ALISO CANYON GAS LEAK Results of Air Monitoring and Assessments of Health

SECOND SUPPLEMENTAL REPORT

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SECTION I. Introduction and Purpose

This is the fourth in a series of reports prepared by the Los Angeles County Department of Public Health (Public Health) to assess and describe the possible health impacts of a large natural gas leak which occurred in Los Angeles County. The gas leak began on October 23, 2015 from a well located on Southern California Gas (SoCalGas) Company's Aliso Canyon natural gas storage facility. The well was confirmed as permanently sealed on February 18, 2016 by the California Division of Oil, Gas, and Geothermal Resources (DOGGR).

This report updates and expands information on results from the Expanded Air Monitoring Plan (EAMP) conducted within SoCalGas' Aliso Canyon storage facility and the surrounding community. The EAMP is being conducted under the direction of Public Health and partnering agencies, including Los Angeles County Fire Department (LACoFD), South Coast Air Quality Management District (SCAQMD), Los Angeles Unified School District (LAUSD), California Air Resources Board (CARB), and the Office of Environmental Health and Hazard Assessment (OEHHA).

Previous reports (January 31, 2016, February 5, 2016, and February 13, 2016) provided up-to-date results on the air monitoring and health effects. This report updates previous results by including information from the most recent air monitoring samples for methane and benzene. In addition, this report provides updates on the summary of activities to monitor health effects in humans and animals.

SECTION II. Summary of Activities to Monitor Air Quality and Health Effects

AIR MONITORING

Since the onset of the gas leak, SoCalGas and other agencies have collected air samples to determine the levels of various chemicals in the air. SoCalGas has collected samples from locations on the storage facility, from locations on the facility boundary, and from locations within the community. Originally, all samples were of the "grab" sample type. Under the Expanded Air Monitoring Plan, which began in January 2016, 12-hour "integrated" air samples were also collected. This report summarizes the results for methane and benzene from all of these types of samples. In addition, this report includes new information on the results of 12-hour "integrated" sampling that occurred from community locations.

HUMAN AND ANIMAL HEALTH

The **Community Resource Center** operated by SoCalGas in Porter Ranch remains open. The Center provides a variety of services for community members, and also makes available resources from Public Health

including FAQs regarding human health and pet health, and a survey for residents to inform Public Health regarding issues their pets may have had.

Outreach to medical providers has continued and was successful in reaching out to all health care providers in and around the area who were not reached during earlier efforts.

Public Health continues to receive emails and phone calls to its **complaint line** from residents who provide information about any symptoms they may experience.

Additional activities included a new effort to analyze health-related information contained in Public Health's Acute Communicable Disease Control's **Syndromic Surveillance system**. This system captures data on patients' chief complaint(s) from participating emergency department (ED) visits in Los Angeles (LA) County. The system's capability is optimized to detect emerging diseases which are severe enough to require ED visits. Data from hospitals participating in the Syndromic Surveillance system which also serve Porter Ranch and adjacent communities were examined for increases in symptoms possibly related to the gas leak (e.g., headaches, nose bleeds, nausea, vomiting [i.e., gastrointestinal symptoms], dizziness, lethargy, and eye irritation). Results from hospital EDs serving Porter Ranch and adjacent communities were compared to results from other hospital EDs in LA County. Of note, since Syndromic Surveillance is limited to data collected from hospital EDs, it will not capture information on conditions which cause only mild symptoms. In particular, Syndromic Surveillance does not capture people who seek treatment at urgent care centers, clinics, or their private physicians--locations where they are much more likely to seek care for conditions causative of mild symptoms.

The Veterinary Public Health Program (VPH) continues its activities to assess possible effects of the gas leak on the **health of animals** in the surrounding area.

SECTION III. Results of Activities to Monitor Air Quality and Assess Health Effects

EXPANDED AIR MONITORING

Within the Aliso Canyon Facility (Oct. 30, 2015 – Feb. 13, 2016)

Since October 30, 2015, over 1,000 samples have been collected and analyzed for methane, volatile organic chemicals and sulfur odorants from the nine "grab" sample locations within the facility, as displayed in **Table 1**. The maximum level of methane detected was 4,340 ppm and the maximum level of benzene was 30.6 ppb. While the methane level within the facility is well above that measured in the community, it is below the flammable limit of 50,000 ppm. All measured benzene levels were below the occupational

permissible exposure limit of 1,000 ppb. Tests for sulfur odorants have consistently shown that the level is below the detection limit of current analytic methods.

