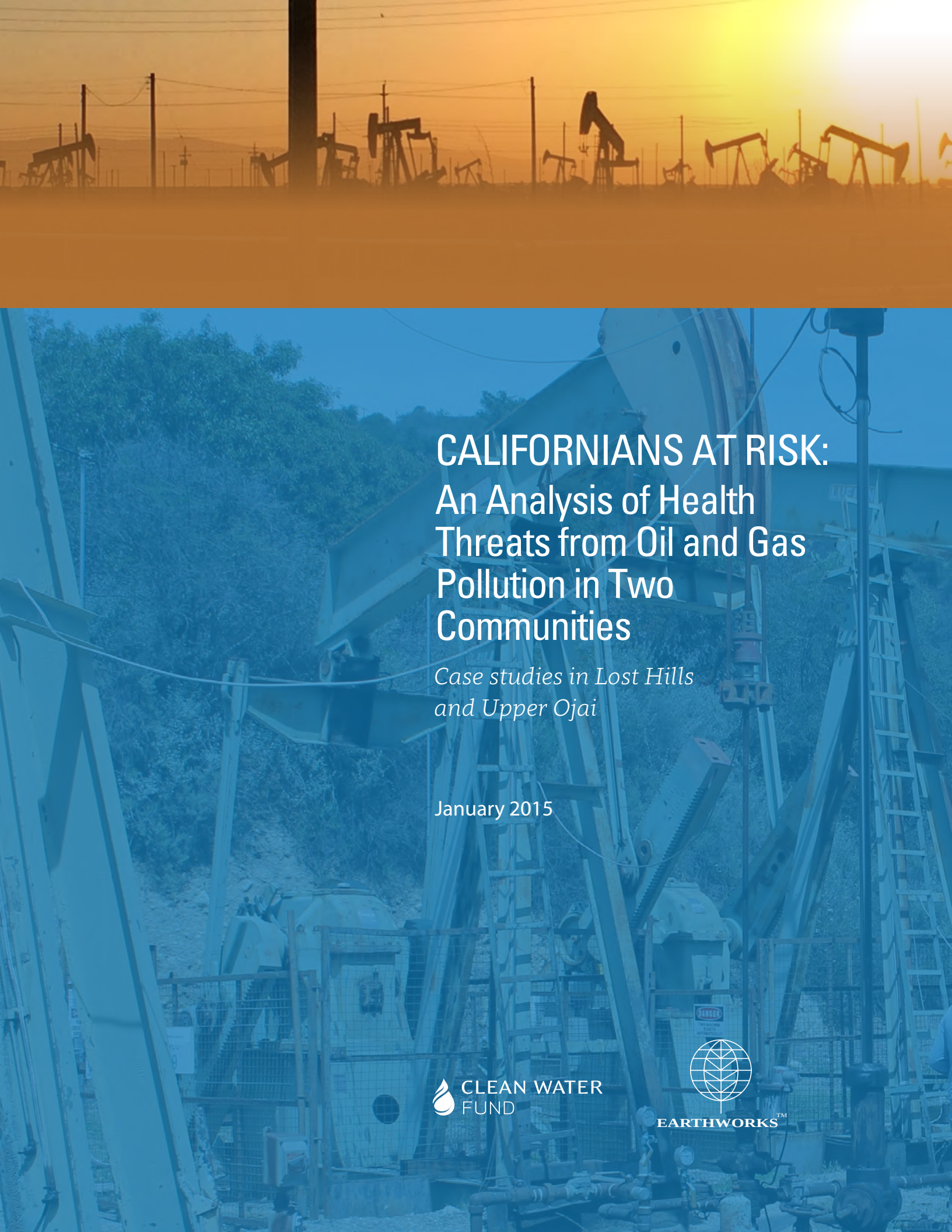

CALIFORNIANS AT RISK:
An Analysis of Health Threats from Oil and Gas Pollution in Two Communities

Case studies in Lost Hills and Upper Ojai

January 2015

CLEAN WATER FUND

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Report available at: http://californiahealth.earthworksaction.org
Photos by Earthworks

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For 25 years, Earthworks has been protecting communities and the environment from the impacts of irresponsible mineral and energy development while seeking sustainable solutions.

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Clean Water Fund works to empower people to take action to protect America's waters, build healthy communities, and to make democracy work for all of us.

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Executive Summary

California is wine country known for its tourism, agricultural, and entertainment industries, but to the more than 5 million residents living within a mile of oil and gas drilling operations, it's oil country. Tens of thousands of active wells produced nearly 200 million barrels of oil in 2013, making California one of the largest oil producers in the country. Despite the fact that so many citizens reside close to oil and gas facilities, neither the industry nor state regulatory agencies have adequately investigated the impacts on public health. No extensive studies have been conducted to determine how communities and people living close to oil and gas in California are affected.

In order to begin to understand the impacts of oil and gas development on California communities, this project conducted an investigation of health and air contaminants in two communities living in close proximity to drilling operations - Lost Hills in Kern County, and Upper Ojai in Ventura County. By using a combination of air sampling data and information from health surveys, our assessment aimed to test whether populations living near oil and gas production are being exposed to potentially toxic chemicals associated with the production and transportation of oil and gas. The assessment is based on FLIR camera imaging and air sampling data collected near production facilities, as well as data collected from health surveys. The project also aimed to identify contaminants that are present in the air in two communities in California, and to understand whether the risk of exposure exists.

The sampling and health survey results showed that the communities of Upper Ojai in Ventura County, and Lost Hills in Kern County, are being exposed to air contaminants that are typically associated with air emissions from oil and gas development.

The results showed that the communities of Upper Ojai in Ventura County, and Lost Hills in Kern County, are being exposed to air contaminants that are typically associated with air emissions from oil and gas development. These contaminants may negatively affect the health of the communities and pose a serious risk of long-term exposure. However, the frequency and number of samples was limited; therefore, the results of this investigation must be viewed as a snapshot of air emissions and a clear warning sign of problems, not as generalizable results.

FLIR (infrared) camera filming revealed visible emissions from several oil and gas facilities near the two communities. Air sampling revealed the presence of 15 compounds known to have negative effects on human health, as well as 11 compounds for which no health data is available. In addition, the air sampling and health surveys show that residents in both communities report odor issues likely related to the oil and gas development close to their homes. Health surveys conducted in both communities show evidence of health effects that is consistent with contaminants that are associated with oil and gas and which were detected through air sampling, such as nosebleeds, headaches, sinus problems, and skin rashes.

The findings of the assessment provide communities with a snapshot of the types of air contaminants they are being exposed to, the known effects of those contaminants on public health, and the levels of exposure. The data provides a basis for these two communities, and others living in close proximity to oil and gas development, to request further investigation into health impacts associated with oil and gas production, and to push policymakers and regulatory

agencies to address their health concerns. Long-term studies into the health impacts of oil and gas operations on California communities will enable regulations to be developed that, if effectively enforced, protect public health and increase understanding of the health impacts that arise from oil and gas development in California.

Introduction

California is a land of contrasts. Parallel to the glitz and glamour of Los Angeles, the tech hub of Silicon Valley, and the charm of wine county, lie some of the poorest and most environmentally contaminated areas in the country. In the San Joaquin Valley, nearly 84,000[1] oil wells dot the landscape, surround strawberry fields, or poke through the tops of almond trees. In Los Angeles, beneath the lights and opulence of Hollywood, lies the biggest urban oil field in the United States.[2] In Ventura County, pump jacks steadily siphon oil near schools, in people's backyards, and on the grounds of a fire station.

A recent analysis shows that approximately 5.4 million people, or 14% of the state's population, live within 1 mile of a well. More than 1.8 million of these people live in areas suffering from environmental justice issues (according to CalEnviroscreen 2.0). These highly vulnerable communities make up 92% of people suffering from environmental justice issues in California. This includes Latinos/Hispanics (69%), African Americans (10%), and Asian Americans (11%).[3]

Although the impacts from oil and gas development are not widely acknowledged, it is a reality to those who live in these areas. Oil and gas development has been taking place in the Golden State since the 19th century, shaping most aspects of life for those unlucky enough to live near it. From contaminated water, to noxious odors, to severe health impacts, the conditions that arise from living near oil and gas operations make daily life a continuous struggle. The most disadvantaged community members often have no choice in where they live, and no voice in the decision-making processes that affect their daily lives.

Approximately 5.4 million people, or 14% of the state's population, live within 1 mile of a well. More than 1.8 million of these people live in areas suffering from environmental justice issues.[3]

Recent reviews of the research on public health impacts from oil and gas development have highlighted the overall lack of attention and research devoted to documenting these impacts. Regulatory agencies in California have not extensively studied the effects of oil and gas development on public health, mirroring the silence that has accompanied contamination events from related activities over the years.

This assessment is the first step in providing insight regarding health impacts related to air emissions from oil and gas development in California. Such impacts in other states are beginning to be reported in peer-reviewed journals, where the research is linking exposure to oil and gas emissions with sub-chronic health effects, adverse birth outcomes, as well as higher prevalence of symptoms such as throat and nasal irritation, sinus problems, eye burning, severe headaches, persistent cough, skin rashes, and frequent nose bleeds.

From May to September 2014, Earthworks, in partnership with Clean Water Fund, and community members in Lost Hills, Kern County, and Upper Ojai, Ventura County, performed an exploratory health assessment of oil and gas development using multiple data collection

techniques, including a survey and air quality samples. Researchers used a forward looking infrared (FLIR) camera to detect unseen emissions from oil and gas facilities, and collected air samples using Summa canisters, which were sent to an independent, certified lab for analysis. Researchers also collected air samples at the source of the emissions, when possible, or in areas directly downwind from the source of the odor or vapor (but no further than 20 feet), including pump jacks and wellheads, pipelines, evaporation pits, processing facilities, and storage areas.

For decades, the oil and gas industry has operated in California, recklessly endangering communities and putting profits above people. The state agency in charge of regulating oil and gas in California, the Division of Oil, Gas, and Geothermal Resources (DOGGR), has failed to address the negative consequences of oil and gas development, allowing the industry to operate throughout the state without adequate oversight. One reason is that state law, specifically Public Resources Code section 3106[4], provides a mandate to DOGGR to facilitate extraction. The unfortunate outcome is that DOGGR staff historically have focused on that mandate, and failed to provide adequate emphasis on the protection of human life and natural resources.

In regulating the oil and gas industry, California agencies have failed to prioritize public health and natural resources, ranging from lax regulation of wastewater disposal, air emissions, seismic impacts, and protection of water resources. In some cases, the regulations have been weak; in others, the agencies have done a poor job of exercising existing regulatory authority and/or conducting enforcement. Furthermore, agencies charged with protecting health and the environment have historically lacked the resources to do the job.

In California, the Air Resources Board (ARB) regulates air emissions from non-stationary sources. Stationary sources, including oil and gas production, storage, transport, and disposal facilities, are regulated by the 35 local Air Pollution Control Districts (APCDs), or Air Quality Management Districts (AQMDs). This leads to inconsistent regulations throughout the state, with some districts having more stringent regulations than others, and varying levels of enforcement between districts. For example, regulations on vapor recovery systems, spills, leaks, monitoring, reporting, and economic hardship exemptions, among others, vary from one district to the next. For more information, please see Appendix A.

In California, air emissions fall under the purview of the California Air Resources Board (ARB). ARB regulates all aspects of air emissions and air quality for non-stationary sources in the state, and ensures compliance with federal and state regulations. Stationary sources, including oil and gas production, storage, transport, and disposal facilities, are regulated by the 35 local Air Pollution Control Districts, or Air Quality Management Districts. See Appendix A for more information.

Unfortunately, due to the industry-friendly regulatory environment, and the lack of studies on the public health impacts from oil and gas specific to California, communities are left to fend for themselves. Complaints to regulatory districts, health departments, or elected officials, often go unanswered. In many cases, the agencies receive analyses and data from the industry, skewing the results. Complaints may be closed without follow up, or if there is a violation, industry may be allowed to fix it without any penalty.

Background:
Oil and gas production in California and known public health impacts

Oil and Gas Production in California

Oil has been a major industrial activity in California for over a hundred years. With the discovery of oil fields in Los Angeles and the San Joaquin Valley at the turn of the 20th century, the state became a major player in fueling the nation's growing demand for gasoline.[5] By 1900, California produced 4.3 million barrels of oil, increasing to 34 million barrels in 1905, and 77.7 million barrels by 1910.[6] Currently, the state is the 4th largest producer of oil in the United States, pumping out 199.6 million barrels in 2013.[7]

Production has been steadily declining since hitting a peak in the mid 1980's; however, the use of unconventional stimulation techniques has caused increases in production in some fields.[8] Kern County has the largest and most productive fields, providing nearly 80% of all oil produced in California.[9] Additional development occurs in Ventura, Los Angeles, Monterey, and Santa Barbara counties. Most production occurs onshore, although some offshore production also takes place.

Lakeview Gusher, Kern County, California 1910. Photo - California Department of Conservation

Although oil has brought with it great prosperity to some, the Golden State has paid a heavy price in terms of environmental damage. In March 1910, Lakeview 1 well caused a gusher that lasted for 32 months until September 1911, spilling nearly 8.2 million barrels of oil (Figure 1).[10] On January 28, 1969, a blowout on an offshore platform caused an estimated 80,000 to 100,000 barrels of oil to spill into the waters off Santa Barbara County.[11] The spill had a devastating effect on wildlife. An estimated 3,600 dead seabirds, seals, and dolphins were found on shorelines, while thousands of fish and other invertebrates were killed due to the destruction of kelp forests.[12]

In 1994, after nearly 40 years of unseen and unreported leaks, Unocal publicly acknowledged damage to the Guadalupe-Nipomo Sand Dunes. An estimated 12 million gallons of oil and diluent were spilled over 2,700 acres beneath the dunes, making it the largest spill in California history.[13] Because the spill was not readily visible, it did not receive ample media coverage. Most recently, a ruptured pipeline in the Los Angeles suburb of Glendale caused 10,000 gallons of oil to spill into the streets, sending a gusher up to 50 feet in the air.[14] Although the spill did not cause much damage, it raised public awareness of the dangers associated with oil drilling and transport in urban settings.

