3. Test Date

Testing was conducted on July 13, 2021.

1.4. Test Parameters and Methods

The following emission parameters were measured:

Parameter	Monitoring & Analytical Protocols
NMOC, THC, NOx, CO & O_2	EPA Methods 3A, 7E, 10 & 25A
DSCFM	EPA Method 19 (exhaust)
Inlet NMOC & CH_4	EPA Method 18 & 25C
Fixed Gases, Btu/CF & F Factor	ASTM D-1945 & 3588
LFG organics & TRS	Modified EPA TO-15 & D-6228

1.5. Sampling and Observing Personnel

Sampling was performed by Bobby Asfour and Shaun Irwin of BE. The BAAQMD was notified of the test date; however, there was no representative present to witness the test program.

SECTION 2. SUMMARY OF RESULTS

2.1. Emission Results

Table 2.1 summarizes the flare outlet average test results. Triplicate 30-minute runs were performed according to BAAQMD and EPA test methods. Individual run results are presented in Table 1 on page 7. Landfill Gas Characterization results are located in Appendix B.

Table 2.1: Flare Outlet (A-4)

Parameter	Average Results	Limits
NOx, lbs/MMBtu	0.0195	**0.06**
CO, lbs/MMBtu	< 0.002	**0.20**
NMOC, ppm @ 3% O_2	< 2.3	**30**
CH_4 Destruction Efficiency	> 99.997	**≥ 99**

2.2. Process Data

Table 2.3 presents the Flare Operational Parameters. The flare temperature and fuel flow rate on the flare control panel was recorded by the flare monitoring system and provided by a facility representative. Process data and Fuel Meter calibrations can be found in Appendix E.

Table 2.3: Operational Parameters

Parameter	Fuel Flow Meter, SCFM	Flare Temp., ^oF
Run # 1	69	1,619
Run # 2	69	1,631
Run # 3	69	1,625

2.3. Allowable Emissions

See Table 2.1 above. The test results show that the flare is operating within the PTO gaseous emission limits and is therefore in compliance.

2.4. Comments: Discussion of Quality Assurance and Errors

Quality assurance procedures listed in the above referenced test methods and referenced in the Source Test Plan were performed and documented. The QA/QC procedures are described in Section 4.3 of the report. Documentation of the QA/QC is provided in Appendix A, B & D.

SECTION 3. SOURCE OPERATION

3.1. Process Description

The landfill gas fired flare is a control device for the treatment of landfill gas (mainly methane, carbon dioxide and nitrogen) that is generated from the decomposition of waste. The gas is collected in a network of interconnected pipes from several landfill gas extraction wells that draw a vacuum on the vapors in the landfill. The vapors are treated to remove condensate and particulate material, and then they are incinerated in the flare.

3.2. Flow Diagram

A digital image of the flare stack is contained in Appendix F.

3.3. Process and Control Operating Parameters

The flare was operated at ~1,625 ^{o}F at a fuel rate of ~69 SCFM according to the flare's monitoring devices. Flare monitoring data was provided by the facility and can be found in Appendix E.

3.4. Normal Operating Parameters

The flare was operating normally during the test periods.

3.5. Testing or Process interruptions and changes

There were no testing or process interruptions during the test series.

SECTION 4. SAMPLING AND ANALYSIS PROCEDURES

4.1. Port Location

Emissions from the flare were sampled via a circular stack with two ports 90^o apart located approximately 5 stack diameters downstream of the burners and 1 stack diameter upstream from the exit. Access to the sampling ports was provided using a 40-foot boom-lift.

The dimensional cross-sections of the stack are 56-inches (Area SQFT = 17.104). The fuel line to the flare is a 6-inch stainless steel pipe. A single port/tap was located on the flame arrestor, 2-feet upstream from the flare wall.

4.2. Point description/Labeling – ports/stack

The stack ports were not labeled but were designated as facing south and east.

4.3. Method Description, Equipment, Sampling, Analysis and QA/QC

Sampling and analytical procedures of the methods were followed as published in the BAAQMD Manual of Procedures, CARB Stationary Source Test Methods Volume I and the EPA "Quality Assurance Handbook for Air Pollution Measurement Systems" Volume III, US EPA 600/4-77-027b.

The following is an overview of the Testing Performed

Parameter	Location	Method(s)	Duration	# of Runs
THC, CH_4, NMOC, NO_x, CO & O_2	Exhaust	EPA Methods 3A, 7E, 10, 18 & 25A	30 mins	3
Flow Rate	Exhaust	EPA 19	30 mins	3
LFG organics & TRS compounds	Inlet	TO-15 & ASTM D-6228	30 mins	1
C1-C6, O_2, N_2, BTU-Fixed Gasses	Inlet	ASTM D-1945/3588	30 mins	1
Flow Rate & Flare Temp.	Inlet	Flare Metering System	~10 mins	3
NMOC & CH_4	Inlet	EPA Method 18 & 25C	30 mins	3

EPA Method 7E, 10 & 3A are all continuous monitoring techniques using instrumental analyzers. Sampling is performed by extracting exhaust flue gas from the stack, conditioning the sample and analyzing the flue gas using continuous monitoring gas analyzers in a CEM test van. The sampling system consists of a stainless-steel sample probe, Teflon sample line, glass-fiber particulate filter, glass moisture-knockout condensers in ice, Teflon sample transfer tubing, diaphragm pump and a stainless steel/Teflon manifold and flow control/delivery system. A constant sample and calibration gas supply pressure of 5 PSI is provided to each analyzer to avoid pressure variable response differences. The entire sampling system is leak checked prior to and at the end of the sampling program. The BE sampling and analytical system is checked for linearity with zero, mid and high-level span calibration gases, and is checked for system bias at the beginning of the test day.