Since January 12, 2016, three locations within the facility have continued to collect samples, but are now collecting 12-hour "integrated" samples, as seen in **Table 2**. The maximum level of methane detected was 720 ppm and the maximum level of benzene was 8.4 ppb. While the methane level is well above that measured in the community, it is below the flammable limit of 50,000 ppm. The average benzene level of 0.84 ppb is well below the occupational permissible exposure limit of 1,000 ppb. Tests for sulfur odorants have consistently shown that the level is below the detection limit of current analytic methods.

Aliso Canyon Property/Community Boundary (Jan. 12, 2016 – Feb. 13, 2016)

As displayed in **Table 3**, 12-hour "integrated" sampling began on January 12, 2016, at six sample locations along the property boundary as part of the Expanded Air Monitoring Plan. Methane levels have ranged from 1.8 to 24 ppm with an average of 4.9 ppm, which are above background levels (2 ppm) and below the flammable limit (50,000 ppm). Benzene levels have ranged from 0.05 to 0.42 ppb with an average of 0.15 ppb, which is below the chronic exposure limit (appropriate for 12-hour "integrated" samples) of 1.0 ppb.

Within the Community (Oct. 30, 2015 – Feb. 14, 2016)

Table 4 summarizes the results of "grab" samples that have been collected from various locations in the community and analyzed for methane, benzene, and odorants. Results are largely unchanged from those previously reported. Methane levels have ranged from 0.2 to 231 ppm, with an average of 7.3 ppm. These levels are above levels normally observed within the Los Angeles Air Basin, but remain well below flammability limits. Benzene levels have ranged from 0.1 to 5.6 ppb with an average of 0.29 ppb. During the last week of measurements (Feb. 4 to Feb. 10, 2016), the maximum benzene level was 0.61 ppb and the average was 0.17 ppb (results not shown). All sample results have been below California Environmental Protection Agency's (Cal EPA's) short-term exposure limit (appropriate for "grab" samples) of 8.0 ppb and do not pose an increase in the risk of short-term health effects.

Table 5 summarizes the results of 12-hour "integrated" sampling, which began on January 29, 2016, at 12 sample locations in the community. Methane levels have ranged from 1.6 to 8.4 ppm, with an average of 3.1 ppm. These levels are above levels normally observed within the Los Angeles Air Basin, but remain well below flammability limits. Benzene levels have ranged from 0.05 to 0.5 ppb with an average of 0.14 ppb. All sample results have been below Cal EPA's chronic exposure limit (appropriate for 12-hour "integrated" samples) of 1.0 ppb and do not pose an increase in the risk of short-term health effects.

Figure 1 displays the weekly maximum, minimum, and average methane levels detected in "grab" samples collected by SoCalGas from within the community. Methane levels for the most recent week for which data are available (Feb. 4 to Feb. 10, 2016) remain above background levels (2 ppm) and below the flammable limit (50,000 ppm) with a maximum of 30 ppm, average of 4.9 ppm, and a minimum of 0.22 ppm.

Following the control of the natural gas leak from the well within Aliso Canyon storage facility on February 11, 2016, peak methane levels have decreased to a maximum of 5.3 ppm and an average of 2.7 ppm (results not shown). These levels do not pose an increase in health risk. The SCAQMD results show a high of 616 ppm which was collected on October 26, 2015. The next measurement collected by SCAQMD on November 12, 2015 showed that the level had dropped to 14 ppm. Overall, the chart shows that there has been a trend of decreasing methane levels over time, with highest levels of methane measured in October and November 2015.

Figure 2 displays daily maximum 1-hour methane levels from continuous 24-hour community monitoring conducted by SCAQMD and CARB for the past month (January 18 – February 18, 2016). From January 18 until February 11 (the date on which SoCalGas controlled the flow of gas from the SS-25 well), maximum 1-hour methane levels ranged from 2 to 96 ppm, with an average of 9.7 ppm. **Figure 3** displays results for the 7-day period of February 12 thru February 18, 2016. This figure shows that following well control, maximum 1-hour methane levels ranged from 2 to 4 ppm. The highest methane levels since well control were measured on February 12 and have since remained at 3.2 ppm or below. Compared to typical background measurements for methane in the Los Angeles basin (2 ppm), these initial community sampling results following well control suggest air quality in Porter Ranch is returning to pre-incident conditions.