In 2013, a jury awarded Starrh farms $8.5 million in punitive damages, after produced water contamination from Aera polluted the farm's groundwater sources.[15] In July 2014, 13 wastewater injection wells were shut down in Kern County when they were found to be injecting wastewater into underground sources of drinking water. Officials identified disposal into these aquifers from wells that have received produced water since as far back as the 1970s. Testing continues, and 11 wells remain shut down.[16] DOGGR and the US Environmental Protection Agency are currently performing a thorough oversight of the Underground Injection Control Program (UIC) in California.[17]

Although the environmental impacts from oil and gas development are sometimes readily visible, and largely studied in the aftermath, the impacts on public health have not been as thoroughly studied. Millions of people in California live in areas of active oil and gas production, and face the risk of exposure to air, water, and soil contamination. There is an enormous need for the state to study the public health impacts associated with oil production, particularly in communities in close proximity to oil production operations.

Public Health Impacts

Recent reviews of the research on public health impacts from oil and gas development have highlighted the overall lack of attention and research devoted to documenting these impacts. For example, Shonkoff, et. al. (2014) found only 33 peer-reviewed articles presenting original data on health impacts, out of more than 200 that pertained directly to shale development.[18] This gap mirrors the "silence" by regulatory agencies and industry that has accompanied contamination from oil production activity over the years, both in California and in the country as a whole. As researchers have noted, the silence in the research reflects more a lack of interest by both industry and regulators, than a lack of actual impacts.[19]

This assessment is the first step in providing health impact information related to air emissions from oil and gas development in California. As such, this section focuses on summarizing the current state of knowledge in the air sector. However, it is important to note that there is an increasing body of knowledge focused on documenting contamination and impact pathways related to water and soil. For example, Bamberger and Oswald (2012) published a study documenting 24 cases of livestock, domesticated animals, and humans that have been adversely impacted by exposure to contaminated water and soil.[20] Similarly, recent research by a range of scientists consistently indicates that contamination of shallow aquifers used for drinking water may occur through a variety of mechanisms; that groundwater resources appear to be at increased risk of contaminant infiltration as a result of stimulation activities, and that poorly constructed or faulty well casings may allow for chemicals present in production waters to leak from production wells into the surrounding geology.[21]

Health impacts due to air emissions from oil and gas development are beginning to be reported in peer-reviewed journals, where the research is linking exposure to these emissions with sub-chronic health effects, adverse birth outcomes, as well as higher prevalence of symptoms such as throat and nasal irritation, sinus problems, eye burning, severe headaches, persistent cough, skin rashes, and frequent nose bleeds among respondents living within 1,500 feet of facilities, compared to those who lived >1500 feet.[22] Research by Colborn (2011) and others has shown that fracturing (fracking) fluids, drilling muds, flowback, and produced waters contain chemicals that at elevated doses or certain concentrations have been associated with health effects including skin and eye irritation, neurological and nervous system damage, cancer, and endocrine disruption.[23]

A study by the City of Ft. Worth, Texas, on air quality in gas fields found concentrations of formaldehyde above state regulatory standards at 750 feet beyond the site fence line.[24] Furthermore, a Colorado School of Public Health study of air emissions around gas well operations found that residents living less than a half mile from oil and gas operations are at higher risk of respiratory, neurological, and other health impacts, and have a higher lifetime risk for cancer, based on exposure to pollutants, than those at longer distances.[25]

The major limitations that emerge from the research include the concentration of the pollutants in the environment, the frequency and duration of exposures experienced by individuals, and potency of pollutants from oil and gas development.

Lost Hills, California. The Lost Hills oil field, circled in blue is directly to the west of the community, also circled in blue. Source – Google.

Project Locations

Lost Hills, Kern County

Lost Hills is a small community in unincorporated Kern County, nestled at the intersection of Interstate 5 and California Highway 46. The California Aqueduct runs through the western part of the town, separating the town from the Lost Hills oil field located to the west-northwest of the population centers. The community is located approximately 42 miles west-northwest of Bakersfield.[26] Climate is classified as semi-arid, with hot summers often surpassing 100°F, and average rainfall of 5" per year.[27]

As of the 2010 census, Lost Hills had a population of 2,412, of which more than 97% identified as Hispanic or Latino.[28] More than 70% of the population is employed by the agricultural industry, with 50% of the populace having an education level of a high school degree or less. The average income for households is $29,348, with 43% of the population living below the poverty line. There is no central municipal government; aspects of town management are run by the County of Kern from the seat in Bakersfield.[29]

The Lost Hills oil field, located directly to the northwest, west and southwest of the town, extends for nearly 10 miles to the north of State Road 46. Discovered in 1910, it is the sixth largest producing field in the state, averaging 10.8 million barrels of oil, and 9 billion cubic feet

In Kern County, thousands of wells dot the landscape.

of natural gas in 2013.[30] The Lost Hills field recently became the second largest producer of natural gas in California,[31] largely due to unconventional drilling techniques, such as hydraulic fracturing. According the voluntary reporting website Fracfocus.org, 184 wells have been fracked since 2011.[32] Beginning in 2014, when mandatory reporting began pursuant to SB 4(Pavley), 48 well stimulation notices have been submitted to DOGGR from Aera Energy, LLC (Aera) (36 notices), Chevron Corporation (Chevron) (10) and Seneca Resources (2).[33] According

to DOGGR's post stimulation disclosures, Aera, and Chevron, the main operators in the field, have hydraulically fractured 24 wells.[34] As a consequence, production has increased dramatically.[35]

Since the 1980s, operations at the oil field have caused large areas of the surface to experience subsidence of up to 1 foot per year.[36] In 1976 and 1978, two wells blew out and caused the wellheads to collapse into large craters. Subsidence can lead to other problems, including casing fracture and well failures, which can contaminate surface and groundwater resources.[37]

Accidents and spills are a part of operations in the Lost Hills oil field. On November 23, 1998, a well blew out in the field, catching fire and melting nearby drilling equipment. A pillar of fire over 300 feet tall could be seen from 40 miles away, burning between 40 to 100 million cubic feet of gas per day. The fire burned for 14 days until it was put out, yet the well continued to spew oil and gas for six months, until it was finally plugged in May 1999.[38]

The predominant winds in the Lost Hills area are from the north-northwest.[39] Because of the location of the town relative to the oil field, when the wind blows, hydrocarbon odors and other air contaminants are carried directly into the town.

Upper Ojai, Ventura County

Upper Ojai is a rural unincorporated community east of the City of Ojai, in Ventura County. The community is located on State Route 150, between Ojai and Santa Paula. The climate in the area is considered to be Mediterranean, with hot, dry summers, and mild winters. Precipitation averages 21" per year, with most of it falling between November and April.[40] On the map below, the community of Upper Ojai surrounds Summit Elementary School.

Upper Ojai, California. Source - Google

Because the community of Upper Ojai is unincorporated, census figures for the community are not available from the U.S. Census Bureau. Local residents estimate the number of people in Upper Ojai to be between 1,000 to 1,500 residents. The majority of the population (88%) identifies as white, with 17% identifying as Hispanic or Latino.[41] Education levels in the Ojai Valley, which includes Upper Ojai, are high, with 92% and 44% of the population achieving a high school degree or a Bachelor degree (or higher), respectively.[42] Median household income in the valley is $62,804, while the poverty rate stands at 10.4%.[43]

Oil production in the Upper Ojai region began nearly 150 years ago, when Josiah Stanford tunneled through Saltmarsh Canyon, and began transporting oil in 1866.[44] This was the first commercial production of oil established in the State of California. In May 1867, Thomas Bard drilled Ojai #6 well to a depth of 550 feet, establishing the first commercially sustained production of oil in California, at 20 barrels per day.[45] Tunnels in the area continued producing small amounts of oil until they were abandoned in 1998.[46]

Through natural geological processes, oil seeps from the ground in places in Upper Ojai. This phenomenon can easily be observed along State Road 150. It is this seepage that first led drillers to the region, as it was said that "oil [is] struggling to surface at every available point."[47] Production has continued at a steady pace since the 19th century, with dozens of oil and natural gas wells dotting the landscape. The main operators in the area are Vintage California, LLC (Vintage), Ojai Oil Company, Mirada Petroleum, Inc. (Mirada), and Thomson Oil Company, Inc. Each operator produces several thousand barrels of oil per year, along with several thousand cubic feet of natural gas.[48] Data from FracFocus shows that several wells in the area were fracked prior to January 2014.[49] However, since mandatory reporting of well stimulation began in 2014, hydraulic fracturing has not been reported in Upper Ojai.

The predominant winds in the Upper Ojai area vary. Because of Upper Ojai's location, winds may blow from every direction.[50] Due to the continually changing wind patterns, residents cannot avoid any odors from oil and gas facilities that blow into their homes.

Upper Ojai, California. Though the area is predominately rural, oil and gas contribute substantial emissions in a county already exceeding ozone levels set by the state.

The Assessment:
Project Need, Methodology, and Limitations

Project Need

Due to the major gaps in data and information relating to the impacts of oil and gas development on human health in California, Earthworks, in partnership with Clean Water Fund, launched an investigation in affected communities living in close proximity to oil and gas development. Regulatory agencies in California have not extensively studied the impacts of oil and gas on public health, and the need for this kind of data is great in all areas where oil and gas production and transportation occurs in California.

A recent analysis shows that approximately 5.4 million people, or 14% of the state's population lives within 1 mile from a well.[51] They are exposed every day to toxic air contaminants that arise from oil and gas facilities, including production wells, pump jacks, flares, pipelines, compressor stations, refineries, waste disposal sites, and many more. The communities of Upper Ojai, in Ventura County, and Lost Hills, in Kern County, were selected due to their history and close proximity to oil and gas development. The sharp contrast in demographics between the two communities, such as median income, education level, and ethnicity, help us understand how oil and gas development affects a wide range of California's population.

Approximately 5.4 million people, or 14% of the state's population lives within 1 mile from a well. The aim of this assessment was to test whether populations living near oil and gas production are being exposed to potentially toxic chemicals.

By using a combination of air sampling data, and information from health surveys, the aim of the assessment was to test whether populations living near oil and gas production are being exposed to potentially toxic chemicals associated with the production and transportation of oil and gas. The assessment also aimed to identify contaminants that are present in the air in these two communities, and to understand whether the risk of damaging exposure exists.

The findings of the assessment will provide communities with data on air contaminants, their effects on public health, and levels of exposure. Communities and advocates can use this initial data to request further investigation into health impacts associated with oil and gas production, and to push policymakers and regulatory agencies to address their health concerns. Raising awareness among regulatory agencies and elected officials will allow for better communication with constituents and frontline communities at the heart of oil development in California. This type of study will allow for regulations to be developed that, if effectively enforced, protect public health, and for further health impacts assessments to be conducted—in turn increasing understanding of the health impacts that arise from oil and gas development in California.

Methodology

In 2013 in Pennsylvania[52] and Texas,[53] Earthworks performed exploratory health assessments of oil and gas development using multiple data collection techniques including a survey and air quality samples. For this study of community members in Lost Hills, Kern County, and Upper Ojai, Ventura County from May to September 2014, Earthworks – in partnership with Clean Water Fund – used the same methodology.

In previous Earthworks studies, including a peer-reviewed investigation in Pennsylvania in 2013, and Texas in 2013, from May to September 2014, Earthworks, in partnership with Clean Water Fund, and community members in Lost Hills, Kern County, and Upper Ojai, Ventura County, performed an exploratory health assessment of oil and gas development using multiple data collection techniques including a survey and air quality samples.

Researchers used a FLIR (ThermaCAM™ GasFindIR HSX) camera to detect unseen emissions from oil and gas facilities, and collected air samples using Summa canisters, which were sent to an independent, certified lab for analysis. Independent laboratory testing confirms that the Gas FindIR cameras can detect a variety of gases at the minimum detected leak rate (MDLR), including benzene, butane, ethyl benzene, hexane, methane, toluene, and xylene. [54] Although approximately 35 locations were filmed, samples were only collected after FLIR filming confirmed the release of vapors.

Researchers used a FLIR (ThermaCAM™ GasFindIR HSX) camera to detect and record invisible emissions from oil and gas facilities, and collected air samples using Summa canisters, which were sent to an independent, certified lab for analysis.

Researchers collected air samples for analysis to understand whether populations in the project communities are being exposed to contaminants from oil and gas development. Samples were collected from various facilities, including pump jacks and wellheads, pipelines, evaporation pits, processing facilities, and storage areas. Locations were selected based on conversations with local community members who had identified the facilities as a source of hydrocarbon odors, or had experienced negative health impacts when near that location. Community members we spoke to have lived in the communities for at least a year, and/or work near oil and gas facilities.

Air samples were collected using Summa canisters – a stainless steel vessel that has been especially coated on the inside and outside to prevent contamination. ALS Global (ALS), a certified laboratory located in Simi Valley, California, provided canisters. ALS has decades of expertise in providing a full range of analytical testing services based on internationally recognized procedures, such as those used by the EPA and the American Public Health Association (APHA).[55]

Samples were collected as close to the source of the emissions as safety and access allowed, but no further than 20 feet away. A total of 10 Summa canister samples were collected for the assessment – 5 in Upper Ojai, and 5 in Lost Hills. In Upper Ojai one sample was collected during a well abandonment job, as gases were being released into the atmosphere and surrounding community to relieve the pressure of the well before the equipment was removed. The rest of the samples were collected near pipes in pump jacks, a flare, and during loading of petroleum from a storage tank into trucks to be taken away for refining, a process that releases large amounts of odors.

