

# ALISO CANYON GAS LEAK

## *Results of Air Monitoring and Assessments of Health*

*February 5, 2016*

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### **THIS VERSION INCLUDES THE FOLLOWING CORRECTIONS MADE TO THE DOCUMENT THAT WAS RELEASED ON 2/5/2016:**

- Minor typographical errors that have been corrected are not listed here.
- Page 6 (Complaint Line): “Public Health’s Environmental Health Division began tracking complaints by email on November 9, 2015 and by phone on November 20, 2015...” replaces “On September 23, 2015, Public Health’s Environmental Health Division began fielding phone calls and emails...”
- Page 8 (Within the Aliso Canyon Facility): “The average benzene levels of 0.98 ppb is well below the occupational permissible exposure limit of 1,000 ppb” replaces “the average benzene level of 0.98 is near the permissible exposure limit of 1.0 ppb.”
- Page17 (Table 6): Footnote “\*” was edited and footnotes “\*\*\*” and “\*\*\*\*” were added.
- Page 20 (Figure 4): SoCalGas overall average high range corrected.

## SECTION I. Introduction and Purpose

This is the second report published by the Los Angeles County Department of Public Health (Public Health) which summarizes data and information that has been collected in response to the natural gas leak that began on October 23, 2015 at the Southern California Gas (SoCalGas) Aliso Canyon Storage Facility. The previous report, "Aliso Canyon Gas Leak: Results from Expanded Air Monitoring," was published on January 31, 2016 and summarized the results of air monitoring data collected since the beginning of the incident, including initial results of the Expanded Air Monitoring Program (EAMP). While the current report includes updated results as part of the EAMP, it also includes health-related information that has been collected from residents, clinicians and veterinarians. Hence the title of this report has been revised to reflect the broadened scope of activities (i.e., "Results of Air Monitoring and Assessments of Health").

Activities and results summarized in this report represent an ongoing effort to consolidate and evaluate data collected by multiple parties, including Los Angeles County Fire Department (LACoFD), Southern California Gas Company (SoCalGas), South Coast Air Quality Management District (SCAQMD), Los Angeles Unified School District (LAUSD), and California Air Resources Board (CARB). In addition, this report includes results of data collected by the Department of Public Health to assess health effects in affected populations and in animals.

The purpose of this report is to provide members of the affected communities and other various stakeholders with a summary and interpretation of information on health and air quality that has been collected to date. The EAMP and other public health assessment activities will continue until Public Health determines that these are no longer necessary.

## Chemicals of Health Concern

The major constituents of natural gas are methane, ethane and butane. Other compounds, including odorants, hydrogen sulfide, and benzene are present in natural gas in very small amounts.

Air monitoring data collected since the beginning of the incident indicate that the chemicals of concern in the leaking gas are methane, sulfur odorants (including mercaptans), and benzene and related compounds. A brief summary of each of these constituents is provided below.

### Methane

Methane is an odorless and colorless gas. Its primary health effects relate to its flammability as well as its ability to displace oxygen in certain situations within enclosed structures. The levels found in the community are far below the concentrations that would cause oxygen displacement. Therefore, the primary hazard associated with methane in the current situation is flammability. Levels of methane found in the community samples to date are substantially lower than flammable limits (50,000 ppm). Detailed

information on efforts to measure the levels of methane and the results of those efforts are summarized below in the "Results" section.

### **Sulfur Odorants**

Odorants are added to natural gas so that leaks can be detected. Southern California Gas Company uses an odorant called Scentinel® T-50 which contains two ingredients: tetrahydrothiophene (THT) and tert-butyl mercaptan. These odorants produce a strong "rotten-egg," "garlicky," or "skunk-like" smell. These odorants, even at very low levels, can have effects on the eyes, skin, and respiratory system and may cause eye, nose and throat irritation, coughing, nasal congestion, shortness of breath, nausea, stomach discomfort, dizziness, and headaches. Symptoms vary from person-to-person and depend on the frequency and duration of exposure to the odor. Mercaptans and other odorants have not been associated with long-term health effects and short-term symptoms will go away once the odor exposure has diminished.

### **Benzene and Other Chemicals**

Benzene and other chemicals are present in trace amounts in the environment and in the Aliso Canyon Storage Facility. As a result, small amounts of these chemicals are present in natural gas. Among these chemicals, the one of greatest concern is benzene, a chemical known to cause cancer (including leukemia) and other bone marrow disorders in humans. Based on this concern, Public Health deemed it necessary to monitor for benzene and other trace compounds. Results of benzene testing are described later in this report. Air concentrations of other compounds (toluene, ethylbenzene, xylene, and other volatile organic compounds) have been very low and do not pose a short-term or long-term risk at this time.

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

### **Activities to Monitor Air Quality**

Since the beginning of the gas leak, SoCalGas has collected air samples to determine the levels of the various chemicals in the air. Multiple agencies work together to oversee the SoCalGas sampling plan and activities. LA County Fire Health HazMat and Public Health conduct random spot checks of the SoCalGas Company's field sampling techniques to assure these are in compliance with standard protocols.

Other agencies, including the SCAQMD, CARB, and LAUSD have also performed air monitoring activities in response to the Aliso Canyon natural gas leak. Public Health collects and reviews the data from all of these agencies to maintain a complete view of all results, to identify any areas where results may be inconsistent, and to provide an overall interpretation of the available data.

**Table 1** summarizes locations and types of air samples that have been performed by SoCalGas, SCAQMD, CARB and LAUSD. Additional information on the collection of air samples is provided below.

### **SoCalGas**

SoCalGas has collected air samples from three distinct locations: within the Aliso Canyon facility, at the Aliso Canyon property/community boundary, and within the community (see **Figure 1**). Sampling sites in community locations were selected to represent a broad distribution within the community and to include locations associated with highest complaints of odor.