Figure 4 displays the weekly maximum, minimum, and average benzene levels detected in "grab" samples collected by SoCalGas from within the community. The average benzene levels from all "grab" samples across the entire period is 0.40 ppb, which is within the background range (0.1 – 1.8 ppb) in Los Angeles County. Benzene levels for the most recent week for which results are available (Feb. 4 to Feb. 10, 2016) are maximum: 0.61 ppb; average: 0.17 ppb; and minimum: 0.05 ppb. Between October 26, 2015, and February 2, 2016, SCAQMD has taken 84 "grab" samples in the community. Results from these SCAQMD independent samples reveal benzene in a similar range as the SoCalGas samples, from 0.05 to 3 ppb. SCAQMD continues to test for benzene when peak methane readings are found.

Summary: Results from air monitoring show that concentrations of chemicals resulting from the natural gas leak have been decreasing over time. Recent levels in community areas are comparable to or approaching levels measured in other parts of Los Angeles County.

HUMAN HEALTH

The Public Health's **complaint line** received 113 additional reports since February 2, 2016 (total number of reports = 713). Headaches/migraines remain the most frequent symptom reported by 60% of residents, followed by nausea and vomiting (38%), nose bleeds (30%), and respiratory and breathing issues (26%). Nearly one-fifth (19%) reported a smell or odor. Thirteen percent reported seeking medical care from their physician, an emergency department, or urgent care facility. Additionally, 13% reported that their pet was experiencing symptoms.

Results from the **Syndromic Surveillance** system analysis showed that there was no substantial increase in the total number of non-gastrointestinal visits to EDs serving Porter Ranch and adjacent communities. Results from visits occurring since October 23, 2015, were compared with results from visits occurring prior to October 23 (i.e., prior to the gas leak). Additionally, no increases in non-gastrointestinal symptoms was observed between those EDs serving Porter Ranch and adjacent communities compared to EDs serving the rest of LA County. While an increase in gastrointestinal symptoms was observed in EDs serving Porter Ranch and adjacent communities, similar increases also occurred at EDs serving the rest of LA County. Of note, the observed increase in gastrointestinal symptoms across the county reflects a pattern of gastrointestinal illness that has been observed previously (i.e., a pattern in which these illnesses begin to rise in early November and peak) in mid-December and other times of the year.

ANIMAL HEALTH

Public Health surveillance activities included outreach efforts to seventeen local veterinary hospitals, four equine veterinarians, three animal shelters, two horse stables, and one pet boarding facility. Staff continue to contact each site weekly to ask if they have seen any animals who may have become ill as a result of exposure to the natural gas leak. Veterinarians are encouraged to report any cases they think may be associated with the gas leak, either by calling Public Health directly or by submitting a surveillance form provided to them. In addition, staff visit the three animal shelters in the San Fernando Valley twice a week, to ensure those facilities have not been impacted or seen any cases.

A more thorough medical review was completed on the reports that have been received by VPH. To date, local veterinarians have submitted reports concerning animals from 8 households (via Gas Leak Area Animal Disease Special Surveillance forms, or medical records with follow up phone conversations with the veterinarian). The reports include 12 pets (9 dogs and 3 cats), that presented with onset of clinical signs between November 9, 2015, and February 8, 2016. Clinical signs in the 12 animals included: lethargy (3 animals), skin irritation (2 animals), respiratory signs (6 animals), neurologic signs (1 animal), urinary signs (1 animal) and gastrointestinal signs (3 animals). The pet with neurological signs (seizures) was reported by its owner who also provided the contact information for two veterinarians who evaluated the animal. Medical records from the first veterinarian indicated that the signs were consistent with intracranial disease (brain disease) and not likely related to the gas leak. During a phone conversation, the second veterinarian stated that the neurological signs were likely associated with the gas leak, but no additional documentation (Gas Leak Area Animal Disease Special Surveillance form or medical records) were provided.

Among the animals for whom reports were submitted, 1 was euthanized. Seven animals were relocated, three animals remained in the home location, and the relocation status for the remaining one animal was unknown. All animals were housed indoors except 2 (dogs) which were housed outside during the day.

Wildlife Surveillance

In one of the previous reports (February 5, 2016), Public Health reported initial lab reports for three dead birds. The final diagnostic results and interpretation were provided by the laboratory and showed that all three birds had findings in their lungs associated with acute heart and lung failure, the cause of which remains undetermined. Two of the three birds that showed evidence of aspergillosis (fungal infection), did not show evidence of an inflammatory response such that the significance of the fungal infection is unknown. Based on the non-specific changes in the lungs, the laboratory concluded it is not possible to confirm or rule out an inhalant toxin as cause of death in these birds.

VPH has not received any other reports about sick or dead wildlife in the area.