System bias is determined by pulling calibration gas through the entire sampling system. Individual test run calibrations use the calibration gas, which most closely matches the stack gas effluent. The calibration gases are selected to fall approximately within the following instrument ranges; 80 to 95 percent for the high calibration, 40 to 60 percent for the mid-range and zero. Zero, calibration and bias drift values are determined for each test.

EPA 25A (THC as methane by FID) is an accepted method for the determination of Total Hydrocarbons (THC). A flame ionization detector (FID) total hydrocarbon continuous monitor is used for the sampling. The sampling and calibrations are performed through an all heated sample line connected directly to the THC analyzer. The FID in the analyzer is heated to 190 ^{o}C. The calibration gases are selected to fall within the following instrument ranges; 80 to 90 percent for the high calibration, 45 to 55 percent for the mid-range calibration, 25 to 35 percent for the low range calibration and zero. Zero and mid external calibration drift values are determined for each test run.

All BE calibration gases are EPA Protocol # 1. The analyzer data recording system consists of BE's Computer Data Acquisition System (DAS). The NO_2 converter is checked and confirmed to be > 90% efficient.

EPA Methods 7E, 10 & 3A met the following QA/QC method requirements:

System Criteria

Instrument Linearity	≤2% Calibration Span or ±0.5diff.
Instrument Bias	≤5% Calibration Span or ±0.5 diff.
NO_2 Converter Efficiency	≥90%
System Response Time	≤2 minutes

Test Criteria

Instrument Zero Drift	≤3% Calibration Span or ±0.5 diff.
Instrument Span Drift	≤3% Calibration Span or ±0.5 diff.

EPA Method 25A met the following QA/QC method requirements:

System Criteria

Instrument Linearity	≤5% Calibration Gas Conc.

Test Criteria

Instrument Zero Drift	≤3% Span Range
Instrument Span Drift	≤3% Span Range

The following continuous monitoring analyzers were used:

Parameter	Make	Model	Principle
NO_x	CAI	600CLD	Chemiluminescence
CO	TECO	48i	GFC IR analyzer
O_2	CAI	110P	Paramagnetic
THC	CAI	600	FID

EPA Method TO-15 & ASTM D-6228 analysis is used to determine emissions of Organic and inorganic compounds including sulfurs. Inlet gases are filled into tedlar bags corresponding to the test program. The bags are labeled respectively then sent to a laboratory and analyzed for GC/MS (gas chromatography/mass spectrometer) within 72 hours and GC/FPD (gas chromatography/flame photometric detector) within 24 hours for sulfur. For more information on the lab analysis, refer to Appendix B for method description and QA/QC.

EPA Method 18 is used to determine carbon speciated hydrocarbons (C_1, C_2 & C_3+) emissions by gas chromatograph / Flame Ionization Detection (GC/FID). Gaseous emissions are drawn through a Teflon sample line to a tedlar bag located in a rigid leak proof bag container. Sample is drawn into the bag by evacuating the container to stack gas pressure to allow sample flow without using a pump to avoid contamination. Negative pressure is adjusted to maintain an integrated sample flow between 20 to 60 minutes. The bag samples are taken to a laboratory and analyzed within 72 hours. The results are reported as methane with a detection limit of 0.5 ppm for non-methane non-ethane organic compounds (C_3+).

EPA Method 19 is used to determine stack gas volumetric flow rates using oxygen-based F-factors. F-factors are ratios of combustion gas volumes generated from heat input. The heating value of the fuel in Btu per cubic foot is determined from the analysis of fuel gas samples using gas chromatography (GC). Dedicated fuel meters monitor total fuel consumption for the source. The total cubic feet per hour of fuel multiplied times the Btu/CF provides million Btu per hour (MMBTU) heat input. The heat input in MMBTU/hr is multiplied by the F-factor (DSCF/MMBTU) and adjusted for the measured oxygen content of the source to determine volumetric flow rate. This procedure is proposed for pollutants whose compliance standards are based on emission rates (lb/day) or emission factors (lb/MMBtu).

EPA Method 25C is used to determine the emissions of NMOC and can also be used to identify and quantify fixed gases (O_2, CO_2, N_2& CH_4) in conjunction with **EPA Method 3C**. Gaseous emissions are drawn through Teflon sample line to a tedlar bag. Positive pressure is adjusted to maintain an integrated sample flow between 30 to 60 minutes. The bag samples are taken to a laboratory and analyzed for Non-Methane Organic Compound (NMOC) referenced to methane and fixed gases using GC/FID (gas chromatography/flame ionization detector-total combustion analysis and thermal conductivity detector (TCD) within 72 hours.