Two types of air samples have been collected for testing: “grab” samples and time-integrated samples. “Grab” samples provide a snapshot of chemical concentrations and identify short-term peak levels. Time-integrated samples are samples collected continuously across an 8-, 12-, or 24-hour period and provide a more precise estimate of the average concentration over a longer period of time. Samples are tested for various chemicals, including methane, benzene, toluene, ethylbenzene, xylenes, other volatile organic compounds and sulfur compounds. In late January 2016, three locations within the facility were sampled for an expanded list of potential chemicals of concern: volatile and semi-volatile organic compounds, metals, polycyclic aromatic hydrocarbons and radon gas.

### **LAUSD**

LAUSD initially contracted with an environmental consultant to conduct three types of air quality tests at Porter Ranch Community School and Castlebay Lane Charter School. Air sampling activities have included “grab” samples, 8-hour integrated samples, and measurements from hand-held direct reading instruments. Chemicals measured include methane, sulfur compounds, benzene and other compounds, including radon. Beginning in late January, air sampling activities were expanded to include 12 additional schools in the northern Chatsworth and Northridge areas. All results from November 30, 2015 thru January 28, 2016 have been below actionable levels.

### **SCAQMD**

SCAQMD conducts independent air sampling and monitoring activities, including periodic “grab” samples in the community in response to odor complaints and 24-hour sampling in the community every 3 days. Samples are tested for methane and/or volatile organic compounds. Public Health reviews SCAQMD’s independent testing results to validate those provided by SoCalGas.

### **SCAQMD and CARB**

SCAQMD and CARB have joined efforts to position 6 real-time methane monitors in the community (see **Figure 2**). These automated monitoring devices perform continuous methane measurements and provide a real-time estimate of how much methane is in the community at any given time.

## Activities to Assess Effects on Human Health

### Complaint Line

Public Health's Environmental Health Division began tracking complaints by email on November 9, 2015 and by phone on November 20, 2015 from community members with complaints of symptoms or issues potentially related to the Aliso Canyon gas leak. Information on the location and nature of the complaint was collected from each caller. Reports from individual callers are categorized as "household" reports since it is unknown how many people live in each household.

### LAHAN Health Advisory

On January 22, 2016, Public Health distributed a Health Advisory through the Los Angeles Health Alert Network (LAHAN) to inform health care professionals in Los Angeles County about the Aliso Canyon gas leak. The alert included information about the incident, information about possible health effects, as well as information for contacting Public Health for assistance. Of note, all Los Angeles health care providers are encouraged to join LAHAN to receive information during public health emergencies.

### Community Resource Center

On January 25, 2016, Public Health visited the SoCalGas Community Resource Center in the Porter Ranch Town Center. The site coordinator provided a tour of the site and provided information about the services that are provided and the reasons that community members come to the center. The center also has a physician and a toxicologist who are present on-site during peak hours to answer health-related questions.

### Outreach to Medical Providers

On January 27, 2016, Public Health began outreach to medical providers in the communities surrounding the Aliso Canyon facility. Outreach initially targeted providers within a five-mile radius and then later expanded efforts to an eight-mile radius. The purpose of the efforts was to provide information about the natural gas leak as well as to gather information on whether patients may have been seen for symptoms or illness possibly related to the gas leak and the extent to which such visits may have impacted overall health service delivery capability. Informational handouts, fact sheets and copies of the LAHAN Health Advisory were provided at the time of the visit. Facilities included: hospitals (2), emergency departments (2), urgent care facilities (12), medical groups (2), and individual providers (2).

## Activities to Assess Effects on Animal Health

The Veterinary Public Health Program (part of Public Health) has conducted a variety of activities to assess possible effects of the gas leak on the health of animals in the surrounding area. Public Health surveillance activities have extended to include 22 veterinary clinics, three animal shelters, two horse stables, and one pet boarding facility.

### Veterinary Clinic Outreach

A Gas Leak Area Special Surveillance Form was created and distributed to clinics to facilitate the reporting of potential cases of illness in pets or other animals. Staff also contact each site weekly to ask if they have seen any pets who may have become ill as a result of exposure to the gas fumes. In addition, Public Health created a webpage related to pet health and the gas leak, and posted information on what and how to report potential cases. Public Health also contacted equine veterinarians that may provide care for horses and other large animals in the area to ask if they have seen any horses or other animals with nose bleeds or illnesses that may be related to exposure to the gases.

### Animal Shelters and CDFW

Public Health also contacted local animal shelters and the California Department of Fish and Wildlife (CDFW) to request notification of sick or dead wildlife in the area. Staff have visited the three shelters in the San Fernando Valley twice a week, to ensure those facilities have not been impacted or seen any cases. Public Health has also communicated with staff from the California Department of Fish and Wildlife to ensure coordination if any wild animals reported ill or dead.

### Reports from Pet Owners

In response to media reports of high numbers of potentially affected animals in the region, Public Health expanded surveillance efforts to receive reports directly from members of the community. A Pet Health Fact sheet was developed and distributed through various channels to encourage pet owners to report any potentially related illnesses in their pets. Pet owners were instructed to report via the on-line animal disease reporting portal or by directly contacting the Veterinary Public Health program office.

To support outreach efforts, Public Health has created a website focusing on animal health. The website provides information about all of the above activities, as well as easy access to documents and reporting forms.

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

### Results of Air Monitoring

#### Within the Aliso Canyon Facility (Oct. 30, 2015 – Jan. 27, 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 2**. The maximum level of methane detected was 4,340 ppm and the maximum level of benzene was 30.6 ppb. While the methane level is well above that measured in the community, it is below the flammable limit of 50,000 ppm. Less than 1% of facility samples detected levels of benzene that exceeded the acute exposure limit of 8.0 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 3**. 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 0.98 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 – Jan. 27, 2016)

As displayed in **Table 4**, 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 1.9 to 24 ppm with an average of 5.3 ppm, which are above background levels (2 ppm) and below the flammable limit (50,000 ppm). Benzene levels have ranged from 0.08 to 0.42 ppb with an average of 0.18 ppb, which is below the chronic exposure limit of 1.0 ppb.