Reports from Pet Owners

Public Health expanded surveillance efforts to receive reports directly from members of the community on pet illnesses they think may be related to exposure from the gas leak. Pet owners are instructed to report through a pet owner questionnaire (online and hardcopy) or by directly contacting the VPH office.

To date, there have been four reports received from pet owners (5 dogs, 1 cat). This includes the animal with neurological signs (seizures) mentioned above. The clinical signs that owners reported were urinary signs (1 animal), skin irritation (3 animals), gastrointestinal signs (2 animals), neurologic signs (1 animal), and lethargy (2 animals). Among the four reports, 1 animal died. Each case was investigated further by contacting the pet's veterinarian to determine if the illness may have been related to gas exposure. Of the four reports, two veterinarians could not be reached despite multiple attempts, one case is still pending the receipt of additional information, and one report had conflicting medical opinions, as mentioned previously. VPH will continue to monitor pet health in the area and collect reports from local veterinary clinics and pet owners.

SECTION IV: Summary

This report updates information provided in the report issued on February 13, 2016. Results from Public Health's complaint line, from animal health-related activities, and from air monitoring are largely unchanged from the previous report. Reports of symptoms felt to be related to the gas leak continued to be reported through January and into early February, and the profile of symptoms remains similar to earlier results. Reports of animal ill health remained sparse; while some reports suggested that animal illness might be related to the gas leak, results have been inconclusive. Air monitoring results continue to show that levels of methane and benzene from various locations are lower than levels seen immediately after the start of the gas leak, and in all cases remain below health protection limits.

A new analysis of data from Public Health's Syndromic Surveillance system showed that patient visits to Emergency Departments in the Porter Ranch community did not increase for most symptoms following the onset of the incident; while patient visits with gastrointestinal symptoms increased these occurred simultaneously with a similar increase seen in other parts of Los Angeles County as well.

New results of 12-hour "integrated" air samples collected from within the Porter Ranch community show levels that are consistent with recent "grab" samples also collected from within the community. While methane levels remain modestly higher than levels seen in other parts of Los Angeles County, they are well below flammability limits and appear to be on a trend approaching LA County background levels. Benzene levels are similarly well below health protection limits.

Data provided in this report includes only limited information following the control of the well on February 11, 2016. The well was confirmed as permanently sealed on February 18, 2016. It will be important in the weeks ahead to monitor changes in results from air sampling to confirm that the air quality in the communities surrounding the Aliso Canyon facility return to levels comparable with the rest of the Los Angeles basin.

Appendix

(Tables and Figures)

TABLE 1- Within Facility Cumulative "Grab" Sample Summary

Source	**Southern California Gas Company**
Type	**"Grab" (10-minute) samples**
Dates	**October 30 - January 11, 2016†**
Chemicals Tested	**Methane, BTEX, Sulfur Compounds**

Chemical	Within Facility						
	Number Detected / Total Samples	% Detects	Range (Min-Max)	Average*	Health Protective Levels	Units
Methane	1080 / 1080	100.0%	1.3 - 4340	59.7	50,000**	ppm
Benzene	363 / 1079	33.6%	0.05 - 30.6	1.3	1,000***	ppb
tert-Butyl Mercaptan	0 / 1044	0.0%	ND	NA	N/A	ppb
Tetrahydrothiophene	0 / 1040	0.0%	ND	NA	N/A	ppb

ppm = parts per million; ppb = parts per billion; ND = non-detectable; NA = not available

†"Grab" samples were discontinued on January 11, 2016 and replaced with 12-hour samples (table 2)

*Average of detected concentrations.

**Lower explosive limit.

*** Occupational permissible exposure limit.

TABLE 2- Within Facility Cumulative 12-hour Summary

Source	**Southern California Gas Company**
Type	**12-Hour Samples**
Dates	**January 12 – February 13, 2016**
Chemicals Tested	**Methane, BTEX, Sulfur Compounds**

Chemical	Within Facility						
	Number Detected / Total Samples	% Detects	Range (Min-Max)	Average*	Health Protective Levels	Units
Methane	201 / 201	100%	2.5 - 720	55.4	50,000**	ppm
Benzene	201 / 201	100%	0.06 - 8.4	0.84	1,000***	ppb
tert-Butyl Mercaptan	0 / 201	0%	ND	NA	NA	ppb
Tetrahydrothiophene	0 / 201	0%	ND	NA	NA	ppb

ppm = parts per million; ppb = parts per billion; ND = non-detectable; NA = not available

*Average of detected concentrations.