In Lost Hills, all samples were collected in the Lost Hills oil field. Samples came from a steam injection wellhead, downwind from the loading of trucks with materials for a hydraulic fracturing job, next to an unlined produced water evaporation pit, at a public access road that

goes through the northern edge of a refinery less than half mile from the Lost Hills school, and at the approximate center of the Lost Hills oil field, north of State Road 46. All samples were collected by Earthworks researchers and sent for analysis to the ALS laboratory in Simi Valley. ALS analyzed the samples for volatile organic compounds (VOCs) using EPA Method TO-15,[56] for methane using EPA Method TO-3,[57] and for tentatively identified compounds (TICS).

The project collected health information from forty community members using a health survey (Appendix B and C) – designed by Wilma Subra,[58] an environmental chemist and President of Subra Company. The survey focused on a range of exposures, health symptoms, and medical history. With the understanding that the primary routes of exposure to chemicals and other harmful substances used and generated by oil and gas facilities are inhalation, ingestion, and dermal absorption, the survey explored such variations through checklists of health symptoms grouped into categories such as skin, neurological, and reproductive.

All the symptoms included in the survey could potentially be caused by exposure to substances known to be associated with gas and oil facilities. A similar structure was followed for categories in the participant's disease history. Additional questions focused on the participant's occupational background, exposure to other toxic chemicals, proximity to oil and gas facilities, and type and frequency of odors encountered in the community. Surveys were provided in English and Spanish, depending on the participants' preference.

All participants completed the survey voluntarily, were fully informed of the reason for the survey, and how the data would be analyzed and used. Surveys were completed individually, or in the case of the elderly or children, parents or another adult completed the survey for these participants. Some participants in Lost Hills chose to provide answers verbally to Clean Water Fund researchers, who visited the members individually. Due to concerns expressed by community members about confidentiality, participants were given the option of completing the surveys anonymously, which some chose to do. Surveys completed anonymously included all data, except full name and address of the participant, ensuring identity protection. Earthworks researchers analyzed surveys for correlations between proximity to emission sources, frequency of reported odors, reported health symptoms, and known health symptoms from air emissions oil and gas development.

Limitations

During the assessment, certain constraints were present, which limited the scope of work. Limited resources available meant that we were unable to collect ambient air samples in the project communities that would account for ambient air emissions, including oil and gas production, agriculture, cattle production, wildfires, and manufacturing, among others. Air sample collection varies depending on conditions at the time of sampling, including, but not limited to, proximity to the source of the contaminant, ambient air contamination already present in the area, weather, landscape conditions, wind, temperature, and timing. Additionally, upwind and downwind samples were not collected at the communities. These types of samples, though important, are outside of the scope of this project

In order to determine if emissions were occurring in a facility, the FLIR camera had to be in relatively close proximity to the emission source. Although the camera can detect visible emissions from great distances, the image quality decreases. For the purposes of positive

identification and accuracy in detecting the emissions, Earthworks researchers recorded them at close proximity, but no farther than 20 feet from the source.

Our ability to approach oil and gas facilities also proved to be a limitation in the study. Many facilities, such as pump jacks and evaporation pits, which were identified by community members as producing hydrocarbon odors, were not tested. This occurred mostly because facilities were located on private property. On one occasion, representatives from Vintage and DOGGR attempted to intimidate Earthworks researchers as they were filming with the FLIR camera at a site in Upper Ojai, with permission from the surface property owner.

Finally, the data collected in the surveys served to obtain initial exploratory information for follow up studies. It was not meant to obtain a representative sample nor to establish statistical validity. The project did not investigate additional factors that can influence health conditions or cause symptoms, such as those included in assessments conducted using control groups in non-impacted areas or investigations into the comparative health histories of participants. Although important, that type of investigation exceeded the resources available for this assessment.

Storage tanks are typical sources of VOC (Volatile Organic Compound) emissions.

Findings and Results

FLIR Camera Results

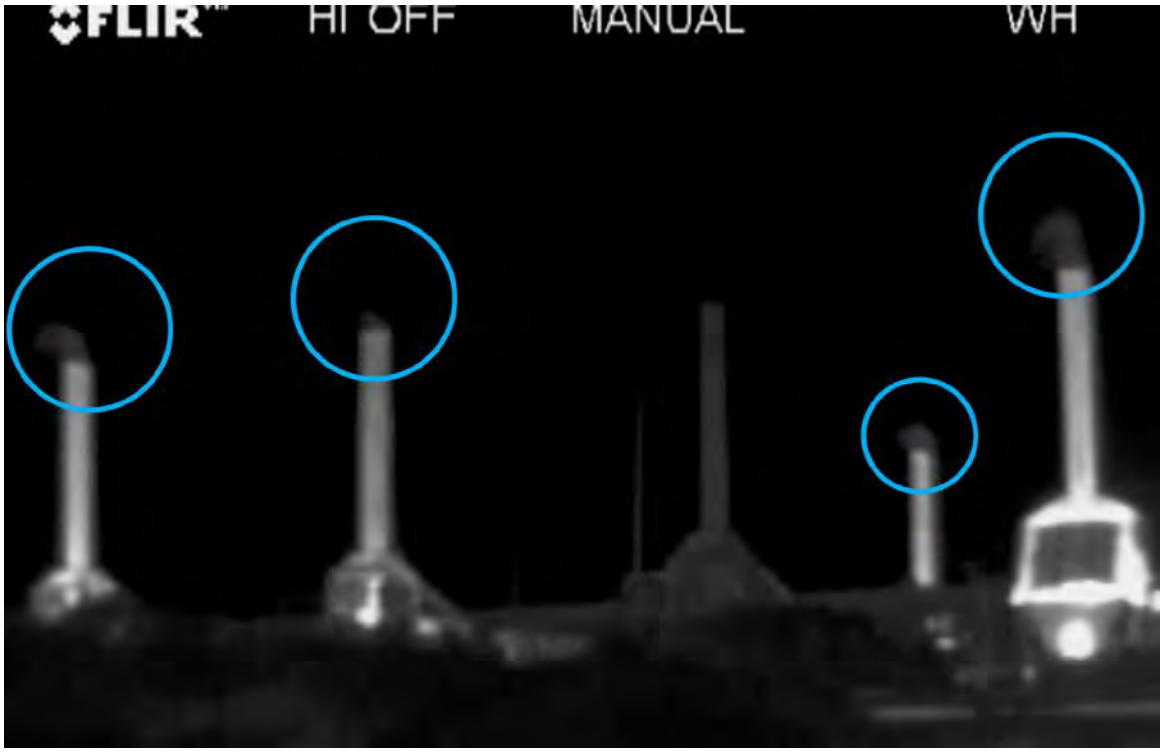
In May and July 2014, the project conducted filming using a FLIR Gas FindIR camera. By first identifying the source of the contamination, researchers collected air samples for analysis to determine if residents are being exposed to contaminants from oil and gas development.

Using the FLIR camera, researchers observed the abandonment of a well in Upper Ojai. According to the property owner at the time of filming, this was one of several wells that had been abandoned on his property over the past months. He described the procedure as fast, bringing with it many unpleasant hydrocarbon odors. As the gas was released, he described the sound as similar to one of a large jet engine. However, as workers from Vintage recognized that we were filming, they proceeded to allow the gas to escape slowly, instead of releasing it quickly in one short burst. In the video, gases can be seen escaping the well directly into workers' faces. Figure 4 shows gases escaping from the wellhead during the abandonment procedure.

Additional emissions were detected at nearby Vintage-owned wells. Sizable emissions from a well operating on the grounds of Fire Station 20 were detected, yet no footage was recorded since permission was needed from the Ventura County Fire Department (VCFD) to film on their property. When permission was denied, a complaint was filed with VCAPCD. However, the complaint was dismissed after the operator, Ojai Oil Company, inspected the site.

With the infrared FLIR camera, vapors that cannot be seen with the naked eye are now visible. Even small plumes can be seen indicating that volatile organic compounds, VOCs, are escaping from the well as a worker stands nearby (circled in blue).

In Lost Hills, the FLIR camera proved very useful in identifying facilities that are emitting unseen pollutants into the air. Vapors could be seen from processing facilities, wells, and unlined evaporation pits. The Lost Hills oil field is the sixth largest producer in California, producing millions of barrels of oil per year, and has ramped up production recently due to unconventional well stimulation practices, such as hydraulic fracturing. Because the wind direction mainly blows from the northwest to the southeast, vapors that emanate from the field are directly taken to the populated areas in the community of Lost Hills.



Emissions, circled in blue, observed from a processing facility in the Lost Hills oil field, with the aid of the FLIR infrared camera.

At the same processing facility taken on the same day within minutes of the picture above, emissions are invisible without the FLIR camera.

Emissions rising from a processing facility in the Lost Hills oil field. Note the blue circle indicating a plume. These emissions cannot be seen without the assistance of the FLIR infrared camera.

Summa Canister Results

All samples in Upper Ojai revealed the presence of methane, dichlorodifluoromethane, trichlorofluoromethane, and isoprene. Samples also revealed the presence of ethanol, acetone, n-Heptane, toluene, n-Hexane, n-Nonane, alpha-Pinene, propane, isobutene, n-Butane, n-Pentane, acetaldehyde, trimethylsilanol, n-Nonanal, and an unidentified siloxane.

All samples in Lost Hills revealed the presence of methane, dichlorodifluoromethane, and trichlorofluoromethane. Samples also revealed the presence of ethanol, acetone, ethyl acetate, acetaldehyde, and trimethylsilanol. Most of these compounds are byproducts of hydrocarbon production.

Samples in Lost Hills also revealed the presence of dodecane (C12H26), decalin (C10H18), a tetramethylbenzene isomer, 1-methyldecalin (C11H20), didichlohexyl (C12H22), 1-trydecyne (C13H24), and a chemical compound which could not be identified by the lab, and was labeled as *"unidentified compound."* These compounds, and the unidentified compound, were recorded from a sample collected at the edge of a produced water evaporation pond. Research on these compounds turned up very little data; however, decalin is a known industrial solvent that is used as a fuel additive.[59]

Air samples are collected in Summa canisters– stainless steel vessels that have been especially coated on the inside and outside to prevent contamination.

Table 1: Compounds identified during lab analysis in Upper Ojai				
Sample ID and Location	**Detected Compound**	**(µg/m3)**	**Short Term ESL (µg/m3)**	**Long Term ESL (µg/m3)**
CA001 Upper Ojai	Methane	3.0 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.1	420	42
	Acetone	6.9	7,800	4,800
	Trichlorofluoromethane	1.1	28,000	5,600
	n-Hexane	1.1	5,300	200
	Propane	8.7	Simple asphyxiant	
	Isobutane	6.0	23,000	7,200
	n-Butane	8.7	66,000	7,200
	n-Pentane	3.2	4,100	7,100
	Isoprene	**17**	60	6
	Trimethylsilanol	**4.7**	30	3
CA002 Upper Ojai	Methane	3.2 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.1	420	42
	Ethanol	230		
	Acetone	6.7	7,800	4,800
	Trichlorofluoromethane	1.1	28,000	5,600
	n-Nonane	0.70	2,000 (ppbV)	200 (ppbV)
	alpha-Pinene	4.3	100	350
	Acetaldehyde	3.5	15	45
	Isoprene	**6.7**	60	6
	Trimethylsilanol	**12**	30	3
CA003 Upper Ojai	Methane	2.3 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.0	420	42
	Trichlorofluoromethane	1.2	28,000	5,600
	Propane	2.9	Simple asphyxiant	
	Isoprene	3.4	60	6
CA004 Upper Ojai	Methane	2.3 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.0	420	42
	Acetone	11	7,800	4,800
	Trichlorofluoromethane	1.2	28,000	5,600
	Propane	4.3	Simple asphyxiant	
	n-Butane	2.9	66,000	7,200
	Isoprene	**9.0**	60	6
CA005 Upper Ojai	Methane	2.5 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.3	420	42
	Acetone	16	7,800	4,800
	Trichlorofluoromethane	1.3	28,000	5,600
	n-Heptane	0.68	2,750	350
	Toluene	0.88	3,500	1,200
	Propane	4.3	Simple asphyxiant	
	Isoprene	2.8	60	6
	Trimethylsilanol	**12**	30	3
	Unidentified Siloxane	5.4	1,000	100
	n-Nonanal	2.8		

KEY:
ppmV – parts per million by volume • ppbV – parts per billion by volume • (µg/m3) – micrograms per cubic meter • ESL – Effect Screening Level (Source: Texas Commission on Environmental Quality) • Compounds exceeding the long-term ESLs are marked in bold and highlighted.

Tables 1 and 2 list the compounds identified during lab analysis from samples collected in Upper Ojai and Lost Hills. Samples are reported in micrograms per cubic meter, except for methane, which is reported in parts per million by volume. The reported values for each compound were compared to the Effect Screening Levels (ESLs), as described by the Texas Commission on Environmental Quality (TCEQ). None of the compounds exceeded the short-term ESLs, except trimethylsilanol, which exceeded the long-term ESLs in five of the samples. Additionally, isoprene exceeded the long-term ESLs in three of the samples collected. Compounds exceeding the long-term ESLs are marked in bold.