#### Within the Community (Oct. 30 – Jan. 28, 2016)

**Table 5** summarizes the results of “grab” samples collected from various locations in the community that have been analyzed for methane, benzene, odorants, and volatile chemicals. Results are largely unchanged from those previously reported. Methane levels have ranged from 1.2 to 231 ppm, with an average of 8.0 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 0.38 ppb. During the last week of measurements (Jan. 21 to Jan. 27, 2016), the maximum benzene level was 0.55 ppb and the average was 0.15 ppb. All sample results have been below Cal EPA’s short-term exposure limit of 8.0 ppb and do not pose an increase in the risk of short-term health effects.

**Figure 3** 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 (Jan. 21 to Jan. 27, 2016) remain above background levels (2 ppm) and below the flammable limit (50,000 ppm). 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 AQMD on November 12th 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 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 0.38 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 (Jan. 21 – Jan. 27, 2016) are maximum: 0.55 ppb, average: 0.15 ppb, and minimum: 0.063 ppb. Between October 26, 2015 and January 17, 2016, SCAQMD has taken nearly 40 “grab” samples in the community. Results from these SCAQMD independent samples reveal benzene in a similar range as the SoCalGas samples, from 0.1 to 3 ppb (results not shown). SCAQMD continues to test for benzene when peak methane readings are found.

Results from 12-hour community samples collected by SoCalGas are pending at this time.

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 levels measured in other parts of Los Angeles County.

## Results of Activities to Assess Effects on Human Health

### Complaint Line

Analysis of complaints received to date (**Table 6**), show that the primary symptoms reported by affected residents include: headaches/migraines (61%); nausea, vomiting, stomach aches, diarrhea (40%); nose bleeds (32%); respiratory or breathing symptoms (27%); chest tightness, coughing, palpitations (24%); and dizziness, lightheaded (22%). Overall, 17% of residents reported a smell or odor. The profile of reported symptoms is consistent with health effects that may result from exposure to odorants, though the prevalence of reports of odor/smell is lower than expected and the prevalence of reports of nosebleeds is higher than expected. Additionally, 9% reported that their pet had been affected. **Figures 5 & 6** show the locations of the households (based on address) where symptoms were reported.

## Community Resource Center (CRC)

Most residents visit the CRC to submit temporary relocation claims or to obtain air filters for their homes. While the total number of daily visits routinely exceeds 400, on average less than 2 or 3 percent of visits (about 8 visits each day) are related to health concerns.

## Outreach to Medical Providers

Most providers with whom Public Health spoke did not report having patients with any significant health problems related to the incident. One urgent care provider mentioned seeing many patients with complaints potentially related to the incident. Due to privacy limitations, additional information about specific patients could not be obtained.

Summary: Complaints received through the Environmental Health complaint line and an informal report from one urgent care center suggest that a large number of residents have experienced symptoms that they attribute to the gas leak, and some have sought medical care. Analysis of the symptoms reported by residents suggests that many of these are consistent with symptoms that can occur from exposure to odorants. Relatively few recent visits to the Community Resource Center are related to health concerns, suggesting that health effects may have diminished over time or, alternatively, that persons with health effects are seeking advice or evaluation elsewhere.

## Results of Activities to Assess Effects on Animal Health

### Veterinary Clinic Outreach

Public Health has reached out to 22 veterinarian clinics. Some have said that they observed an increase in visits, yet few veterinarians have felt that these were related to the Aliso Canyon gas leak. There have been a few cases of people reporting their pets as lethargic, vomiting, in respiratory distress, and one case of a dog being euthanized. Veterinarians have been 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. To date, only five written case reports have been received from veterinary hospitals. None of the shelters or stables reported animal illnesses related to the gas leak.

### Outreach to Larger Animal Veterinarians

Although some veterinarians reported occasionally seeing horses with nose bleeds, this symptom did not appear to be related to natural gas exposure. In each case, the horses had other recognized causes for the nosebleed (trauma or hematoma). No other illness or symptoms in horses have been reported as possibly related to the natural gas leak.

## Outreach to Animal Shelters and CDFW

CDFW and the shelters have not received any reports of sick or dead wildlife that may be related to the gas leak. Public Health was notified that 4 to 5 birds had been found dead in a swimming pool at a home in Porter Ranch in mid-January. The resident was concerned that the birds had died after being exposed to gases associated with the Aliso Canyon gas leak. Staff collected three specimens (dead birds) from the Greater Los Angeles Mosquito and Vector Control District office and took them to the California Animal Health and Food Safety Lab for necropsy (autopsy of an animal). Initial necropsy results indicated hemorrhage on the edge of three birds' lungs. On February 2, 2016, the lab reported that two of the three birds showed evidence of aspergillosis (a fungal infection); one bird had the infection in its nasal passages; the other, in its lungs. The third bird had no evidence of this fungal infection. Aspergillosis is not a rare disease in wild birds. Poor overall health can increase a bird's susceptibility to this fungus. It is possible that aspergillosis is an incidental finding in the two birds (warbles), or that other health stressors (such as gas exposure) may have increased their susceptibility to fungal infections. Therefore, the significance of the fungal infections is unknown at this time. Final laboratory results, including the laboratory's interpretation of results, are expected to be available soon.

## Reports from Pet Owners

During the past week, three reports were received from pet owners. Information is being gathered from the owners, as well as their pet's veterinarian, to determine if the illness may have been related to gas exposure.