**Lower explosive limit.

*** Occupational permissible exposure limit.

Table 3- Boundary Cumulative Summary

Source	**Southern California Gas Company**
Type	**12-Hour Samples**
Dates	**January 12 – February 13, 2016**
Chemicals Tested	**Methane, BTEX, Sulfur Compounds**

	Boundary						
Chemical	**Number Detected / Total Samples**	**% Detects**	**Range (Min-Max)**	**Average***	**Health Protective Levels**	**Units**
Methane	400 / 400	100%	1.8 - 24	4.9	50,000**	ppm
Benzene	400 / 400	100%	0.05 - 0.42	0.15	1.0***	ppb
tert-Butyl Mercaptan	0 / 400	0%	ND	NA	NA	ppb
Tetrahydrothiophene	0 / 400	0%	ND	NA	NA	ppb

ppm = parts per million; ppb = parts per billion; ND = non-detectable; NA = not available
*Average of detected concentrations.
**Lower explosive limit.
*** Chronic reference exposure limit.

Table 4- Community Cumulative "Grab" Sample Summary

Source	**Southern California Gas Company**
Type	**"Grab" (10-minute) Samples**
Dates	**October 30 – February 14, 2016**
Chemicals Tested	**Methane, BTEX, Sulfur Compounds**

	Community						
Chemical	**Number Detected / Total Samples**	**% Detects**	**Range (Min-Max)**	**Average***	**Health Protective Level**	**Background Levels**	**Units**
Methane	2062 / 2062	100%	0.2 - 231	7.3	50,000**	NA	ppm
Benzene	1008 / 2059	49%	0.1 - 5.6	0.29	8.0***	NA	ppb
tert-Butyl Mercaptan	0 / 1983	0%	ND	NA	NA	NA	ppb
Tetra-hydrothiophene	0 / 1983	0%	ND	NA	NA	NA	ppb

ppm = parts per million; ppb = parts per billion; ND = non-detectable; NA = not available
*Average of detected concentrations.
**Lower explosive limit.
*** Acute reference exposure limit.

Table 5- Community 12-Hour Sample Summary

Source	**Southern California Gas Company**
Type	**12-Hour Samples**
Dates	**January 29 - February 13, 2016**
Chemicals Tested	**Methane, BTEX, Sulfur Compounds**

	Community					
Chemical	**Number Detected / Total Samples**	**% Detects**	**Range (Min-Max)**	**Average***	**Health Protective Levels / Background**	**Units**
Methane	93 / 93	100%	1.6 - 8.4	3.1	NA	ppm
Benzene	93 / 93	100%	0.05 - 0.5	0.14	NA	ppb
Toluene	28 / 93	30%	0.2 - 1.30	0.51	NA	ppb
m&p-Xylenes	17 / 93	18%	0.13 - 0.64	0.31	NA	ppb
tert-Butyl Mercaptan	0 / 93	0%	ND	NA	NA	ppb
Tetrahydrothiophene	0 / 93	0%	ND	NA	NA	ppb

ppm = parts per million; ppb = parts per billion; ND= non detected; NA = not available