Table 2: Compounds identified during lab analysis in Lost Hills

Sample ID and Location	Detected Compound	(µg/m3)	Short Term ESL (µg/m3)	Long Term ESL (µg/m3)
CA006 Lost Hills	Methane	2.2 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.2	420	42
	Ethanol	93		
	Trichlorofluoromethane	1.3	28,000	5,600
CA007 Lost Hills	Methane	2.2 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.0	420	42
	Ethanol	9.7		
	Acetone	8.0	7,800	4,800
	Trichlorofluoromethane	1.2	28,000	5,600
	Dodecane (C12H26)	6.7	770	350
CA008 Lost Hills	Methane	2.2 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.2	420	42
	Ethanol	9.4		
	Acetone	12	7,800	4,800
	Trichlorofluoromethane	1.3	28,000	5,600
	Ethyl Acetate	18	1,400	1,440
	Acetaldehyde	5.6	15	45
	Trimethylsilanol	**4.1**	30	3
	Decalin (C10H18)	2.8	3,500	350
	Dodecane (C12H26)	5.1	770	350
	Tetramethylbenzene	3.7	1,250	125
	1-Methyldecalin (C11H20)	3.1		
	Didichlohexyl (C12H22)	5.0		
	1-Trydecyne (C13H24)	3.8	1,000	100
	Unidentified compound	4.7		
CA009 Lost Hills	Methane	2.2 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.4	420	42
	Acetone	17	7,800	4,800
	Trichlorofluoromethane	1.14	28,000	5,600
	Acetaldehyde	3.0	15	45
	Dodecane (C12H26)	3.7	770	350
CA010 Lost Hills	Methane	2.3 (ppmV)	Simple asphyxiant	
	Dichlorodifluoromethane (CFC12)	2.3	420	42
	Acetone	21	7,800	4,800
	Trichlorofluoromethane	1.2	28,000	4,800
	Acetaldehyde	3.5	15	45
	Trimethylsilanol	**3.4**	30	2

KEY:
ppmV – parts per million by volume • ppbV – parts per billion by volume • (µg/m3) – micrograms per cubic meter • ESL – Effect Screening Level (Source: Texas Commission on Environmental Quality) • Compounds exceeding the long-term ESLs are marked in bold and highlighted.

ESLs are "screening levels used to evaluate the potential for effects to occur as a result of exposure to concentrations of constituents in the air. ESLs are based on data concerning health effects, the potential for odors to be a nuisance, and effects on vegetation."[60] Short-term ESLs indicate a 1-hour averaging period, while long term ESLs indicate an annual averaging period.[61] It is important to note that the ESLs from Texas were used because information from California is limited. Regulatory agencies have not developed an extensive list of ESLs specific to California, leaving many communities without knowledge of the "safe" levels of known and unknown contaminants in the air from oil and gas development.

The detected compounds are known to cause a variety of health effects, ranging from headaches and dizziness, to vomiting and throat irritation. Some compounds are known carcinogens, and can affect the nervous and reproductive systems. Some compounds have not been studied at all, meaning that there is no way to know how they will affect public health.

Table 3: Known health effects of compounds detected in Upper Ojai and Lost Hills

Compound	Health Effect[62]
Methane	Can cause suffocation, headache, dizziness, weakness, nausea, vomiting, loss of coordination and judgment, increased breathing rate, and loss of consciousness.
Dichlorodifluoromethane (CFC12)	Can cause eye, mouth, nose, and throat irritation, eye burning, dizziness, lightheadedness, and trouble with concentration. Exposure to high concentrations can cause the heart to beat irregularly and stop.
Acetone	Can cause skin, eye, nose, and throat irritation, coughing, and wheezing. Exposure to high concentrations can cause headache, nausea and vomiting, dizziness, lightheadedness, and fainting. There is limited evidence that acetone may damage the male reproductive system (including decreasing the sperm count) and affect female fertility in animals.
Trichlorofluoromethane	Can cause lightheadedness, dizziness, and lung irritation. Exposure to high concentrations can lead to irregular heartbeat.
n-Hexane	Can cause, skin, eye, nose, throat, and lung irritation, skin and eye burning, coughing, wheezing, shortness of breath, headache, nausea, vomiting, dizziness, lightheadedness, and fainting. Higher levels of exposure can cause coma and death. n-Hexane may damage the testes. Prolonged or repeated contact can cause a skin rash, dryness and redness, may damage the nervous system causing numbness, tingling, blurred vision, "pins and needles," and weakness in the hands and feet.
Propane	Can cause headaches, dizziness, lightheadedness, weakness, nausea, vomiting, loss of coordination and judgment, fainting, and death.

Table 3: Known health effects of compounds detected in Upper Ojai and Lost Hills	
Isobutane	Can cause nose and throat irritation, coughing, and wheezing. Exposure to high concentrations can cause dizziness, lightheadedness, irregular heartbeat, disorientation, and fainting. Very high levels can cause suffocation from lack of oxygen, with loss of consciousness, convulsions, coma, and death.
n-Butane	No data available
n-Pentane	No data available
Isoprene	Can cause skin, eye, nose, and throat irritation, coughing, wheezing, headache, dizziness, lightheadedness, and fainting. Isoprene may be a carcinogen in humans since it has been shown to cause liver, lung, mammary gland, and other types of cancer in animals. It may also have the potential for causing reproductive damage in humans. Isoprene can also irritate the lungs - repeated exposure may cause bronchitis to develop.
Trimethylsilanol	No data available
Ethanol	Can severely irritate and burn the skin and eyes, with possible eye damage. Can irritate the nose, throat, and lungs, and cause coughing and shortness of breath. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema).
n-Nonane	Can cause irritation of the skin, eyes, nose, and throat, coughing, and shortness of breath. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema), dizziness, lightheadedness, uncoordinated behavior, and fainting.
alpha-Pinene	Can cause skin, eye, nose, and throat irritation, coughing, wheezing, headache, nausea, and vomiting. Very high exposure may affect the nervous system causing loss of coordination, dizziness, confusion, seizures, and coma. alpha-Pinene can irritate the lungs - repeated exposure may cause bronchitis to develop. A skin allergy may occur with itching, redness, and/or an eczema-like rash. If an allergy develops, very low future exposure can trigger symptoms. alpha-Pinene may also damage the kidneys.
Acetaldehyde	Can irritate the skin causing a rash or burning feeling on contact. Can also irritate the eyes, nose, lungs, and throat, cause severe eye burns, and coughing and/or shortness of breath. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema). Exposure to high concentrations can also cause headache, dizziness, lightheadedness, and fainting. Acetaldehyde may be a carcinogen in humans since it has been shown to cause cancer of the nose and larynx

Table 3: Known health effects of compounds detected in Upper Ojai and Lost Hills	
	in animals. Acetaldehyde may be a teratogen (causing malformation in embryos) in humans since it is a teratogen in animals. Acetaldehyde may cause a skin allergy - if an allergy develops, very low future exposure can cause itching and a skin rash. Repeated exposure may cause chronic irritation of the eyes leading to permanent damage. Acetaldehyde can irritate the lungs - repeated exposure may cause bronchitis to develop.
n-Heptane	Can cause irritation of eyes, nose, and throat, headache, lightheadedness, dizziness, lack of coordination, loss of consciousness, loss of appetite, and nausea. Repeated exposure may cause skin rash, dryness, and redness. N-Heptane may affect the nervous system.
Toluene	Can cause eye, skin, nose, and throat irritation, coughing, and wheezing. Toluene may affect the nervous system causing trouble concentrating, headaches and slowed reflexes. Higher levels can cause dizziness, lightheadedness, and fainting. Toluene may be a teratogen in humans since it is a teratogen in animals. Prolonged or repeated exposure can cause drying and cracking of the skin, with redness and a skin rash. Repeated exposure may cause liver, kidney and brain damage.
Unidentified Siloxane	No data available
n-Nonanal	No data available
Dodecane (C12H26)	No data available
Ethyl Acetate	Can cause irritation of skin, eyes, nose, and throat. Exposure to high levels can cause dizziness, lightheadedness, and fainting. Ethyl Acetate may decrease fertility in males. Repeated contact can cause drying and cracking of the skin. Long-term exposure can affect the liver and kidneys.
Decalin (C10H18)	No data available
Tetramethylbenzene	No data available
1-Methyldecalin (C11H20)	No data available
Didichlohexyl (C12H22)	No data available
1-Trydecyne (C13H24)	No data available

Health Surveys

In Lost Hills, a total of 27 health surveys were collected. One participant chose to stay anonymous. The youngest participant was 5 years old, while the oldest was 71 years old. The longest a person has resided in Lost Hills is 20 years, with the shortest being 3 years. Female participation in the survey was greater, with 55.5% of the surveys; males completed 44.5% of the surveys. All participants live in the Lost Hills area (zip code 93249).

92.3% reported identifying odors in their homes and community in Lost Hills. Odors were described as petroleum, burning oil, rotten eggs, chemicals, chlorine or bleach, a sweet smell, sewage, and ammonia.

Representative of the demographics in Lost Hills, 81% of participants completed the survey in Spanish; 19% completed the survey in English. Due to its close proximity to the Lost Hills oil field, 81% of participants mentioned living less than 1 mile from a well or other oil facility, with 52% of those reporting that they lived less than 0.5 miles from a well or other oil facility. Agriculture is a major employer in the community, and a majority of respondents currently work, or have worked, in the surrounding fields. Because of this, 59% of respondent reported being exposed to other chemicals, primarily pesticides and other agricultural chemicals.

Several residents reported their medical history, which included thyroid problems (7%), diabetes (7%), asthma (11%), and sinus infections (19%). A young female participant, born in Lost Hills, has suffered from spinal bifida since birth. All respondents are non-smokers.

Of all respondents, 92.3% reported identifying odors in their homes and community; 11% reported odors 2 to 3 times per week, with 82% reporting odors every day. Odors were described as petroleum, burning oil, rotten eggs, chemicals, chlorine or bleach, a sweet smell, sewage, and ammonia. Participants reported that when odors were detected in the air, symptoms included headache (63%), nausea/dizziness (37%), burning or watery eyes (37%), and throat and nose irritation (18.5%). One respondent reported vomiting when odors are detected.

Two participants reported having stillborn children, two participants reported their children having learning disabilities after birth, and one participant reported their child as having low birth weight at birth. This data serves as exploratory information, and can serve to inform follow up studies on the rates and causes of birth disorders in both project communities.

In order to identify current health problems affecting the community, the survey explored variations through checklists of health symptoms grouped into categories such as skin, neurological, and reproductive. Table 4 represents the categories and percentage of the participants who identified as suffering from health symptoms in those categories in Lost Hills, based on the 27 surveys collected.

Kern County irrigation canal and almond groves.

Pump jack in a field in Ventura County.

Table 4: Percentage of participants reporting health symptoms after exposure to hydrocarbons odors in Lost Hills	
Category	**Percentage of respondents suffering from health symptoms in the category**
Skin – e.g. rashes, irritation, dry skin, etc.	70
Vision/Eyes – e.g. eye burning, dry eyes, frequent tearing of the eyes, etc.	67
Sinus/Respiratory – e.g. wheezing, sinus problems, chronic cough, etc.	59
Behavior/Mood/Energy – e.g. increased fatigues, depression, anxiety, etc.	52
Digestive/Stomach – e.g. abdominal pain, diarrhea, vomiting, etc.	44
Muscles/Joints – e.g. arthritis, muscles aches, reduced muscle strength, etc.	33
Neurological – e.g. loss of memory, balance difficulty, dizziness, etc.	30
Ear/Nose/Mouth – e.g. hearing loss, nosebleeds, discoloration of teeth, etc.	26
Kidney/Urological – e.g. frequent urination, discolored urine, blood in urine, etc.	22
Other – e.g. severe headaches, fainting.	19
Lymphatic/Thyroid – e.g. lumps or swelling in neck, armpit, or groin, excessive sweating, etc.	15
Reproductive – e.g. menstrual disturbances, vaginal discharge, infertility, etc.	7
Immunological – e.g. frequent infections, poor wound healing, fevers of unknown cause, etc.	4
Cardiological/Circulatory – e.g. stroke, irregular heart beat, high blood pressure, etc.	4

In Upper Ojai, participation was smaller, with a total of 13 health surveys collected. Only two participants chose to provide their full names, while the majority decided to stay anonymous. The youngest participant was 9 years old, while the oldest was 88 years old. The longest a person has resided in Upper Ojai is 35 years, with the shortest being 8 months. Female participation in the survey was greater, with 61.5% surveys; males completed 38.5% of the surveys. All participants live in the Upper Ojai area (bisected by zip codes 93023 and 93060).

There are dozens of wells close to homes and in private properties in Upper Ojai. Due to this, 61.5% of participants mentioned living less than 0.25 miles from a well or other facility, with one

participant reporting a well 100 yards from her home. Only one participant reported being exposed to other chemicals, which included film development chemicals.

Several residents reported medical history, including sinus/respiratory infections (23%), thyroid problems (15%), diabetes (8%), arthritis, (8%), autoimmune disorders (8%), and cancer (15%). Of all respondents, 61.5% reported identifying odors in their homes and community 2 to 3 times per month. Odors were described as a gasoline smell, combined with the smells of acids. Participants reported that when odors are detected in the air, symptoms include nausea/dizziness (15%), nosebleeds (8%), and throat and nose irritation (8%). Two participants reported having stillborn children.

61.5% reported identifying odors in their homes and community in Ojai. Odors were described as a gasoline smell combined with the smells of acids.

Table 5 represents the categories and percentage of the participants who identified as suffering from health symptoms in those categories in Upper Ojai, based on the total of 13 surveys collected.

Pump jack and tanks, Ventura County.