Summary: Although there have been media reports of hundreds of animals becoming ill after exposure to gases in the Porter Ranch area, Public Health has received only a few reports from veterinarians and pet owners. Additionally, there have been no official reports of wildlife becoming ill or dying in the area. Thus, Public Health is unable at this time to substantiate the claim that numerous animals have become ill as a result of the gas leak. Public Health will continue to gather reports and other information from residents, veterinarians and other agencies to assess the impact of the gas leak on the health of pets and other animals in the community.

## SECTION IV. Summary

Multiple efforts have been initiated by Public Health, in coordination with a variety of other agencies, to gather, analyze, and interpret health-related data in the context of the Aliso Canyon natural gas leak.

Collection of air samples began one week after the onset of the leak and was expanded in January 2016 to include additional sites, additional chemicals, and longer sampling periods as part of the Expanded Air Monitoring Plan. Methane levels have remained above normal, but have decreased substantially over time, reflecting the decrease in pressure within the storage facility and a resulting decrease in emissions. Methane levels remain below the flammability limit (50,000 ppm or 5%) at all locations.

Odorants have remained below instrument detection limits throughout the entire period, including immediately after the leak, even at locations near the leaking well.

Benzene and other chemicals were originally detectable at levels above normal from within community sampling sites, but peak levels remained below acute exposure thresholds. Average levels appear to have been below chronic exposure levels, and now are below levels seen elsewhere in the county.

Collectively, air monitoring data suggest that health effects resulting from the on-going leak should be limited to short-term effects resulting from exposure to the odorants.

Analysis of complaints received by the Environmental Health division of Public Health demonstrate that many persons experienced symptoms, and that the pattern of symptoms are largely related to the odorants. Many of the symptoms are in line with those discussed on the manufacturer's Data Safety Sheet and previous studies. The high prevalence of reported nosebleeds (32%) and low prevalence of reported odor (17%) are noteworthy, however, and somewhat inconsistent with expectations. Additional testing may be warranted to investigate these observations further.

Information collected from one healthcare provider in the community indicated that initial symptoms were severe enough to cause some individuals to seek medical care. More recently, information collected from numerous healthcare facilities and providers in the surrounding community suggest that impact of the gas leak on healthcare service delivery has been minimal --- this despite reports of persistent symptoms in numerous residents, including the dislocation of persons from more than 5,000 homes. These observations suggest that health effects resulting from the gas leak may have waned over time. It is also possible that symptoms experienced by residents may not rise to a level of significance that would require them to visit a health care provider. In addition, the rate of symptoms in the community over time may have decreased as affected individuals have relocated to locations outside of the affected area. Public Health will continue to explore the prevalence and trends of health symptoms among persons living in the affected communities.

Efforts to investigate claims of significant health effects in pets and other animals have not produced evidence to support these claims. Reports from veterinarians, animal shelters, and from community residents as well as investigations of effects on specific animals have not disclosed information that supports a detectable impact on animal or pet health. These results suggest that impacts on animal health have not been significant, or that such an impact has waned substantially over time.

Public Health will continue efforts to monitor the results of air sampling and will continue both active and passive surveillance to monitor health effects in human and animal populations. Further investigations to assess possible causes of the high prevalence of nosebleeds may be warranted and will be discussed with other agencies.

# Appendix

(Tables and Figures)

Table 1- Air Monitoring Testing by Proximity to Aliso Canyon Storage Facility

Location/Region	"Grab" Sample Testing	Integrated Testing	Other Testing
<b>Within Aliso Canyon Facility</b>	<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 10/30/15 thru 01/11/16</li> <li>• 9 locations</li> <li>• 2 times per day</li> </ul>	<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 01/12/16 to current</li> <li>• 12-hour</li> <li>• 3 locations</li> <li>• 2 times per day</li> </ul>	<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 01/16/16 to current</li> <li>• 7-day radon test</li> <li>• 1 location</li> </ul>
<b>Facility/Community Boundary</b>		<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 1/12/16 to current</li> <li>• 12-hour</li> <li>• 6 locations</li> <li>• 2 times per day</li> </ul>	<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 12/17/15 to current</li> <li>• Monitoring for oily residue</li> <li>• Vertical and horizontal plexi-glass plates</li> <li>• 6 locations</li> </ul>
<b>Community</b>	<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 10/30/15 to current</li> <li>• 11 locations</li> <li>• 2 times per day</li> </ul> <p><b>SCAQMD</b></p> <ul style="list-style-type: none"> <li>• 10/26/15 to 12/18/15</li> <li>○ 15 visits to various residential locations in response to odor complaints</li> <li>• 12/16/2015 to current</li> <li>○ 29 samples at 4 locations, triggered by methane monitor</li> </ul> <p><b>LAUSD</b></p> <ul style="list-style-type: none"> <li>• 11/30/15 to current</li> <li>• Up to 10 school sites</li> <li>• Minimum of 2 times per day</li> </ul>	<p><b>SoCalGas</b></p> <ul style="list-style-type: none"> <li>• 1/28/16 to current</li> <li>• 12-hour</li> <li>• 3 locations</li> <li>• 2 times per day</li> </ul> <p><b>SCAQMD</b></p> <ul style="list-style-type: none"> <li>• 12/21/15 to current</li> <li>• 2 locations</li> <li>• Once every 3 days</li> </ul> <p><b>LAUSD</b></p> <ul style="list-style-type: none"> <li>• 11/30/15 to current</li> <li>• 8-hour</li> <li>• Up to 10 school sites</li> <li>• one time per day</li> </ul>	<p><b>SCAQMD &amp; CARB</b></p> <ul style="list-style-type: none"> <li>• 12/16/15 to current</li> <li>• Continuous</li> <li>• Began with two locations, now 8 locations</li> </ul> <p><b>LAUSD</b></p> <ul style="list-style-type: none"> <li>• 11/30/15 thru current</li> <li>• Real-time hand-held (instantaneous) measurements</li> <li>• Up to 14 school sites</li> <li>• 12/4/15 to 12/10/15 Radon at 2 school sites</li> </ul>

**TABLE 2- Within Facility Cumulative “Grab” Sample Summary**

**Source** Southern California Gas Company  
**Type** “Grab” (10-minute) samples  
**Dates** October 30 - January 11  
**Chemicals Tested** Methane, Other Hydrocarbons, 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

\*Average of detected concentrations.