Figure 1. Average Weekly Methane Concentrations in the Community

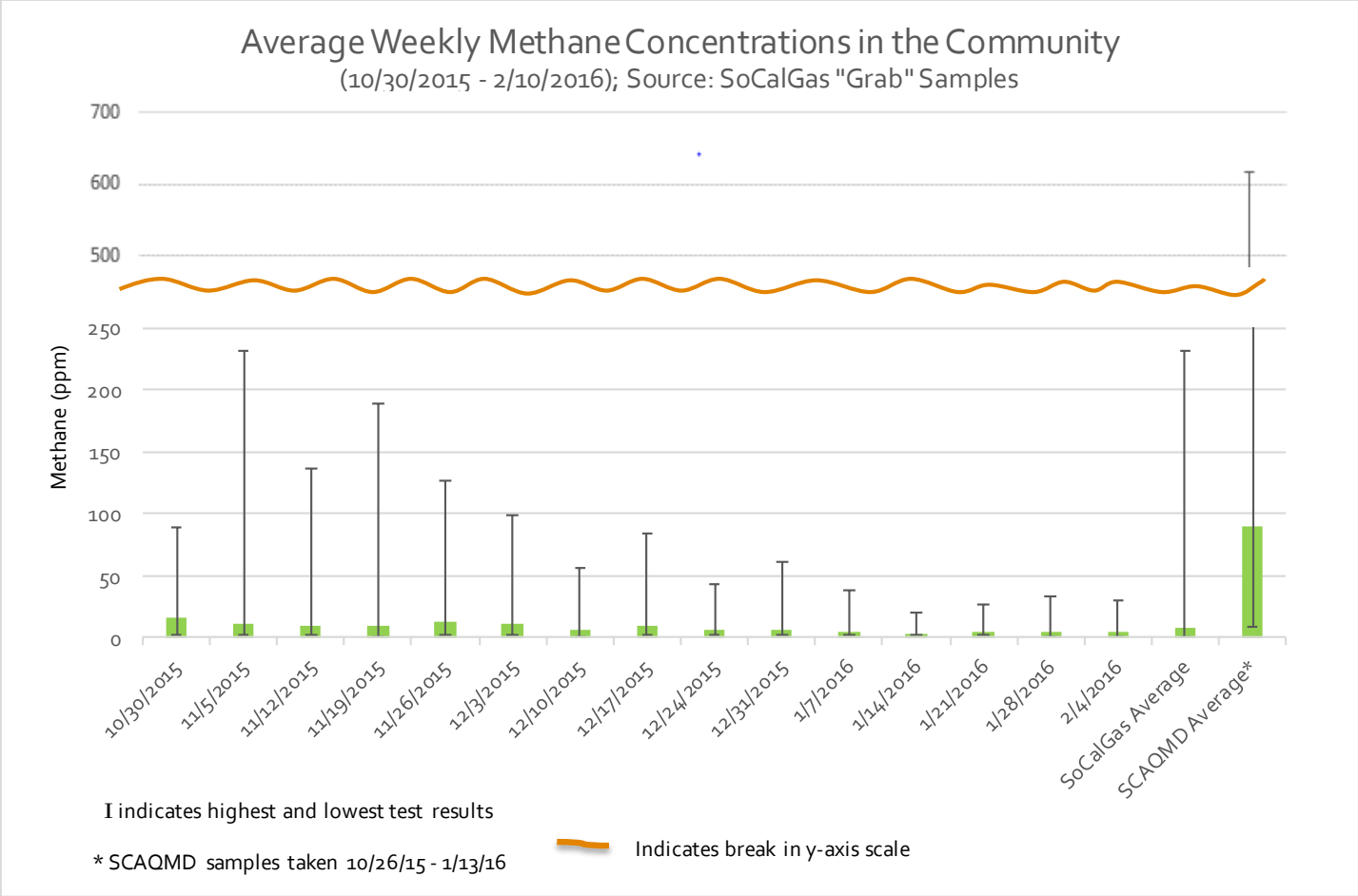


Figure 2. SCAQMD and CARB Community Monitoring