Table 5: Percentage of participants reporting health symptoms after exposure to hydrocarbons odors in Upper Ojai	
Category	**Percentage of respondents suffering from health symptoms in the category**
Sinus/Respiratory – includes wheezing, sinus problems, chronic cough, etc.	54
Muscles/Joints – includes arthritis, muscles aches, reduced muscle strength, etc.	38
Neurological – includes loss of memory, balance difficulty, dizziness, etc.	38
Digestive/Stomach – includes abdominal pain, diarrhea, vomiting, etc.	31
Ear/Nose/Mouth – includes hearing loss, nosebleeds, discoloration of teeth, etc.	31
Behavior/Mood/Energy – includes increased fatigues, depression, anxiety, etc.	31
Reproductive – includes menstrual disturbances, vaginal discharge, infertility, etc.	15
Skin – includes rashes, irritation, dry skin, etc.	8
Vision/Eyes – includes eye burning, dry eyes, frequent tearing of the eyes, etc.	8
Cardiological/Circulatory – includes stroke, irregular heartbeat, high blood pressure, etc.	8
Other – includes severe headaches, fainting, etc.	8
Kidney/urological – includes frequent urination, discolored urine, blood in urine, etc.	0
Lymphatic/Thyroid – includes lumps or swelling in neck, armpit, or groin, excessive sweating, etc.	0
Immunological – includes frequent infections, poor wound healing, fevers of unknown cause, etc.	0

The medical information identified by respondents of both communities in the surveys cannot be directly attributed to oil and gas production, but the reported symptoms are consistent with health impacts associated with exposure to the compounds detected during air sampling.[63] Research has linked exposure to oil and gas emissions with sub-chronic health effects, adverse

birth outcomes, as well as higher prevalence of symptoms such as throat and nasal irritation, sinus problems, eye burning, severe headaches, persistent cough, skin rashes, and frequent nose bleeds.[64]

All respondents, except one, have been living in these communities for at least a year, allowing time for exposure to air contaminants that arise from oil and gas production. Although a complete picture of community-wide impacts cannot be obtained due to the number of surveys collected, the information begins to fill some of the data gaps that exist, helping residents identify a potential source of the negative health impacts they are suffering.

Cotton fields bordered by pump jacks, Kern County.

Conclusions

Using a combination of FLIR camera filming, air sampling, and health surveys, the results show that the communities of Upper Ojai in Ventura County, and Lost Hills in Kern County, are being exposed to air contaminants typically associated with oil and gas production. These contaminants may be negatively affecting the health of the residents, and pose a serious risk of long-term exposure and public health if nothing is done to mitigate their effects. Since the frequency and number of samples was limited, the results of this investigation should be viewed as a snapshot of air emissions from two communities near oil and gas development, and their potential impacts on public health, and not as a generalizable result.

FLIR camera filming revealed visible emissions from several oil and gas facilities. The case of the well abandonment in Upper Ojai showed that operators are failing to follow and enforce health and safety procedures for their workers. Air sampling revealed the presence of 15 dangerous health associated compounds known to have negative effects on human health, as well as 11 compounds for which no data is available. Additionally, sampling revealed the presence of a compound that could not be identified by the lab. Health surveys revealed data on the frequency of odors experienced by the communities—every day in Lost Hills—and the health symptoms that arise from odors caused by oil and gas development.

As seen in the results from the air sampling and health surveys, residents in both study communities are suffering from odors, oil and gas development close to their homes, and show evidence of health problems that are consistent with the oil and gas contaminants detected in each community. The results show that negative health impacts from oil and gas development can occur regardless of differential community demographics.

Although emissions detected during air sampling did not exceed the short-term ESLs, trimethylsilanol did exceed the long-term ESLs in five of the samples. Additionally, isoprene exceeded the long-term ESL in three of the samples collected. The results indicate that communities of Upper Ojai and Lost Hills are being exposed at levels above the recommended long-term ESLs. Both of these chemicals are associated with skin, eye, and respiratory irritation, which are common health problems in both communities.

The sampling work conducted represents a "snapshot in time," and does not take into account other large releases that may occur at other times, or the cumulative health effects of releases into an already impaired air shed, such as the one that exists in this region of California. Scientific research has not determined how the human body reacts to continuous, low-level exposure over extended periods of time, such as the 35 years one of the participants in the survey has lived close to oil and gas development. Additionally, the cumulative effects of combined exposure to the 27 compounds detected during air sampling, including the 11 compounds that do not have health data, and the one that could not be identified by a certified laboratory, can prove to be a continued risk to public health, as no related scientific studies have been conducted.

Community Follow Up

Upon completion of the health assessment, we began the process of bringing the findings to the communities featured in this report, since community engagement and response is a central part of the arc of this project.

Lost Hills

At the initial community meeting, held on October 15, 2014, eight residents sought basic health information. The group consisted of monolingual Spanish speakers with an average of 4th grade education. The group was most concerned with air quality impacts on lungs, chronic obstructive pulmonary disease (COPD), diabetes, and cancer. Four residents expressed concern about depression and their inability to "cope" with everyday stressors.

At this stage of the engagement process, a handful of community members are willing to shape the next stage and help encourage participation. They asked for larger meetings to invite friends and relatives to learn about air quality, community monitoring, and water quality. The primary goal is to address specific local concerns related to health and wellness, as well as learn about how to address specific medical concerns and identify and gain access to adequate health services.

Upper Ojai

The community meeting in Upper Ojai, held on October 13, 2014, consisted of a larger number of participants, thirteen in total. Unlike their counterparts in Lost Hills, the Ojai residents are predominately white, middle to upper middle class, and have a minimum of an undergraduate education. The participants viewed the community meeting as an opportunity to develop working/research groups to investigate methodologies to test air for contaminants.

The engagement level of the Upper Ojai residents is more as decision makers. They are members of local associations, boards, or professional organizations. At least one is a member of an investigative research group. They are prepared to utilize a range of mechanisms to facilitate the widest possible participation from the local community and their collective networks, both for addressing local issues and influencing statewide and regional policies.

Recommendations

Additional air monitoring near oil and gas operations is needed in California, and in the two communities in this project. Ongoing, consistent and accurate air quality data should be a priority of state regulators in order to better understand the impacts of oil and gas development on California communities. Monitoring stations set up to specifically distinguish emissions associated with oil and gas production from ambient air quality are necessary to understand the source of the emissions. Stations throughout oil and gas areas, such as oil fields, disposal areas, and processing facilities, will allow for better data collection. Detecting such emission is vital in order to reduce their impact on California's air quality, and fully protect communities. Such data, when provided publicly in an easily understandable format can aid in efforts to increase transparency, raise awareness, and allow the public to protect themselves. Additionally, such data can be used to further long-term studies to fully understand the health impacts on California's communities.

An independent, in-depth study that accounts for all major variables should be conducted to understand how oil and gas development is affecting communities throughout California. This includes long-term exposures, cumulative exposures, and the effects of combined exposure to multiple contaminants over the short and long-term. Additionally, communities must have access to health service providers specifically trained to deal with their unique medical symptoms, and be given a voice as to how natural resources surrounding their communities are exploited. Without a proper understanding of these issues, and ways to solve them, problems will continue to affect not only California's most vulnerable communities, but communities across all demographics.

Pump jack in Kern County.

As long as oil and gas facilities function, communities will be at risk. Monitoring and long-term scientific studies are necessary while these facilities are operational. It is important to consider a multi-faceted approach to solve the problems facing California's communities because of oil and gas development. Proper scientific studies, comprehensive monitoring, involved grassroots communities, and regulatory agencies that fully protect citizens, can lead to a prosperous future premised on protection of public health and the environment.

Additional Resources

Scientists, researchers, and organizations are currently looking into how oil and gas development affects public health. Further research is being conducted into additional effects from oil and gas development, including water, soil, climate change, economics, environmental justice, transportation via rail, social impacts, regulatory efficiency, and seismic activity, among others.

The following reports provide information on the negative impacts posed by oil and gas development and well stimulation.

- Warning Signs: Toxic Air Pollution Identified at Oil and Gas Sites
- Hydraulic Fracturing Stimulations and Oil Drilling Near California Schools and within School Districts Disproportionately Burdens Hispanic and Non-White Student
- Drilling Deeper: A Reality Check on the U.S. Government Forecasts for a Lasting Tight Oil & Shale Gas Boom
- Drilling in California: Who's at Risk
- Monster Wells: Despite Drought, Hundreds of Fracking Sites Used More Than 10 Million Gallons of Water
- In the Pits: Oil and Gas Wastewater Disposal into Open Unlined Pits and the Threat to California's Water and Air
- Blackout in the Gas Patch: How Pennsylvania Residents are Left in the Dark on Health and Enforcement
- On Shaky Ground: Fracking, Acidizing, and Increased Earthquake risk in California

Various national, state, and local organizations are engaged in the issue of fracking, and many advocate for the protection of public health and the environment from the dangers of oil and gas development.

- Californians Against Fracking
- CA Frack Facts
- Center for Biological Diversity
- Center on Environmental Health
- Citizens Coalition for a Safe Community
- Citizens for Responsible Oil and Gas
- Clean Water Action/ Clean Water Fund
- Earthjustice
- Earthworks
- Environmental Defense Center
- Environmental Working Group

- Environment California
- FracTracker Alliance
- Food and Water Watch
- Global Community Monitor
- Natural Resources Defense Council
- Physicians for Social Responsibility
- Physicians, Scientists, and Engineers for Healthy Energy
- Post Carbon Institute
- ShaleTest
- Sierra Club
- The Center on Race, Poverty and Environment
- The Endocrine Exchange

Endnotes

[1] Srebotnjak, Tanja, Rotkin-Ellman, Miriam. (2014). *Drilling in California: Who's at Risk?* Natural Resources Defense Council. Retrieved from website: http://www.nrdc.org/health/files/california-fracking-risks-report.pdf

[2] Freeport-McMoran Oil and Gas. (2013). *History of Inglewood Oil Field.* Retrieved from website: http://www.inglewoodoilfield.com/history-future-of-inglewood/

[3] Srebotnjak, Tanja, Rotkin-Ellman, Miriam. (2014). *Drilling in California: Who's at Risk?* Natural Resources Defense Council. Retrieved from website: http://www.nrdc.org/health/files/california-fracking-risks-report.pdf

[4] Department of Conservation. (2013). *Codes and Regs References – California Codes and Regulations.* Retrieved from website: http://www.conservation.ca.gov/index/Pages/coderegs.aspx

[5] Harold F. Williamson et al. (1963). The American Petroleum Industry the Age of Energy 1899-1959. p 17.

[6] Department of Conservation. (2014). *Oil and Gas Production History in California.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/history/History_of_Calif.pdf

[7] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2014). *2013 Preliminary Report of California Oil and Gas Statistics.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2013/PR03_PreAnnual_2013.pdf

[8] U.S. Energy Information Administration. (2014). *Petroleum and Other Liquids – California Field Production of Crude Oil.* Retrieved from website: http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFPCA2&f=A

[9] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2014). *2013 Preliminary Report of California Oil and Gas Statistics.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2013/PR03_PreAnnual_2013.pdf

[10] Department of Conservation. (2014). *Oil and Gas Production History in California.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/history/History_of_Calif.pdf

[11] Environmental Defense Center. (2011). *Offshore* Oil. Retrieved from website:

http://www.edcnet.org/learn/current_cases/offshore_oil/

[12] Clarke, Keith C., Hemphill, Jeffrey J. (2002). *The Santa Barbara Oil Spill, A Retrospective.*

Yearbook of the Association of Pacific Coast Geographers, University of Hawai'i Press,

vol. 64, pp. 157-162. Retrieved from website: http://www.geog.ucsb.edu/~kclarke/Papers/SBOilSpill1969.pdf

[13] Leavenworth Stuart. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=17291

[14] CBS Interactive. (2014). *Crews Clean up to 10,000 Gallons of Crude Oil on California Streets.* Retrieved from website: http://www.cbsnews.com/news/50000-gallons-of-crude-oil-spill-onto-los-angeles-california-street/

[15] Barrios, Henry. (2013). *Aera Starrh Lawsuit Goes to Jury.* Bakersfield Californian. Retrieved from website: http://www.bakersfieldcalifornian.com/business/kern-gusher/x837007080/Aera-Starrh-lawsuit-goes-to-jury

[16] Cox, John. (2014). *State Poised to Shut Down 11 Local Oil Injection Wells.* Bakersfield Californian. Retrieved from website: http://www.bakersfieldcalifornian.com/business/kern-gusher/x634489929/State-poised-to-shut-down-11-local-oil-injection-wells

[17] Nemec, Richard. (2014). *California Oil, Gas Drilling Wastewater Under Renewed Scrutiny.* Natural Gas Intel Shale Daily. Retrieved from website: http://www.naturalgasintel.com/articles/99283-california-oil-gas-drilling-wastewater-under-renewed-scrutiny

[18] Shonkoff, Seth B., Hays, Jake, Madelon, Fikel L. (2014). *Environmental Public Health Dimensions of Shale and Tight Gas Development.* Retrieved from website: http://dx.doi.org/10.1289/ehp.1307866

[19] Maryland Institute for Applied Environmental Health, School of Public Health, University of Maryland, College Park. (2014). *Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland.* Retrieved from website: http://phpa.dhmh.maryland.gov/OEHFP/EH/SitePages/MarcellusShale.aspx.