\*\*Lower explosive limit.

\*\*\* Occupational permissible exposure limit.

**TABLE 3- Within Facility Cumulative 12-hour Summary**

**Source** Southern California Gas Company  
**Type** 12-Hour Samples  
**Dates** January 12 - January 27  
**Chemicals Tested** Methane, BTEX, Sulfur Compounds

Chemical	Within Facility						
	Number Detected	Total Samples	% Detects	Range (Min-Max)	Average*	Health Protective Levels	Units
Methane	96 /	96	100%	2.6 - 720	64.1	50,000**	ppm
Benzene	96 /	96	100%	0.08 - 8.4	0.98	1,000***	ppb
tert-Butyl Mercaptan	0 /	96	0%	ND	NA	NA	ppb
Tetrahydrothiophene	0 /	96	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 4- Boundary Cumulative Summary

**Source** Southern California Gas Company  
**Type** 12-Hour Samples  
**Dates** January 12 - January 27  
**Chemicals Tested** Methane, BTEX, Sulfur Compounds

Chemical	Boundary						
	Number Detected	Total Samples	% Detects	Range (Min-Max)	Average*	Health Protective Levels	Units
Methane	196 /	196	100%	1.9 - 24	5.3	50,000**	ppm
Benzene	197 /	197	100%	0.08 - 0.42	0.18	1.0***	ppb
tert-Butyl Mercaptan	0 /	197	0%	ND	NA	NA	ppb
Tetrahydrothiophene	0 /	197	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 5- Community Cumulative "Grab" Sample Summary

**Source** Southern California Gas Company  
**Type** "Grab" (10-minute) Samples  
**Dates** October 30 - January 28  
**Chemicals Tested** Methane, Other Hydrocarbons, BTEX, Sulfur Compounds

Chemical	Community							
	Number Detected	Total Samples	% Detects	Range (Min-Max)	Average*	Health Protective Level	Background Levels	Units
Methane	1702 /	1702	100%	1.2 - 231	8.0	50,000**	NA	ppm
Benzene	766 /	1699	45%	0.1 - 5.6	0.38	8.0***	NA	ppb
tert-Butyl Mercaptan	0 /	1623	0%	ND -	NA	NA	NA	ppb
Tetrahydrothiophene	0 /	1623	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 6- Summary of Reported Symptoms\***

Symptom	% of Reports 9/23/15-1/25/16**		% of Reports 1/26/2016-2/2/2016		% of Running Total 9/23/15-2/2/16**	
	n=498		n=102		n=600	
Headache/Migraine	303	61%	63	62%	366	61%
Nausea/Vomiting/Stomachache/ GI/Diarrhea	207	42%	31	30%	238	40%
Bloody Nose	170	34%	19	19%	189	32%
Respiratory/Breathing Symptoms Chest	126	25%	33	32%	159	27%
Tightness/Coughing/Palpitations	111	22%	30	29%	141	24%
Dizzy/Lightheaded	106	21%	26	25%	132	22%
Eye Irritation/Vision Complaints	81	16%	25	25%	106	18%
Sore Throat	80	16%	16	16%	96	16%
Smell/Odor***	76	15%	27	26%	103	17%
Sinus Pressure/Irritation/Nasal Congestion/Runny Nose	75	15%	23	23%	98	16%
Fatigue/Lethargy/Weakness	55	11%	27	26%	82	14%
Rash/Itchy, Dry, Irritated Skin	42	8%	4	4%	46	8%
Irritability/Insomnia/Stress/ Depression/Anxiety	24	5%	9	9%	33	6%
Body Aches/Flu-like Symptoms	12	2%	9	9%	21	4%
Pre-existing Condition	55	11%	18	18%	73	12%
Went to MD/ER/Hospital	54	11%	26	25%	80	13%
Pet Affected	43	9%	8	8%	51	9%
Complained to SCG	11	2%	14	14%	25	4%
Complained to AQMD	2	0%	0	0%	2	0%
Relocated or Requested Relocation	26	5%	34	33%	60	10%

\*Most complaints were reported by persons living in households in the surrounding community. More than one person could be living in the household, however, since the number of people in each household is unknown, the numbers reflect if there is any report of the symptom and not multiple reports of the same symptom in the same household. Households may have reported more than one symptom, therefore percents do not total 100.