ASTM D-1945 & D-3588 analysis is used to determine the composition of fuel gas (e.g. Methane, fixed gases & BTU Content). Inlet gases are filled into a tedlar bag, the bag is labeled respectively then sent to a Laboratory and analyzed for fixed gases, methane and C_1-C_6 using GC/FID (gas chromatography/flame ionization detector). Each compound has calorific values that are used to calculate the gas higher heating values.

4.4. Analytical Laboratories

Three summa canisters were sent to AAC Lab. for EPA Method 25C, TO-15 (NMOC, organic compound analyses).

Three inlet and three outlet tedlar bag samples were brought to the BE Lab for ASTM D-1945/3588/6228 & EPA Method 18 (heat input, TRS & C_1, C_2, C_3+).

For more information on the analysis procedure and QA/QC refer to Appendix B.

TABLE #1
Berkeley Landfill
Flare
Test Results

TEST	1	2	3	AVERAGE	LIMIT
Test Location	Outlet	Outlet	Outlet		
Test Date	7/13/21	7/13/21	7/13/21		
Test Time	1116-1146	1158-1228	1238-1308		
Standard Temp., °F	70	70	70		
Process Data					
Flare Temp., ^{o}F	1,619	1,631	1,625	1,625	
Fuel F-Factor, DSCF/MMBtu @ 70^{o}F	10,660	10,495	10,468	10,541	
Inlet Methane (CH_4) Content, %	23.41	24.36	25.47	24.41	
Inlet Fuel Flow Rate, DSCFM	69	69	69	69	
Heat Input, MMBtu/hr	0.99	1.02	1.07	1.03	
Heat Input, MMBtu/day	23.65	24.54	25.63	24.61	
Outlet Flow Rate, DSCFM (M19)	480	461	481	474	
Outlet Emissions					
O_2, %	13.27	12.79	12.81	12.96	
CO, ppm	<1	<1	<1	<1	
CO, ppm @ 15% O_2	<0.77	<0.73	<0.73	<0.74	
CO, lbs/hr	<0.0003	<0.0003	<0.0003	<0.0003	
CO, lbs/MMBtu (O_2 based)	<0.0021	<0.0020	<0.0020	<0.0020	**0.20**
NO_x, ppm	9.29	9.89	9.92	9.70	
NO_x, ppm @ 15% O_2	7.19	7.19	7.23	7.20	
NO_x, lbs/hr	0.0028	0.0030	0.0030	0.0029	
NO_x, lbs/MMBtu (O_2 based)	0.0197	0.0194	0.0195	0.0195	**0.06**
THC, ppm as methane (25A)	<1.0	<1.0	<1.0	<1.0	
CH_4, ppm (M18)	<1.0	<1.0	<1.0	<1.0	
CH_4, lbs/hr	<0.001	<0.001	<0.001	<0.001	
NMOC, ppm (M25A)	<1.0	<1.0	<1.0	<1.0	
NMOC, ppm @ 3% O_2 as CH_4	<2.3	<2.2	<2.2	<2.3	**30**
VOC, lbs/hr as methane	<0.001	<0.001	<0.001	<0.001	
Inlet					
Inlet CH_4, ppm (M18)	234,100	243,600	254,700	244,133	
Inlet CH_4, lbs/hr	40.1	41.7	43.6	41.8	
Inlet VOC, ppm as methane (M25C)	139	222	169	177	
Inlet VOC, lbs/hr as methane	0.024	0.038	0.029	0.030	
Landfill Gas Sulfur Content					
Inlet Total Sulfur as H_2S, ppm	9.60	10.70	11.20	10.50	**300**
Destruction Efficiency					
CH_4, Destruction Efficiency %	>99.997%	>99.997%	>99.997%	**>99.997%**	**≥99%**
NMOC, Destruction Efficiency %	>95.0%	>97.0%	>95.9%	**>95.95%**	**≥98%**

Outlet NMOC = Total hydrocarbons (non-detect)

WHERE:

MW = Molecular Weight
DSCFM = Dry Standard Cubic Feet Per Minute
ppm = Parts Per Million Concentration
lbs/hr = Pound Per Hour Emission Rate
lbs/MMBtu = Pounds per million BTU
CO = Carbon Monoxide (MW = 28)
NOx = Oxides of Nitrogen as NO_2 (MW = 46)
THC = Total Hydrocarbons as Methane (MW = 16)
VOC = Total Non-Methane Hydrocarbons as Methane-C1 (MW = 16) CH_4

CALCULATIONS:

VOC ppm = THC ppm - CH_4 ppm
lbs/hr = ppm * DSCFM * MW *60 / 379 x 10^6 (@60^{o}F)
lbs/day = lbs/hr * 24
Removal Efficiency = (inlet lbs/hr-outlet lbs/hr) / Inlet lbs/hr
ppm @ 3% O_2 = ppm * 17.9 / (20.9-stack O_2)
lbs/MMBtu = Fd * M.W.* ppm * 2.59E-9 * (20.9/(20.9-%O_2))