[20] Bamberger, Oswald. (2012) *Impacts of Gas Drilling on Human and Animal Health.* New Solutions 22:51–77. Retrieved from website: http://www.psehealthyenergy.org/data/Bamberger_Oswald_NS22_in_press.pdf

[21] Adgate, JL, Goldstein, BD, McKenzie, LM. (2014). *Potential public health hazards, exposures and health effects from unconventional natural gas development.* Environ Sci Technol. doi: 10.1021/es404621d. Retrieved from website: http://pubs.acs.org/doi/abs/10.1021/es404621d

[22] Mckenzie, LM, Guo, R, Witter, RZ, et al. (2014). *Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado.* Environ Health Perspect. doi: 10.1289/ehp.1306722. Retrieved from website: http://ehp.niehs.nih.gov/1306722/ Steinzor, N., Subra, W., Sumi, L. (2013). *Investigating Links Between Shale Gas Development an Health impacts Through a Community Survey Project in Pennsylvania.* New Solutions, Vol. 23(1) 55-83. Retrieved from website: http://www.prendergastlibrary.org/wp-content/uploads/2013/03/New-Solutions-23-1-Binder.pdf

[23] Colborn, T, Kwiatkowski, C, Schultz, K, et al. (2011). *Natural Gas Operations from a Public Health Perspective.* Hum Ecol Risk Assess An Int J 17:1039–1056. doi: 10.1080/10807039.2011.605662. Retrieved from website:

http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/fracking%20chemicals%20from%20a%20public%20health%20perspective.pdf. Colborn, T, Schultz, K, Herrick, L, Kwiatkowski, C. (2014). *An Exploratory Study of Air Quality Near Natural Gas Operations.* Hum Ecol Risk Assess An Int J 20:86–105. doi: 10.1080/10807039.2012.749447. Retrieved from website: http://endocrinedisruption.org/assets/media/documents/HERA12-137NGAirQualityManuscriptforwebwithfigures.pdf

[24] Eastern Research Group, Inc. and Sage Environmental Consulting, L.P. (2011). *City of Fort Worth Natural Gas Air Quality Study, Final Report*. Retrieved from website:http://fortworthtexas.gov/uploadedFiles/Gas_Wells/AirQualityStudy_final.pdf.

[25] McKenzie, Lisa M., Witter, Roxanna Z. Newman, Lee S. Adgate, John L. (2012). *Human health risk assessment of air emissions from development of unconventional natural gas resources.* Science of the Total Environment. Sci Total Environ 424:79–87. doi: 10.1016/j.scitotenv. Retrieved from website: http://cogcc.state.co.us/library/setbackstakeholdergroup/Presentations/Health%20Risk%20Assessment%20of%20Air%20Emissions%20From%20Unconventional%20Natural%20Gas%20-%20HMcKenzie2012.pdf

[26] Durham, David L. (1998). California's Geographic Names: A Gazetteer of Historic and Modern Names of the State. Word Dancer Press. p. 1066.

[27] Weatherbase. (2014). *Lost Hills, California*. Retrieved from Website: http://www.weatherbase.com/weather/weather-summary.php3?s=206540&cityname=Lost+Hills%2C+California%2C+United+States+of+America&units=.

[28] U.S. Census Bureau. (2014). *2010 Census Interactive Population Search – CA – Lost Hills CDP*. Retrieved from website: http://www.census.gov/2010census/popmap/ipmtext.php?fl=06:0644280

[29] U.S. Census Bureau. (2014). *American Factfinder – Lost Hills CDP, California.* Retrieved from website: http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml

[30] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2014). *2013 Preliminary Report of California Oil and Gas Statistics.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2013/PR03_PreAnnual_2013.pdf

[31] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2014). *2013 Preliminary Report of California Oil and Gas Statistics.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2013/PR03_PreAnnual_2013.pdf

[32] Groundwater Protection Council, Interstate Oil and Gas Compact Commission. (2011). *FracFocus Chemical Disclosure Registry – Find a Well.* Retrieved from website: http://www.fracfocusdata.org/DisclosureSearch/StandardSearch.aspx

[33] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. *Well Stimulation Notice Index.* Retrieved from website: http://maps.conservation.ca.gov/doggr/iwst_index.html

[34] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2014). *Division of Oil, Gas, and Geothermal Resources Well Finder*. Retrieved from website: http://www.conservation.ca.gov/dog/Pages/WellFinder.aspx

[35] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2014). *2013 Preliminary Report of California Oil and Gas Statistics.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2013/PR03_PreAnnual_2013.pdf

[36] Tillerson, J.R., Wawersik, W.R. (1992). *Rock Mechanics Proceedings of the 33rd U.S. Symposium.* Retrieved from website: http://www.terralog.com/article/Reservoir%20Compaction%20and%20Surface%20Subsidence%20above%20Lost%20Hills%20Field,%20California.pdf

[37] Land, Paul E. Department of Conservation, Division of Oil and Gas. (1990). *Lost Hills Oil Field.* Retrieved from website: ftp://ftp.consrv.ca.gov/pub/oil/publications/tr32.pdf

[38] San Joaquin Valley Geology. (2014). *Famous Gushers of California.* Retrieved from website: http://www.sjgs.com/gushers.html#losthills

[39] Weather, Wind, Tides, and Radar Services Pty LTD. (2014). *Lost Hills – Kern County Airport.* Retrieved from website: http://wind.willyweather.com/ca/kern-county/lost-hills--kern-county-airport.html

[40] Western Regional Climate Center. (2013). *Ojai, California.* Retrieved from website: http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca6399

[41] U.S. Census Bureau. (2014). *State and County Quickfacts – Ojai (city), California*. Retrieved from website: http://quickfacts.census.gov/qfd/states/06/0653476.html

[42] U.S. Census Bureau. (2014). *State and County Quickfacts – Ojai (city), California*. Retrieved from website: http://quickfacts.census.gov/qfd/states/06/0653476.html

[43] U.S. Census Bureau. (2014). *State and County Quickfacts – Ojai (city), California*. Retrieved from website: http://quickfacts.census.gov/qfd/states/06/0653476.html

[44] Nelson, Michael, P. (2001). *Thomas Bard, Josiah Stanford, and the 1860's Hunt for California Crude.* Pacific Petroleum Geologist Newsletter, no. 2, p. 16-17. Retrieved from website: http://www.ventura.org/rma/planning/pdf/permits/oil/Calif_Crude.pdf

[45] Nelson, Michael, P. (2001). *Thomas Bard, Josiah Stanford, and the 1860's Hunt for California Crude.* Pacific Petroleum Geologist Newsletter, no. 2, p. 16-17. Retrieved from website: http://www.ventura.org/rma/planning/pdf/permits/oil/Calif_Crude.pdf

[46] Nelson, Michael, P. (2001). *Thomas Bard, Josiah Stanford, and the 1860's Hunt for California Crude.* Pacific Petroleum Geologist Newsletter, no. 2, p. 16-17. Retrieved from website: http://www.ventura.org/rma/planning/pdf/permits/oil/Calif_Crude.pdf

[47] Ventura County General Plan. *History of Oil Development in Ventura County*. Retrieved from website: http://www.ventura.org/rma/planning/pdf/permits/oil/History_of_Oil.pdf

[48] Department of Conservation, Division of Oil, Gas, and Geothermal Resources. (2011). Online Production and Injection Query for State of California, Department of Conservation, Division of Oil, Gas, and Geothermal Resources. Retrieved from website: http://opi.consrv.ca.gov/opi/opi.dll/Search?UsrP_ID=100144354&SortFields=WMtr_APINumber&NewSortFields=&FormStack=Main%2COperator%2CSum&PriorState=Opr__Id%3D100000245&Action=%3C%3C+Back

[49] Groundwater Protection Council, Interstate Oil and Gas Compact Commission. (2011). *FracFocus Chemical Disclosure Registry – Find a Well.* Retrieved from website: http://www.fracfocusdata.org/DisclosureSearch/StandardSearch.aspx

[50] Weather, Wind, Tides, and Radar Services Pty LTD. (2014). *Ojai, California.* Retrieved from website: http://wind.willyweather.com/ca/ventura-county/ojai.html

[51] Srebotnjak, Tanja, Rotkin-Ellman, Miriam. (2014). *Drilling in California: Who's at Risk?* Natural Resources Defense Council. Retrieved from website: http://www.nrdc.org/health/files/california-fracking-risks-report.pdf

[52] Steinzor, N., Subra, W., Sumi, L. (2013). *Investigating Links Between Shale Gas Development an Health impacts Through a Community Survey Project in Pennsylvania.* New Solutions, Vol. 23(1) 55-83. Retrieved from website: http://www.prendergastlibrary.org/wp-content/uploads/2013/03/New-Solutions-23-1-Binder.pdf

[53] Wilson, S., Subra, W., Sumi, L. (2013). Reckless Endargement While Fracking the Eagle Ford – Government Fails, Public health Suffers and Industry Profits from the Shale Oil Boom. Earthworks Oil and Gas Accountability Project. Retrieved from website: http://www.earthworksaction.org/files/publications/FULL-RecklessEndangerment-sm.pdf

[54] FLIR Systems, Inc. (2014). *FLIR Product Literature Download Area.* Retrieved from website: http://www.flir.com/thermography/americas/ca/view/?id=58215

[55] ALS Global. (2014). *Environmental Overview.* Retrieved from website: http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental

[56] US. Environmental Protection Agency. (1999). Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). Retrieved from website: http://www.epa.gov/ttnamti1/files/ambient/airtox/to-15r.pdf

[57] U.S. environmental Protection Agency. (1984). Method for the Determination of Volatile Organic Compounds in Ambient Air Using Cryogenic Preconcentration Techniques and Gas Chromatography with Flame Ionization and Electron Capture Detection. Retrieved from website: http://www.epa.gov/ttnamti1/files/ambient/airtox/to-3.pdf

[58] University of Virginia, Department of Chemistry. *Wilma Subra, President Subra Company.* Retrieved from website: http://chem.virginia.edu/wp-content/uploads/2009/04/Subra-Bio.pdf

[59] Decalin Chemicals, LLC. (2014). *Plugs and Exhaust System 25 Hours of Using Decalin.* Retrieved from website: http://decalinchemicals.com/plugs-and-exhaust-system-25-hours-of-using-decalin/

[60] Texas Commission on Environmental Quality. (2014). *About Effect Screening Levels (ESLs).* Retrieved from website: http://www.tceq.texas.gov/toxicology/esl/ESLMain.html

[61] Texas Commission on Environmental Quality. (2014). *About Effect Screening Levels (ESLs).* Retrieved from website: http://www.tceq.texas.gov/toxicology/esl/ESLMain.html

[62] State of New Jersey, Department of Health. (2014). *Right to Know Hazardous Substances Factsheets.* Retrieved from website: http://web.doh.state.nj.us/rtkhsfs/factsheets.aspx?lan=english&alph=A&carcinogen=False&new=False

[63] State of New Jersey, Department of Health. (2014). *Right to Know Hazardous Substances Factsheets.* Retrieved from website: http://web.doh.state.nj.us/rtkhsfs/factsheets.aspx?lan=english&alph=A&carcinogen=False&new=False

[64] Mckenzie, LM, Guo, R, Witter, RZ, et al. (2014). *Birth Outcomes and Maternal Residential Proximity to Natural Gas Development in Rural Colorado.* Environ Health Perspect. doi: 10.1289/ehp.1306722. Retrieved from website: http://ehp.niehs.nih.gov/1306722/ Steinzor, N., Subra, W., Sumi, L. (2013). *Investigating Links Between Shale Gas Development an Health impacts Through a Community Survey Project in Pennsylvania.* New Solutions, Vol. 23(1) 55-83. Retrieved from website: http://www.prendergastlibrary.org/wp-content/uploads/2013/03/New-Solutions-23-1-Binder.pdf

[65] State of New Jersey, Department of Health. (2014). *Right to Know Hazardous Substances Factsheets.* Retrieved from website: http://web.doh.state.nj.us/rtkhsfs/factsheets.aspx?lan=english&alph=A&carcinogen=False&new=False

APPENDIX A:
Air Regulatory Structure in California

In California, air emissions fall under the purview of the California Air Resources Board (ARB). ARB regulates all aspects of air emissions and air quality for non-stationary sources in the state, and ensures compliance with federal and state regulations.[1] Stationary sources, including oil and gas production, storage, transport, and disposal facilities, are regulated by the 35 local Air Pollution Control Districts, or Air Quality Management Districts.[2]

In Ventura County, the Ventura County Air Pollution Control District (VCAPCD) regulates air quality. Formed in 1968 as a result of severe air quality issues in the county, VCAPCD "works with business and industry to reduce emissions from new and existing sources."[3] Currently, Ventura County does meet federal standards for ozone, and does not meet state standards for ozone and particulate matter.[4]

Oil production is regulated by Rule 71.1 – Crude Oil Production and Separation, originally adopted in 1978, and last revised in 1992. The rule requires the use of a vapor recovery system for all storage tanks, wash tanks, produced water tanks, and wastewater separators. The system is to direct all vapors to a fuel gas system, a sales gas system, or to a flare. Projects that are exempt from vapor recovery systems must have tanks with a solid roof that is maintained in good condition, and all tanks are to be equipped with sealed hatches and pressure-vacuum relief valves.[5]

The regulations provide exemptions to facilities that began production prior to 1978, temporary facilities operating for less than 90 days, portable facilities, and facilities undergoing maintenance operations. VCAPCD may also provide exemptions to facilities that have "demonstrated to the satisfaction of the Air Pollution Control Officer that the maximum degree of achievable emission reduction has already taken place,"[6] leaving this to the discretion of the permitting officer. Additionally, if an operator can demonstrate through a cost evolution analysis that installing and maintaining a vapor recovery system is not economically feasible, an exemption may be granted.[7]

Rule 74.10 – Components at Crude Oil and Natural Gas Production and Processing Facilities, regulates leaks at oil and gas facilities in Ventura County. Originally written in 1981, it was last revised in 1998. In manned facilities, inspections for leaks on all operating pump seals, compressor seals, pressure relief valves, and polished rod stuffing boxes shall take place at least once a day. Unmanned facilities must be inspected at least once a week.[8]

All other components not listed above must be inspected every quarter, or once per year for inaccessible components, by using EPA Method 21. If during 2 consecutive calendar quarters the operator can prove that they have successfully operated and maintained all components at the facility, an inspection exemption may be granted so that quarterly monitoring can be reduced to once per year.[9] The operator may inspect the facilities with or without equipment, yet the possibility of detecting leaks without proper equipment is low. Once a leak is detected in components, the operator must fix it within a certain timeframe, depending on the type and quantity of the leak.[10] Table A depicts the repair periods the industry has to repair leaks at oil and gas facilities in areas where the VCPACD maintains jurisdiction.