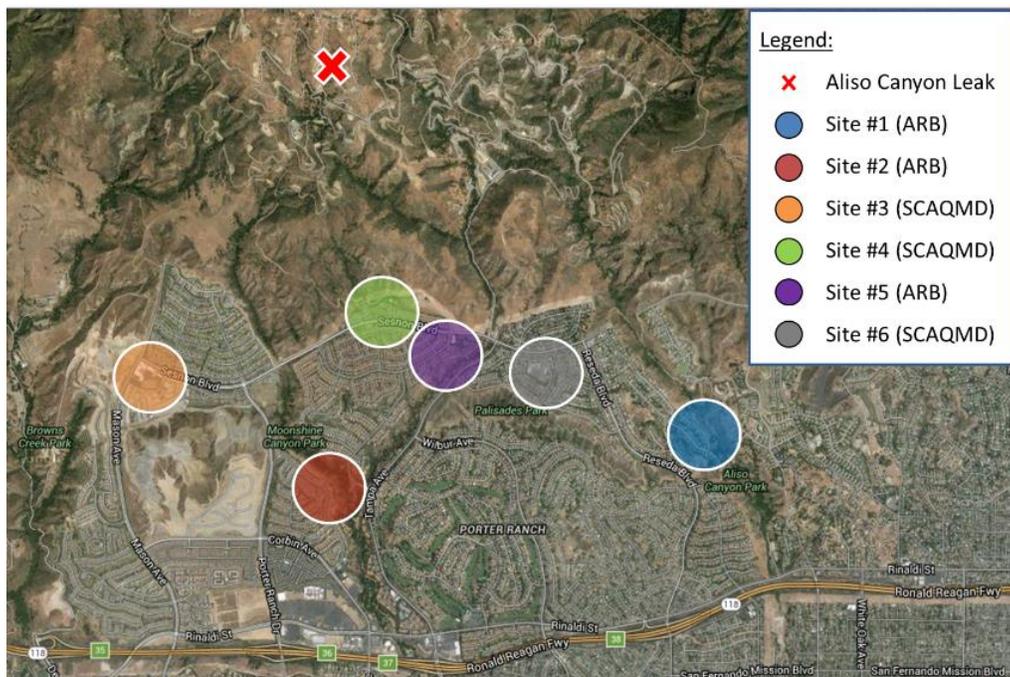
\*\* While emails regarding complaints of symptoms started being received on 11/9/2015, nine of these emails stated their symptoms began prior to start of the gas leak on 10/23/2015 (e.g., symptoms beginning as early as 9/23/2015).

\*\*\*Not all complainants were queried about the presence of an odor. Therefore, the estimate provided is likely less than the true percentage.

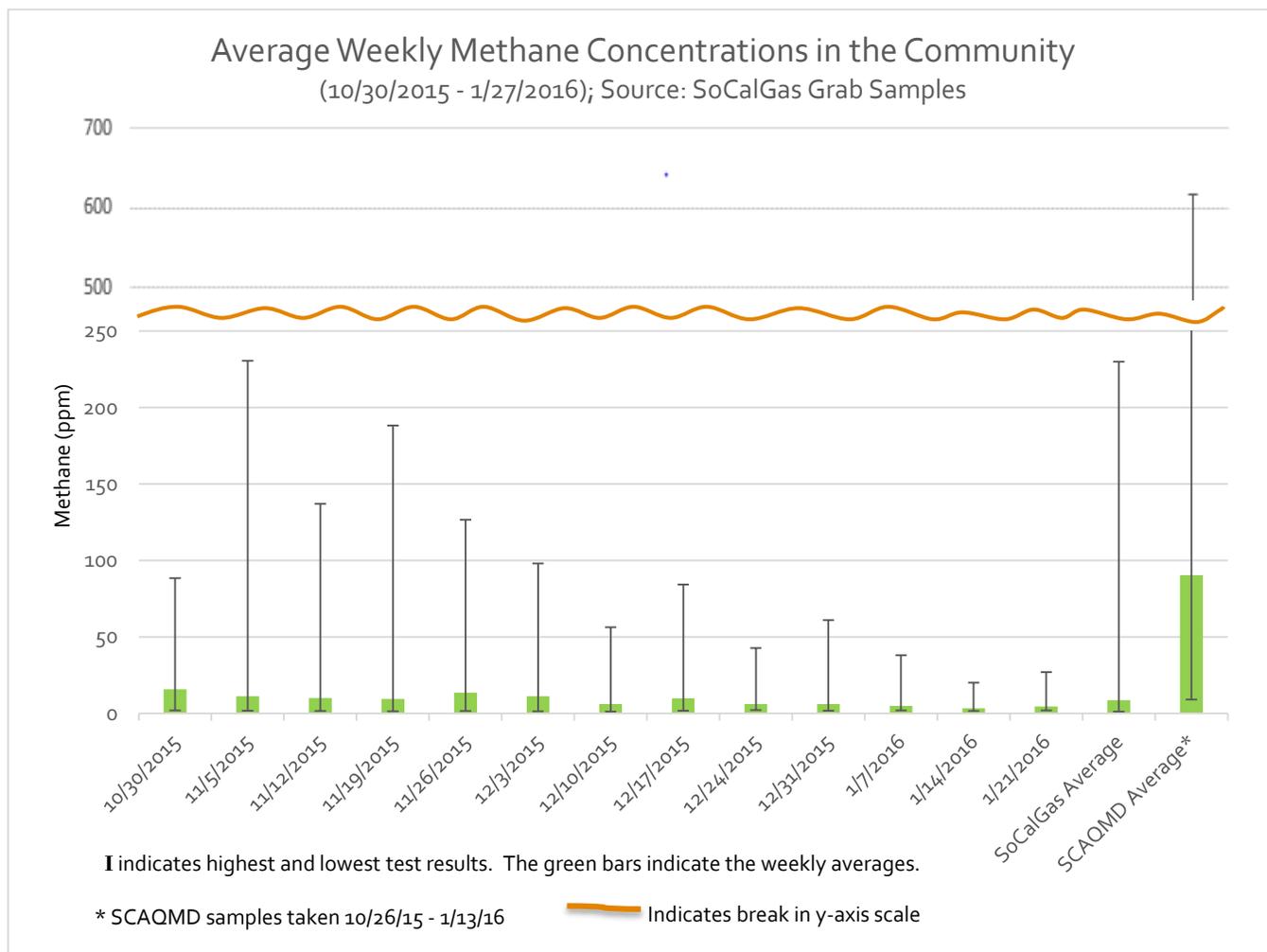
Figure 1- SoCalGas Air Sampling Collection Sites



