

Natural Gas

Flowback



HOW THE TEXAS NATURAL
GAS BOOM AFFECTS
HEALTH AND SAFETY
APRIL 2011



**TEXAS
OGAP**

OIL & GAS ACCOUNTABILITY PROJECT



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Is the state adequately protecting its citizenry?

EXECUTIVE SUMMARY

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In the last decade, hydraulic fracturing and other new drilling technologies have turned North Texas into the leading shale gas-producing area in the country. But the drilling boom has brought with it serious concerns over the health and environmental impacts of an industry that uses large volumes of toxic chemicals in close proximity to Texas communities. The search for deposits of shale gas is spreading to other regions of Texas, raising the question of whether the state is adequately protecting its citizens and its resources.

This investigation by the Earthworks' Texas Oil and Gas Accountability Project concludes that the answer is "No."

We have compiled and collected data on the serious health effects of gas drilling, hydraulic fracturing (e.g., fracking) and production on Texans throughout the Barnett Shale; water contamination and depletion; air pollution and other impacts. We have also documented that the state's present regulations, laws and enforcement policies are far too weak. Not only are the resources for dealing with the health and environmental impacts of gas production insufficient to meet the scale of the boom, but state regulators consistently downplay the risks, take sides with industry against landowners, and respond to complaints feebly, if at all. This report presents case studies of how this denial, complacency and bureaucratic inaction are disrupting the lives of families and communities.

Too often citizen testimonies of health effects or evidence gathered by citizens, as in this report, are dismissed as anecdotal evidence and as long as each case is treated as an isolated incident the larger pattern is ignored. But when so many citizens across almost two dozen counties report similar complaints and symptoms associated with gas drilling, something is wrong. More thorough research is needed to determine if drilling and fracking can be done more safely and under what conditions and locations they should or should not be permitted. At the same time immediate action is warranted to protect public health and the environment.

We recommend:

The Texas Commission on Environmental Quality must significantly step up its currently inadequate efforts to protect public health by strictly enforcing emission limits from oil and gas exploration and production equipment.

The Texas Railroad Commission, long the oil and gas industry's lapdog, must become a watchdog. The Railroad Commission must adopt rules that provide the public with full public disclosure of oil and gas drilling and fracking fluids. To protect surface and groundwater resources from oil and gas contamination, the Commission must implement rules requiring closed-loop drilling systems and water-based drilling fluids.

The Texas Water Development Board must exercise its authority to evaluate groundwater resources and the impact that hydraulic fracturing withdrawal is having on groundwater resources. The agency must implement rules that require recycling of flowback water.

Authority to regulate air emissions from oil and gas exploration and production equipment should be overseen by the U.S. Environmental Protection Agency. The EPA should oversee permitting of existing and future point sources through a federal advisory commission that includes citizen representation. The agency must also identify the sources of methane contaminants in groundwater.



Reilly Ruggiero plays while a drilling rig operates in her back yard.

Photo by Christine Ruggiero

The Texas shale boom

INTRODUCTION

INTRODUCTION — AN OVERVIEW OF THE TEXAS SHALE BOOM

Over the last decade the rise of natural gas prices has driven an unprecedented expansion in exploration and development of so-called unconventional gas resources, especially gas from deeply buried shale rock formations. The shale gas boom has transformed the landscape of many parts of the United States, but none more dramatically than the Barnett Shale formation in North Central Texas, which is by far the leading shale gas-producing region in the nation.¹

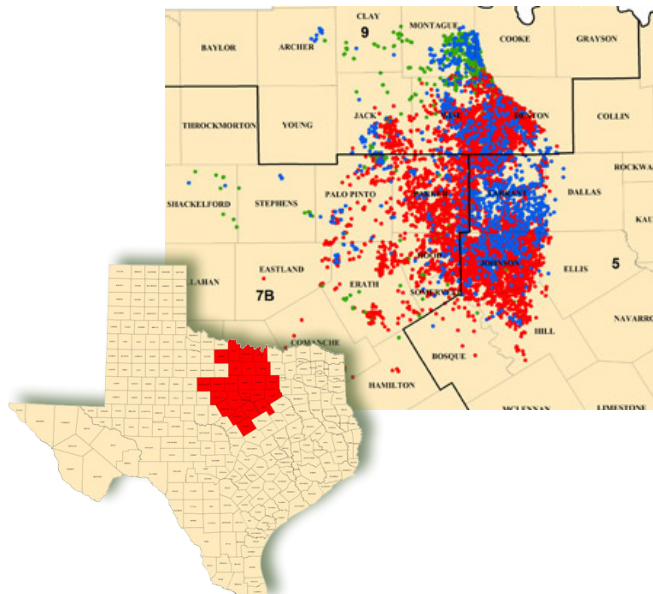
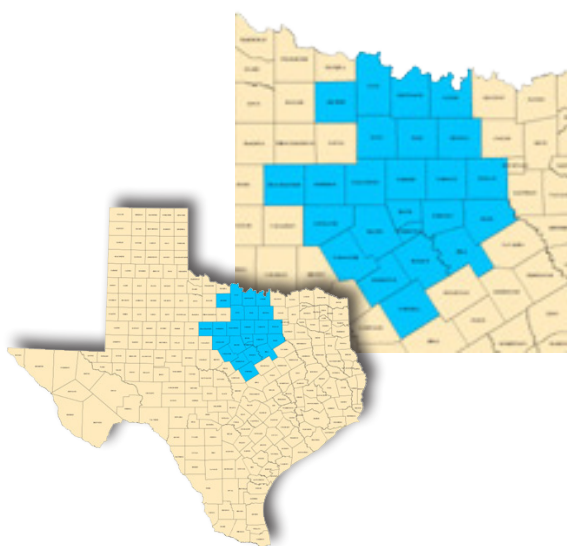
According to the Texas Railroad Commission, which regulates the natural gas industry, the Barnett Shale formation underlies approximately 5,000 square miles, producing gas in 23 counties spreading north, west and south from Fort Worth and Tarrant County.² The Barnett Shale formation was discovered in 1981. Since drilling began in the 1990s, production has skyrocketed from 11 billion cubic feet in 1993 to 1.76 trillion cubic feet in 2009.³