Type of Leak	Time Period (days)[a]	
	Onshore	Offshore
Minor Gas Leak (1,000 to 10,000 ppm)	14	14
Major Gas Leak (10,000 to 50,000 ppm)	5	5
Major Gas Leak (>50,000 ppm)	1 [b,c,d]	5 [d]
Major Liquid Leak	1 [b,c]	5
Minor Liquid Leak	2 [b]	5

Table A: VCAPCD Repair Periods. Source – VCAPC

b Unless prohibited by Cal OSHA standards or 29 CFR 1910.

c Components at oil and gas production facilities shall be repaired within two days of leak detection for liquid leaks and within two days of leak measurement for gaseous leaks.

d The repair period may be extended for noncritical components having major leaks (> 50,000 ppm) if the component is removed from service until repaired.

Once the leak is fixed, operators have up to 3 months to notify VCAPCD, and a component must fail at least 5 times within a 12-month period before it is must be replaced. Exemptions may be granted if an operator can demonstrate economic hardship in replacing the faulty component.[11] Although the regulations mention that notices of violation may be granted, there are no specified consequences were an operator not to comply with VCAPCD regulations. Without consequences, regulations are toothless and become unenforceable. As with other regulatory agencies in California, industry may provide their own inspection reports, laboratory analysis, and other data, leading to a system where industry polices itself.

In the San Joaquin Valley, the San Joaquin Valley Air Pollution Control District (SJVAPCD) is responsible for setting air pollution standards. The SJVAPCD prides itself in its mission to "improve the health and quality of life for all Valley residents through efficient, effective, and entrepreneurial air-quality management strategies."[12] Although it calls itself a "leader" in air-pollution control, that is far from true.

In its 2013 *State of the Air* report, the American Lung Association named 7 California cities as having the worst pollution in the country.[13] Of those, 5 were located in the San Joaquin Valley, where most oil and gas production in the state occurs. In the #1 city, Bakersfield, officials have used colored flags to indicate to indicate air quality, ranging from green for good air quality, to red to classify air that air unhealthy for all groups. In 2014, the air became so bad that officials had to implement a new color - "purple," to identify days when air pollution is above red flag levels.[14]

The SJVAPCD has developed no less than 10 sets of rules to regulate oil and gas in the San Joaquin Valley. The rules regulate a range of activities from steam-enhanced production to refineries. For steam-enhanced wells, Rule 4401 allows a certain number of leaks, based on the number of wells that are connected to a volatile organic compound (VOC) recovery system.[xv] The rule does not apply for up to 40 wells that are owned by one company, and are undergoing pilot testing, up to 40 wells undergoing well stimulation, 5 wells owned by a large producer, and 20 wells owned by a small producer. A small producer is defined as an operator who produces less than 6,000 barrels of oil per day within the district.[15] Table B depicts the number of allowable leaks for steam-enhanced production wells that are connected to a VOC collection and control system in areas where the SJVAPCD maintains jurisdiction.

Number of Steam-Enhanced Crude Oil Production Wells Connected to a VOC Collection and Control System	Number of Allowable Leaks
1 to 25	3
26 to 50	6
51 to 100	8
101 to 250	10
251 to 500	15
More than 500	One (1) for each 20 wells tested with a minimum of 50 wells tested.

Table B: SJVAPCD Number of Allowable Leaks. Source - SJVAPCD

Under Rule 4409, adopted in 2005, light crude oil producing facilities are allowed a similar number of leaks. Exemptions are granted for facilities containing a vapor recovery system, and those that are located underground. Components that are found leaking in excess of set standards may still be used, provided that they are at least identified with a tag for repair. Components are only considered to be "leaking" if they reach a certain number of leaks above a threshold per inspection period (Table C). Inspections are to occur once a day for manned facilities, and once a week for unmanned facilities. However, inspectors are not required to use professional equipment, but instead, facilities may be inspected audio-visually, or by hearing or sight.[17]

Component	Maximum Number of Leaks for 200 or fewer Components Inspected*	Maximum Percent or Number of Leaks for more than 200 Components Inspected*
1. Valves	1	0.5% of number inspected
2. Threaded Connections	1	0.5% of number inspected
3. Flanges	1	0.5% of number inspected
4. Pumps	2	1.0% of number inspected
5. Compressors	1	1 leak
6. PRDs	1	1 leak
7. Polished Rod Stuffing Boxes	4	2.0% of number inspected
8. Other Components not listed in items 1, 2, 3, 4, 5, 6, 7, 9, and 10	1	1 leak
9. Pipes at Light Crude Oil Production Facilities or Gas Production Facilities	Maximum Number of Leaks for 200 or fewer production wells inspected	Maximum Number of Leaks for more than 200 production wells inspected
	2	1% of number inspected
10 Pipes at Natural Gas Processing Facilities	Maximum Number of Leaks	
	2	

Table C: Maximum Allowable Number or Percent of Leaking Components Per Inspection Period.

Leaks and other failures of equipment may not always be detected by human senses. In addition to human senses being subjective depending on the person conducting the inspection, they may not always pick up leaks and vapors that are detectable by other equipment, such as a FLIR camera or a portable VOC detector. Although the SJVACPD claims that it strives to meet air quality standards based on science,[18] the rules for mitigating air contamination from oil and gas production leave a lot to be desired.

One of the core values for the SJVAPCD is *"active and effective air pollution control efforts with minimal disruption to the Valley's economic prosperity."*[19] Unfortunately, the economics of oil and gas production seem to take priority over human health and meaningful air pollution control and mitigation. The SJVACPD represents yet another state agency that has been captured by the industry, and presents no real relief and protection to the residents and workers of the San Joaquin Valley.

Endnotes for Appendix A

[1] California Environmental Protection Agency, Air Resource Board. (2014). *Laws and Regulations.* Retrieved from website: http://www.arb.ca.gov/html/lawsregs.htm

[2] California Environmental Protection Agency, Air Resource Board. (2014). *California Air District Directory.* Retrieved from website: http://www.arb.ca.gov/capcoa/roster.htm

[3] Ventura County Ail Pollution Control District. (2006). *About Us.* Retrieved from website: http://www.vcapcd.org/about.htm

[4] Ventura County Ail Pollution Control District. (2006). *About Us.* Retrieved from website: http://www.vcapcd.org/about.htm

[5] Ventura County Air Pollution Control District. (1992). *Rule 71.1 – Crude Oil Production and Separation.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R71-1.PDF

[6] Ventura County Air Pollution Control District. (1992). *Rule 71.1. – Crude Oil Production and Separation.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R71-1.PDF

[7] Ventura County Air Pollution Control District. (1992). *Rule 71.1. – Crude Oil Production and Separation.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R71-1.PDF

[8] Ventura County Air Pollution Control District. (1998). *Rule 74.10 – Components at Crude Oil and Natural Gas Production and Processing Facilities.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R74-10.PDF

[9] Ventura County Air Pollution Control District. (1998). *Rule 74.10 – Components at Crude Oil and Natural Gas Production and Processing Facilities.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R74-10.PDF

[10] Ventura County Air Pollution Control District. (1998). *Rule 74.10 – Components at Crude Oil and Natural Gas Production and Processing Facilities.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R74-10.PDF

[11] Ventura County Air Pollution Control District. (1998). *Rule 74.10 – Components at Crude Oil and Natural Gas Production and Processing Facilities.* Retrieved from website: http://www.arb.ca.gov/DRDB/VEN/CURHTML/R74-10.PDF

[12]San Joaquin Valley Air Pollution Control District. (2011). *About the District.* Retrieved from website: http://www.valleyair.org/General_info/aboutdist.htm

[13] American Lung Association. (2013). *State of the Air.* Retrieved from website: http://www.lung.org/associations/states/california/assets/pdfs/sota-2013/sota-2013-full-report.pdf

[14] Walsh, Brian. (2014). *See the Worst Place to Breathe in America.* TIME Magazine. Retrieved from website: http://time.com/3399134/air-pollution-climate-change-bakersfield-caifornia/

[15] San Joaquin Valley Air Pollution Control District. (2011). *Rule 4401 Steam-Enhanced Crude Oil Production Wells.* Retrieved from website: http://www.valleyair.org/rules/currntrules/R4401%20Clean%20Rule.pdf

[16] San Joaquin Valley Air Pollution Control District. (2011). *Rule 4401 Steam-Enhanced Crude Oil Production Wells.* Retrieved from website: http://www.valleyair.org/rules/currntrules/R4401%20Clean%20Rule.pdf

[17] San Joaquin Valley Air Pollution Control District. (2005). Rule 4409 Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities. Retrieved from website: http://www.valleyair.org/rules/currntrules/r4409.pdf

[18] San Joaquin Valley Air Pollution Control District. (2005). Rule 4409 Components at Light Crude Oil Production Facilities, Natural Gas Production Facilities, and Natural Gas Processing Facilities. Retrieved from website: http://www.valleyair.org/rules/currntrules/r4409.pdf

APPENDIX B
Health Survey – English

Health Survey

Note: Please fill out a separate survey form for each person in your household. If you prefer to remain anonymous, please just note your age, sex, town, and county. Add additional pages if necessary.

Date this form is completed: _____

Name: _____

Age: _____ Sex: [ ] Male [ ] Female

Physical Address:

_____

Town or city: _____

County:_____ State: _____ Zip: _____

Number of people living in your home: Full time _____ Part time_____

May we contact you for further information? Yes _____ No_____

Phone Number: _____ Email address: _____

Best time to contact you: _____

Form completed by (if other than resident): _____

Information provided by (if other than resident): _____

Location Information

1. How long have you lived at your current address? _____

2. Please list the previous places where you have lived:

Town & state _____ ; from _____ to _____

Town & state _____ ; from _____ to _____

Town & state _____ ; from _____ to _____

3. How close do you or did you live to a gas or oil well? _____
Please indicate the operator of the well nearest to your home and any other identification information, such as location (if known):

_____

4. How close do you or did you live to a flare, compressor station, pipeline station, and/or oil/gas

processing facility? _____

Please indicate what type of facility, and the operator of the facility nearest to your home and any other identification information, such as location, permit number, etc. (if known):

_____

_____

5. How close do you or did you live to an impoundment pond (water or waste pit)?

_____

Please indicate the operator of the pit nearest to your home and any other identification information, such as location (if known):

_____

_____

Exposure

6. Please list your occupations over the last 20 years

Occupation/Company	Years (from-to)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

7. Did you handle chemicals or were you exposed to chemicals in the workplace in your occupations over the last 20 years? Yes _____ No _____ Don't know_____

If yes, please list a common or trade chemical name (if known):

Chemical	Years (from-to)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

8. If any family members handled or were exposed to chemicals in the workplace, did any family member bring home chemicals or clothing used when handling and/or exposed to chemicals?
Yes, chemicals used at work were brought home _____
Yes, clothing worn when handling and/or exposed to chemicals, were brought home _____
No _____
Don't know_____

If yes, please list them (if known):

Chemical	Years (from-to)
_____	_____
_____	_____

9. Smoking History

Do you smoke? Yes _____ No _____
Have you smoked in the past? Yes _____ No _____
For how many years? _____
How many packs per day? _____
Do other members of your household smoke?_____

Health Condition

10. Healthy or Sick
Do you consider yourself: Healthy _____ Sick _____
How frequently are you sick? _____ days per week _____ days per month
Do you have access to doctors or other health care providers? Yes _____ No _____

11. Please list any specific illness or medical problem with the year that the problem first developed.

Year	Sinus/Respiratory	Year	Liver	Year	Kidney/Urological
	Bones/Joints/Arthritis		**Ulcers**		**Blood Disorder**
	Thyroid/Lymphatic system		**Cancer (please specify type)**		**Other**
	Heart/Lungs		**Diabetes**		

Odors and Impacts

12. Do you notice odors in the air? Yes _____ No _____
If yes, how frequently do you notice the odors?
Number of times per day: _____
Number of days per week: _____
Number of days per month: _____
Please describe the odors:
_____
_____

13. Do you notice different odors when the wind is blowing from different directions?
Yes _____ No _____

If yes, please describe the different odors associated with the different wind directions:

_____

_____

14. Do you know where or what gas or oil facility the odors are coming from? Yes ___ No ___

If yes, please describe the sources of odors you are experiencing:

_____

_____

15. Please list any health impacts you experience associated with specific odors and the length of time they last. Examples are provided below. Please mark an X on additional symptoms you have experienced.