Figure 2- SCAQMD and CARB Real-time Community Methane Monitoring



**Figure 3- Average Weekly Methane Concentrations in the Community**



**Figure 4- Average Weekly Benzene Concentrations in the Community**

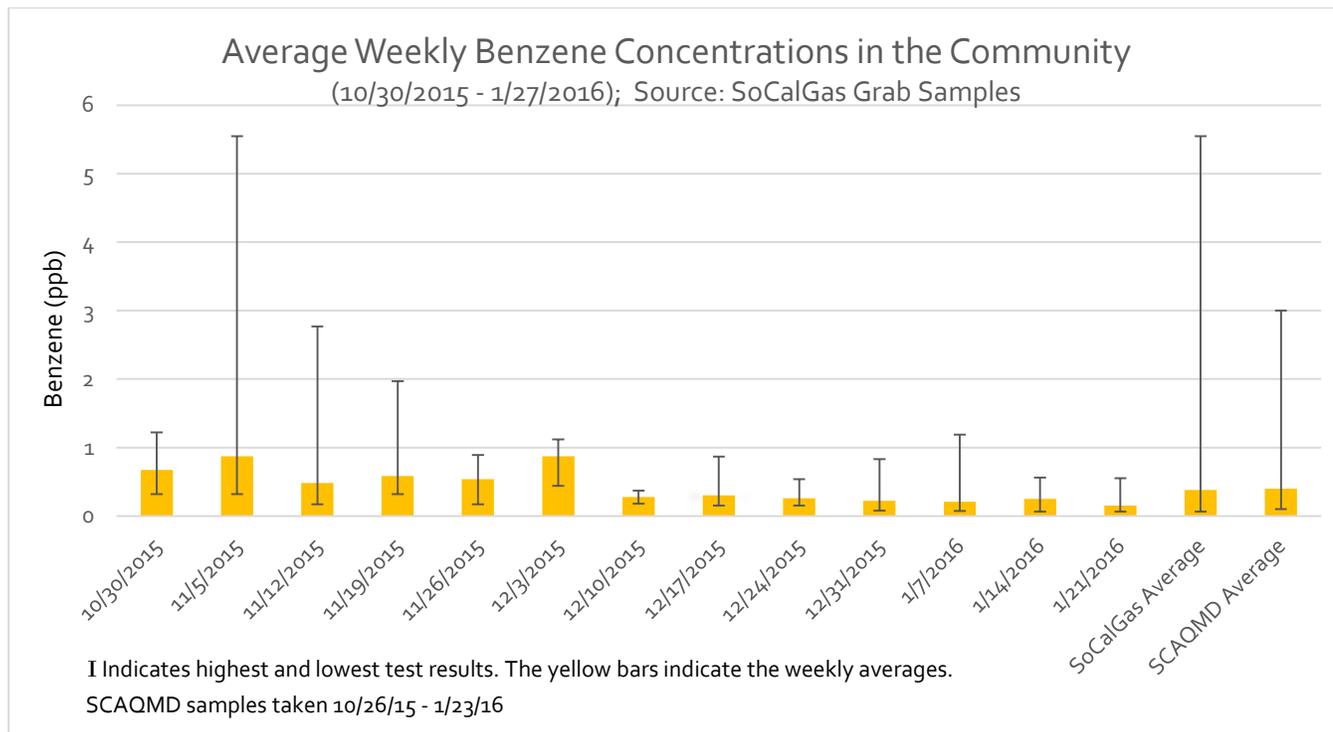
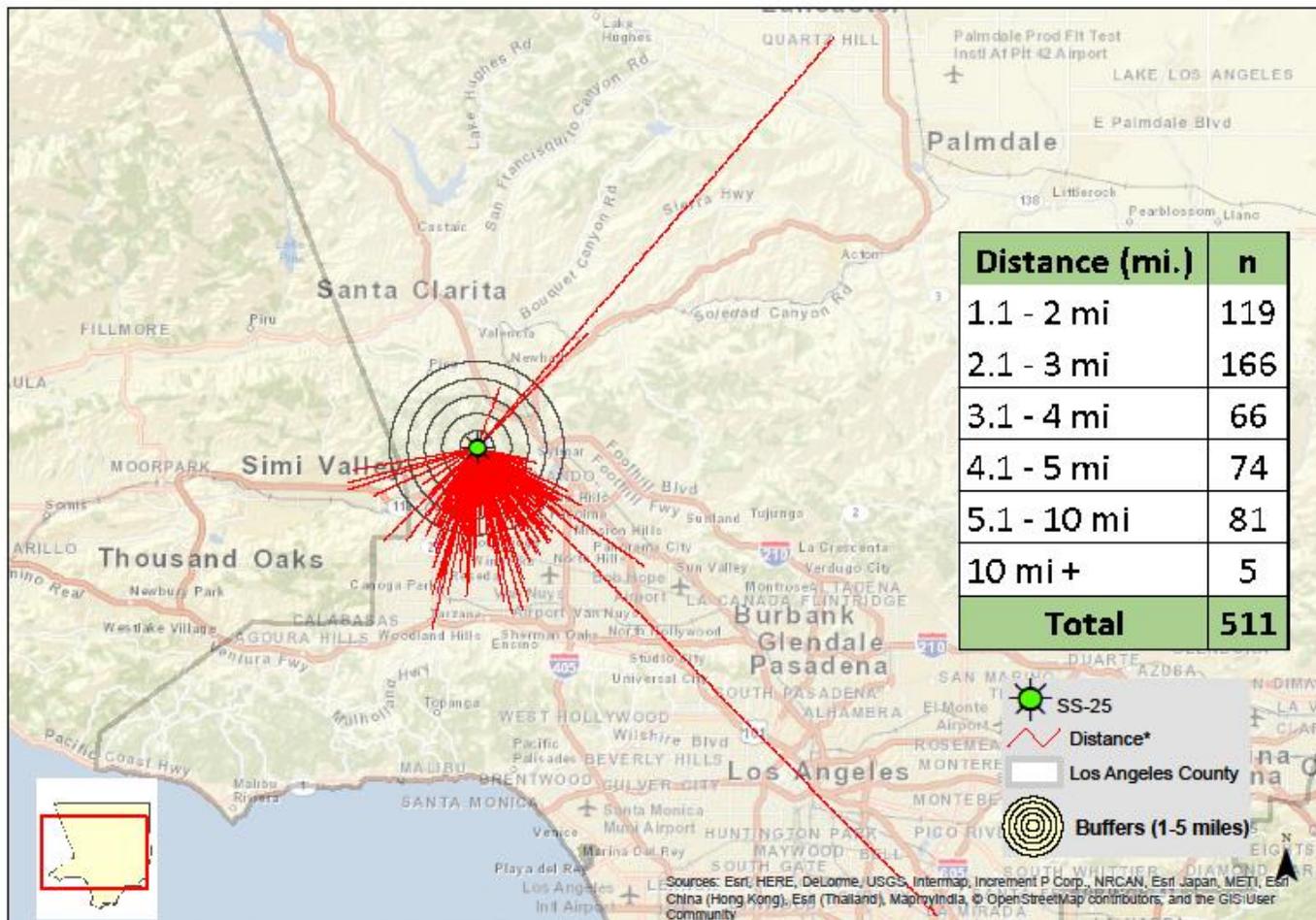
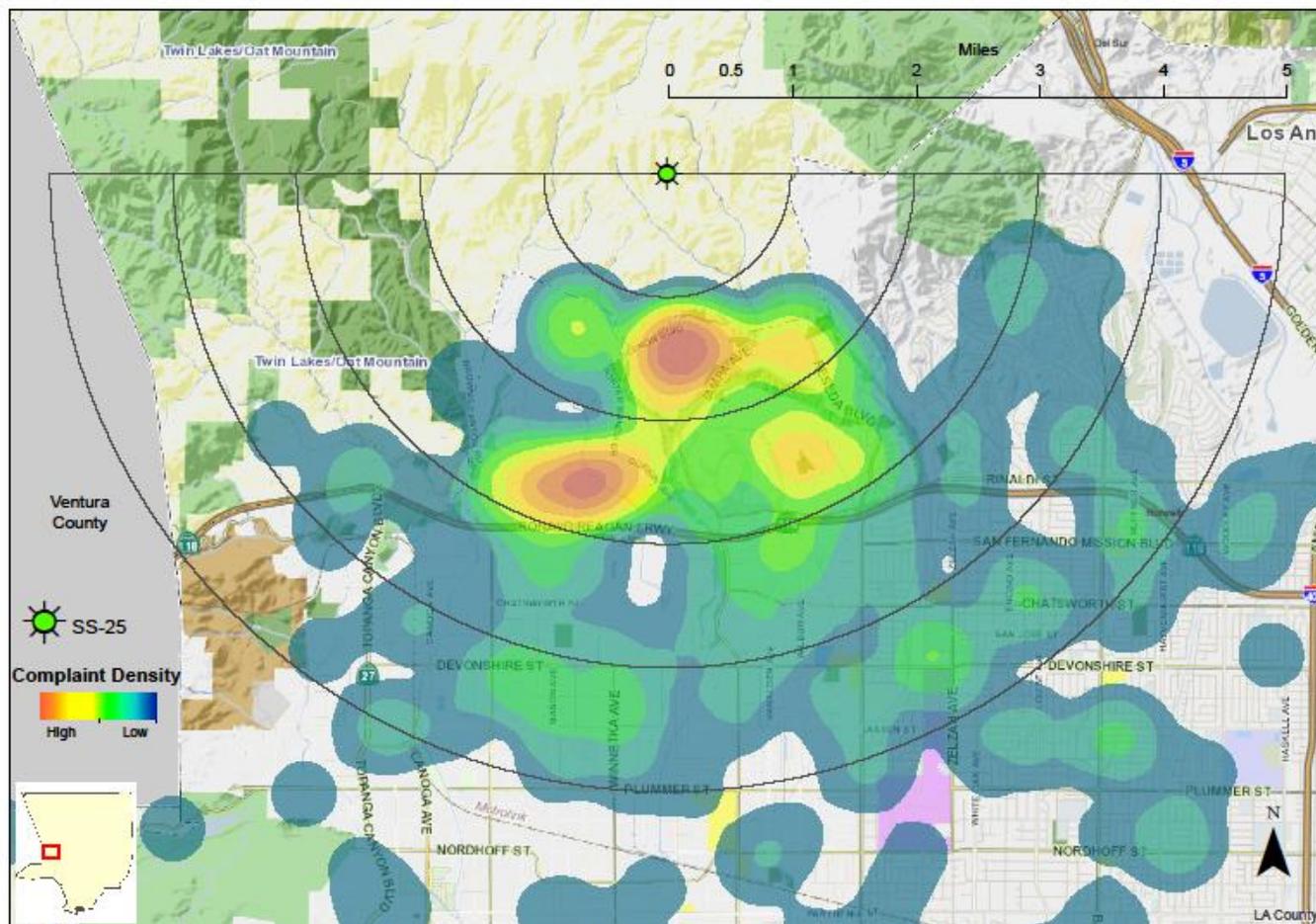


Figure 5-Aliso Canyon Symptoms by Respondent's Address: Distance to Leak



Created by: Office of Health Assessment and Epidemiology, Epidemiology Unit. 02/03/16. Map shows the density of symptom by respondent's addresses. 511 of 687 addresses were located (the rest were excluded due to incorrect or missing addresses). \*Euclidean Distance from SS-25.

Figure 6: Aliso Canyon Symptoms by Respondent's Address: Complaint Density



Created by: Office of Health Assessment and Epidemiology, Epidemiology Unit. 02/03/16. Map shows the density of symptoms by respondent's addresses. 511 of 687 addresses were located (the rest were excluded due to incorrect or missing addresses).