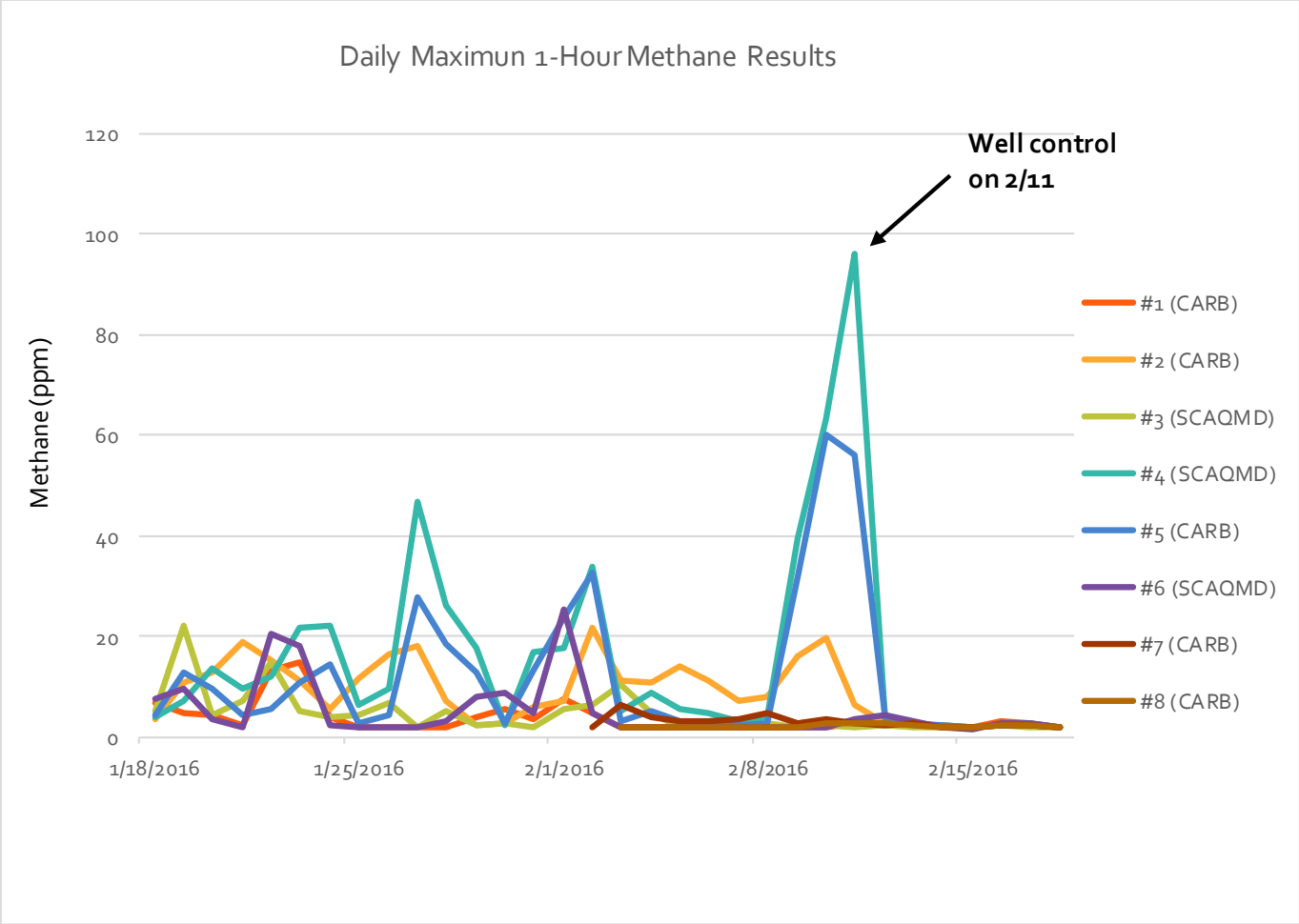


Figure 3. SCAQMD and CARB Community Monitoring

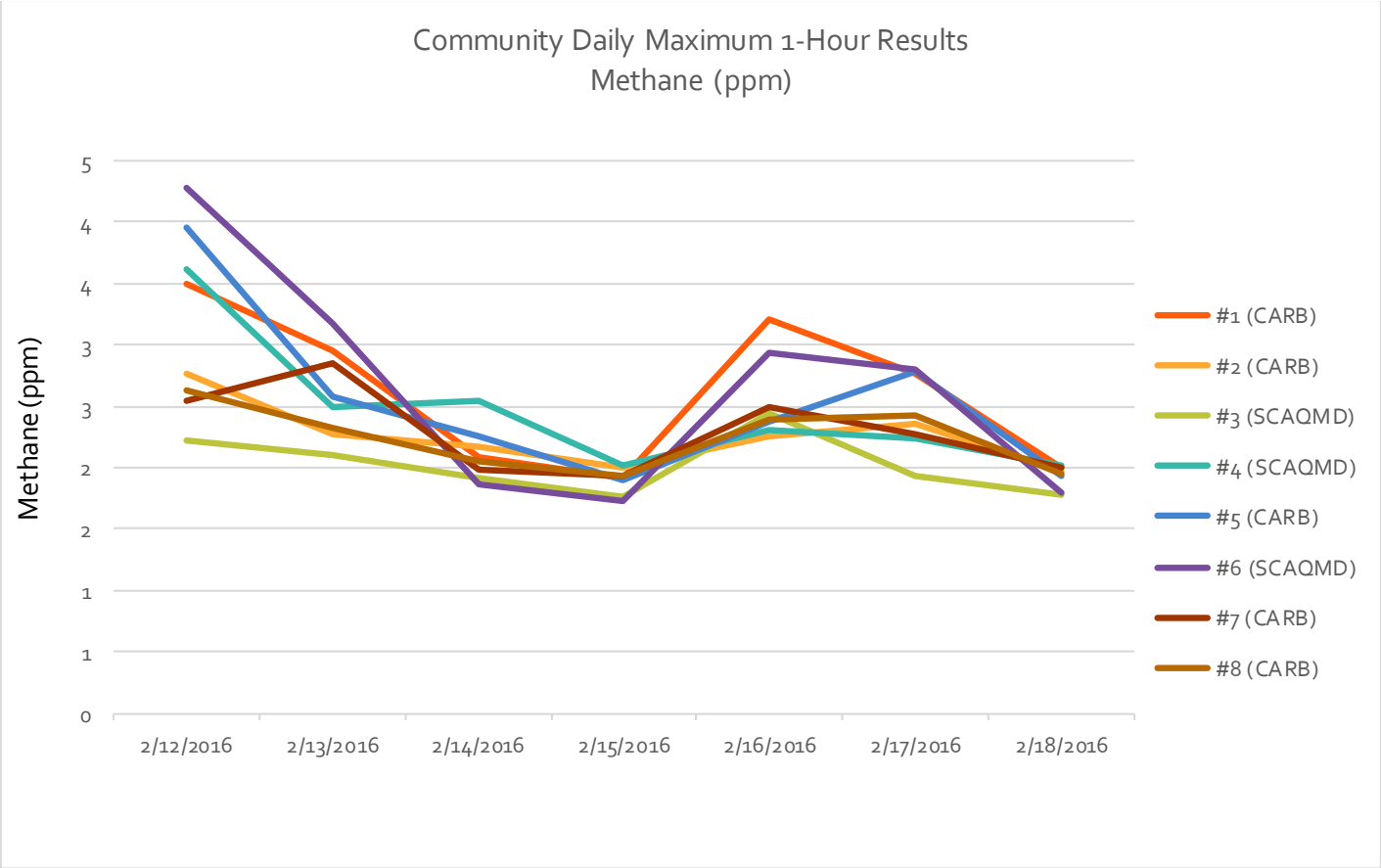
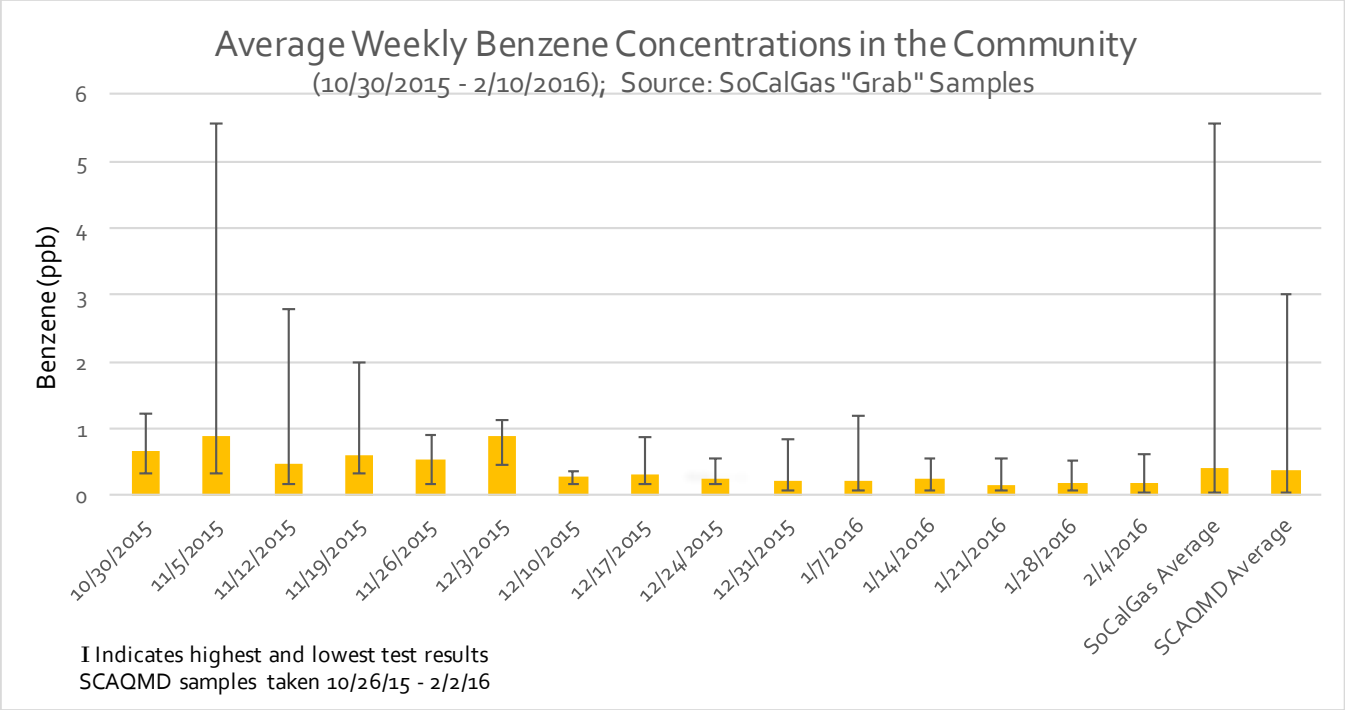


Figure 4. Average Weekly Benzene Concentrations in the Community



Benzene health protective level, established by the US EPA and/or Cal EPA, is 1.0 ppb.