Odor	Health Impact	Length of Time
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Health Symptoms

	Skin		loss of sense of taste		**Muscles/Joints**
	skin rashes		discoloration of teeth		swollen, painful joints
	skin irritation		metallic taste on cough		joint pain
	Hives		redness or swelling of gums		arthritis
	Boils		discoloration of gums		muscle aches or pains
	sores that won't heal		severe salivation		lumbar (lower back) pain
	dry, cracked red skin		sores or ulcers in mouth		weakness
	many pinpoint dots on skin				reduced muscle strength
	burns on skin		**Sinus/Respiratory**		
	peeling hands and arms		loss of sense of smell		**Neurological**
	thickening of skin layer		frequent shortness of breath		loss of memory
	yellowing of skin		difficulty breathing		forgetfulness
	changes in skin color		wheezing		memory problems
	discolored areas of skin		sinus problems		spelling difficulties
			nasal irritation		decreased motor skills
	Digestive/Stomach		persistent cough		learning problems
	abdominal pain		persistent hoarseness		difficulty in drawing
	persistent abdominal pain		chronic cough		staggering/stumbling
	bleeding from rectum		throat irritation		falling
	change in bowel habits		coughing up blood/sputum		balance difficulty
	black stool				nerve damage

	red blood in stool		**Vision/Eyes**		seizures
	Diarrhea		eye burning		body tremors
	persistent indigestion		burns on eye		trembling of hands/arms
	frequent nausea		conjunctivitis		weakness of hands
	Vomiting		blurred vision		tingling of hands
	vomiting blood		dry eyes		disorientation
	loss of appetite		blindness in either eye		hallucination
	weight loss		severe pain in eyes		dizziness
			chronic eye irritation		slurring of speech when tired
	Kidney/Urological		difficulty in vision		difficulty in concentration
	frequent urination		decrease in vision		
	difficulty in starting urine		frequent tearing of eyes		**Cardiological/Circulatory**
	blood in urine		swelling of eyes		blue lips, nose or skin
	sugar in urine		uncontrolled eye movement		stroke
	discolored urine		loss of ability to see colors		irregular/rapid heart beat
	kidney stones		trembling of eyelids		frequent chest pains
			yellowing of eyes		slow heart beat
	Ear/Nose/Mouth				high blood pressure
	hearing loss				low blood pressure
	ringing in ears				abnormal chest x-ray
	difficulty hearing				prolonged bleeding
	noises in ears				
	frequent nosebleeds				
	Behavior/Mood/Energy		**Lymphatic/Thyroid**		**Other/general**
	increased fatigue/tiredness		lumps or swelling in neck		abnormal blood test
	extreme drowsiness		lumps or swelling in armpit		severe headaches
	sleep disorders		lumps or swelling in groin		fainting
	sleep disturbances		lumps in breast		
	Depression		excessive sweating		
	loss of sexual drive				
	problems in judgment		**Immunological**		
	behavioral changes		frequent infections		
	suicidal thoughts		poor wound healing		
	changes in personality		fevers of unknown cause		
	severe anxiety				
	Tension		**Reproductive**		
	compulsive behavior		abnormal PAP smear		
	agitation		abnormal Mammogram		
	appetite disturbances		discharge from nipple		
	frequent irritation		menstrual disturbances		
	difficulty carrying out activities		bloody vaginal discharge		
			infertility		

Child information (if applicable)

Have you had a child/children born with:
Birth defects: Yes _____ No _____

Learning disorders: Yes _____ No _____
Neurological disorders: Yes _____ No _____
Behavioral disorders: Yes _____ No _____
Memory disorders: Yes _____ No _____
Have you had a stillborn child/children: Yes _____ No _____

Is there anything else you've experienced related to health in your household that you can tell us about (e.g. valley fever, pet/livestock illnesses, others)?

_____
_____
_____
_____
_____

Water resources

- Do you use tap water for drinking? Yes _____ No _____
    - If you answered No, check any reasons that you don't use tap water for drinking
        - Taste _____
        - Odor _____
        - High levels of contaminants _____
        - Please list contaminants (if known): _____
- Do you use tap water for other indoor activities (bathing, washing)? Yes ____ No ____
- Do you use tap water for outdoor use such as gardening, automobile washing, etc.? Yes _____ No
- Have you ever had your water tested for possible contaminants? Yes _____ No _____
    - If yes, please describe why you had water tested

_____

- Does your home have a water filtration system installed to purify water? (Not a Brita filter, but a system integrated into your plumbing).
    - Yes _____
    - No _____
    - If yes, please describe the circumstances that led to the installation of this equipment

_____

Your answers will be kept confidential and not shared with anyone. Thank you for completing this form.

APPENDIX C
Health Survey – Spanish

Encuesta de salud

Nota: Por favor complete un formulario de encuesta para cada persona en su hogar. Si usted prefiere permanecer en el anonimato, por favor, solo escriba su edad, sexo, ciudad y condado. Añadir páginas adicionales si es necesario.

Fecha que se completa este formulario: _____

Nombre: _____

Edad: _____ Sexo: [ ] Hombre [ ] Mujer

Dirección:
_____
Cuidad: _____
Condado:_____ Estado: _____ Código Postal: _____

Numero de personas viviendo en su hogar: Tiempo Completo _____ Tiempo Parcial _____

Te podemos contactar para más información? Si _____ No_____

Numero de teléfono: _____ Correo electrónico: _____

Mejor hora para contactarlo: _____

Formulario completado por (si no es miembro del hogar): _____
Información proveída por (si no es miembro del hogar): _____

<u>Información del hogar</u>

1. ¿Cuánto tiempo ha vivido en su dirección actual? _____

2. Por favor indique los lugares anteriores donde usted ha vivido:

Ciudad y estado _____ ; de _____ a _____

Ciudad y estado _____ ; de _____ a _____

Ciudad y estado _____ ; de _____ a _____

3. ¿Que tan cerca vives a un pozo de gas o un pozo de petróleo? _____

Por favor indique el operador del pozo más cercano a su casa y cualquier otra información de

identificación, tales como la ubicación (si lo conoce):

_____
_____

4. ¿Que tan cerca vives a un pozo, estación de compresión, estación de tubería o planta de procesamiento de gas? _____

Por favor, indique qué tipo de tipo de instalación y el operador de la instalación más cercana a su casa y cualquier otra información de identificación, como la ubicación, número, etc. (si se conoce):

_____
_____

5. ¿Que tan cerca vives a en un estanque de embalse (pozo de agua o residuos)?

_____

Por favor indique el operador del pozo más cercano a su casa y cualquier otra información de identificación, tales como la ubicación (si lo conoce):

_____
_____

Exposición

6. Por favor indique sus trabajos/ocupaciones en los últimos 20 años

Ocupación/Empresa	Años (De-a)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

7. Manejaste químicos o se expusieron a los químicos en el lugar de trabajo en sus ocupaciones en los últimos 20 años? Si _____ No _____ No se _____

En caso afirmativo, por favor lista el nombre común o nombre comercial del químico (si lo conoce):

Producto químico	Años (De-a)
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

8. ¿Si algún miembro de la familia maneja o fueron expuestos a productos químicos en el lugar de trabajo, trajeron los productos químicos a la casa o trajeron ropa usada cuando manejaron o fueron expuestos a productos químicos?
Sí, los productos químicos utilizados en el trabajo se trajeron a casa _____

Sí, ropa usada cuando use o fui expuestos a productos químicos, se trajo a casa _____
No _____
No se _____
En caso afirmativo, por favor lista el nombre común o nombre comercial del químico (si lo conoce):

Producto químico	Años (De-a)
_____	_____
_____	_____
_____	_____
_____	_____

9. Historia de fumar
¿Fuma usted? Si _____ No _____
¿A fumado en el pasado? Si _____ No _____
¿Por cuántos años? _____
¿Cuántos paquetes por día? _____
¿Que a otros miembros de su hogar fuman?_____

Condición de salud

10. Sano o enfermo
¿Te consideras?: Sano _____ Enfermo _____
¿Con qué frecuencia estás enfermo? _____ días por semana _____ días por mes
¿Tienes acceso a médicos u otros proveedores de cuidado de la salud? Si _____ No _____

11. Por favor indique cualquier enfermedad específica o problema médico con el año en que el problema se presento por primera vez.

Año	Sinusal/Respiratorio	Año	Hígado	Año	Riñón/Urológicas
	Huesos/Articulaciones/Artritis		**Úlceras**		**Trastorno de la sangre**
	Sistema linfático/tiroides		**Cáncer (por favor especificar tipo)**		**Otros**
	Corazón/pulmones		**Diabetes**		

Los olores y los impactos

12. ¿Ha notado olores en el aire? Si _____ No _____
En caso afirmativo, ¿con qué frecuencia notas los olores?
Número de veces por día: _____
Número de veces por semana: _____
Número de veces por mes: _____
Por favor, describa los olores:
_____
_____

13. ¿Ha notado diferentes olores cuando el viento sopla desde distintas direcciones?
Si _____ No _____

En caso afirmativo, por favor describir los diferentes olores asociados con las direcciones del viento diferentes:
_____
_____

14. ¿Sabes de que facilidad vienen los olores? Si _____ No _____

En caso afirmativo, por favor describa las fuentes de olores que estás experimentando:
_____

15. Por favor indique cualquier impacto de salud asociado con los olores específicos y la longitud del tiempo que duren. Ejemplos se encuentran por debajo. Por favor marque con una X en los síntomas adicionales que haya experimentado.

Olor	Impacto en la salud	Longitud de tiempo
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Síntomas de salud

	Piel		pérdida del sentido del gusto		**Músculos/Articulaciones**
	erupciones en la piel		decoloración de los dientes		articulaciones inflamadas y dolorosas
	irritación de la piel		sabor metálico en la tos		dolor en las articulaciones
	Colmenas		enrojecimiento o inflamación de las encías		artritis
	Forúnculos		decoloración de las encías		dolores musculares
	llagas que no sanan		salivación severa		dolor lumbar (espalda baja)
	enrojecimiento de la piel seca, agrietada		llagas o úlceras en la boca		debilidad
	muchos puntos específicos en piel				fuerza muscular reducida
	quemaduras en la piel		**Sinusal/Respiratorio**		
	pelamineto en las manos y brazos		pérdida del sentido del olfato		**Neurológicos**
	engrosamiento de la capa de la piel		frecuente falta de aliento		pérdida de la memoria
	coloración amarillenta de la piel		dificultad para respirar		olvido
	cambios en el color de la piel		sibilancias		problemas de memoria
	áreas descoloridas de piel		problemas de sinusitis		dificultades de ortografía
			irritación nasal		disminución de las habilidades motoras
	Digestivo/Estómago		tos persistente		problemas de aprendizaje
	dolor abdominal		ronquera persistente		dificultad en el dibujo
	dolor abdominal persistente		tos crónica		escalonamiento/tropezar
	sangrado del recto		irritación de la garganta		cayendo
	cambio en los hábitos intestinales		expectoración con sangre, esputo		dificultad de equilibrio
	taburete negro				daño del nervio
	rojos de la sangre en las heces		**Visión/Ojos**		convulsiones
	Diarrea		ojo ardiente		temblores de cuerpo
	indigestión persistente		quemaduras en el ojo		temblor de las manos y los brazos
	náuseas frecuentes		conjuntivitis		debilidad de las manos
	Vómitos		visión borrosa		sensación de hormigueo en las manos
	vómito con sangre		ojos secos		desorientación
	pérdida del apetito		ceguera en ambos ojos		alucinación
	pérdida de peso		dolor severo en los ojos		mareo
			irritación ocular crónica		dificultad en el habla cuando se cansó
	Riñón/Urológicas		dificultad en la visión		dificultad en la concentración
	ganas frecuentes de orinar		disminución de la visión		
	dificultad en el inicio de orina		frecuente lagrimeo de los ojos		**Cardiología/Circulatorio**
	sangre en la orina		hinchazón de ojos		labios, nariz o piel azules
	azúcar en la orina		movimiento incontrolables del ojo		accidente cerebrovascular
	decoloración de la orina		pérdida de la capacidad para ver los colores		latido del corazón irregular, rápido
	cálculos renales		temblor de los párpados		dolores de pecho frecuentes

			coloración amarillenta de los ojos		latidos cardíacos lentos
	Oídos/Nariz/Boca				presión arterial alta
	pérdida de la audición				presión arterial baja
	zumbido en los oídos				radiografía del pecho anormal
	dificultad de audiencia				sangrado prolongado
	ruidos en los oídos				
	hemorragias nasales frecuentes				
	Comportamiento/Humor/Energía		**Linfático/Tiroides**		**Otros/General**
	fatiga/cansancio		bultos o hinchazón en el cuello		análisis de sangre anormal
	somnolencia extrema		bultos o inflamación en la axila		dolores de cabeza
	trastornos del sueño		bultos o inflamación en la ingle		desmayos
	trastornos del sueño		bultos en los cenos		
	Depresión		sudoración excesiva		
	pérdida de deseo sexual				
	problemas en juicio		**Inmunológica**		
	cambios de comportamiento		infecciones frecuentes		
	pensamientos suicidas		la mala cicatrización de heridas		
	cambios en la personalidad		fiebre de causa desconocida		
	ansiedad severa				
	Tensión		**Reproductiva**		
	comportamiento compulsivo		Papanicolaou anormal		
	Agitación		Mamografía anormal		
	disturbios del apetito		secreción del pezón		
	irritación frecuente		disturbios menstruales		
	dificultad para llevar a cabo actividades		descarga sangrienta vaginal		
			infertilidad		

Información del niño (si corresponde)

¿Tienes un hijo nacido con?:
Defectos de nacimiento: Si _____ No _____
Trastornos del aprendizaje: Si _____ No _____
Trastornos neurológicos: Si _____ No _____
Trastornos del comportamiento: Si _____ No _____
Trastornos de la memoria: Si _____ No _____
¿Tuviste un hijo muerto?: Si _____ No _____

¿Existe algo más que has experimentado relacionados con la salud en su hogar que usted puede decirnos sobre (por ejemplo, enfermedades de mascotas/animales)?

_____
_____
_____
_____
_____

Recursos hídricos

- ¿Utilizas agua del grifo para beber? Si _____ No _____
    - Si Ud. contestó No, chequear cualquier motivo que no usas agua del grifo para beber
        - Sabor _____
        - Olor _____
        - Altos niveles de contaminantes _____
        - Por favor enumere los contaminantes (si lo conoce): _____
- ¿Utilizas agua del grifo para otras actividades (bañarse, lavarse)? Si _____ No _____
- ¿Utilizas agua del grifo para uso al aire libre tales como jardinería, automóviles, lavado, etc..? Si _____ No
- ¿Has tenido pruebas para determinar si hay posibles contaminantes de agua? Si _____ No _____
    - En caso afirmativo, por favor, describa por qué tomo pruebas de agua _____ _____ _____
- ¿Tu casa tiene un sistema de filtración para purificar el agua? (No un filtro Brita, sino un sistema integrado en sus tuberías). Si _____ No _____
    - En caso afirmativo, por favor describa las circunstancias que condujeron a la instalación de este equipo _____ _____ _____

Sus respuestas se mantendrán confidenciales y no compartida con nadie. Gracias por completar este formulario.