But the boom did not really take off until 2001. Between 2001 and 2005, approximately 1,000 to 1,500 wells were completed annually. In 2006, 2007 and 2008, more than 2,000 wells were completed per year. As of November 2010, Railroad Commission records show 15,574 wells drilled in the region, with drilling permits issued for another 3,000 locations. Industry analysts report that Barnett Shale production has not yet peaked,⁴ and that the Barnett Shale may in fact prove to be the largest onshore natural gas field in the United States.⁵

In the past year, concern over the health and environmental impacts of shale gas drilling have led some jurisdictions, including Dallas and Grand Prairie, to issue a temporary moratorium on new wells allowing time to update local ordinances. It is clear, however, that despite restrictions in some locations, Texas' shale gas boom is not going away – in fact, it is spreading from North Central Texas to other parts of the state. The challenge for Texas is not whether to allow shale gas and oil production, but how to protect the communities whose lives and landscapes are being transformed by the boom.

Extracting gas from underground shale deposits is made possible by new horizontal drilling techniques – drilling diagonally under property from an adjacent well – and new well-stimulation processes, chief among them hydraulic fracturing, also known as fracking. Drillers mix hundreds of millions of gallons of water with a cocktail of chemicals and sand and inject the fluid into the wellhead under high pressure. The pressure creates fractures in the shale, allowing gas to be released to the surface. Unfortunately the chemical-laced fracking fluids can also escape from the shale deposit, flowing back to the surface or migrating to groundwater bearing zones. According to Congressional testimony in 2005 by then-Railroad Commission Chairman Vincent Carrillo, 90 percent of all oil and gas wells in the United States are subjected to fracking.⁶

The exact formulas for fracking fluids are closely guarded company secrets, but can include cancer-causing chemicals such as benzene and chromium, heavy metals and dozens of petroleum-derived compounds.⁷ An analysis of fracking chemicals known to be used in Colorado found no fewer than 65 substances that are listed as hazardous under federal law.⁸ Because the oil and gas industry in 2005 got Congress to exempt fracking fluids from the Safe Drinking Water Act – a loophole opened after lobbying by Houston-based Halliburton – oil and gas is the nation's only industry allowed to inject hazardous substances unchecked directly into, or directly adjacent to, underground drinking water sources.⁹



Left: Barnett Shale counties. Right: Producing wells as of December 15, 2010. Oil wells – green; gas wells – red; and drilling permits – blue. <http://www.rrc.state.tx.us/barnettshale/index.php>

LIVING WITH THE BOOM

This large-scale industrial activity deploying vast amounts of hazardous substances is happening not at hard-hat refineries or isolated oil fields, but in Texans' back yards – sometimes literally, as horizontal drilling and split-estate laws make it possible to locate a drill rig a few feet from a residence without the homeowners' consent. It is occurring in cities, suburbs, small towns and rural communities, within just hundreds of feet of homes, churches, schools, parks, farmland, lakes and rivers. Texans living in the Barnett Shale have experienced rapid and in some cases extreme changes in their daily lives.

Fracking and other gas development brings massive drill rigs, high-pressured drilling and stimulation operations, high volumes of toxic fluids, contaminated wastewater, industrial compressor stations, condensate tanks, noisy and polluting diesel engines, networks of pipelines, increased truck traffic and noise, and concerns about drilling waste disposal and safety. Throughout the Barnett Shale, residents are concerned about air pollution from oil and gas operations and the risks of groundwater and surface water contamination by fracking chemicals. Health problems have become central issues, with many residents complaining of odors, dizziness, nosebleeds, headaches, agitation, and in some cases, more severe symptoms.¹⁰ Livestock have died. Homes have been abandoned on advice of physicians.

The industry denies the risks and state regulators downplay them, saying there are no definitive links between drilling, fracking and production operations and residents' complaints and symptoms. As we will see, that's not true: doctors and investigators have documented contamination of people and property with chemicals used by the industry that could not have come from anywhere else. One thing is clear: Where drilling goes, contamination and health problems follow.

The Barnett Shale region is the first area of Texas to experience on a large scale the problems that come with unconventional gas drilling, but it will not be the last. A boom is already well under way in the Eagle Ford Shale formation, which lies under two dozen counties mostly south and west of San Antonio and Bexar County. From just 33 drilling permits in the Eagle Ford in 2008, the number swelled to more than 1,000 by the end of 2010.¹¹

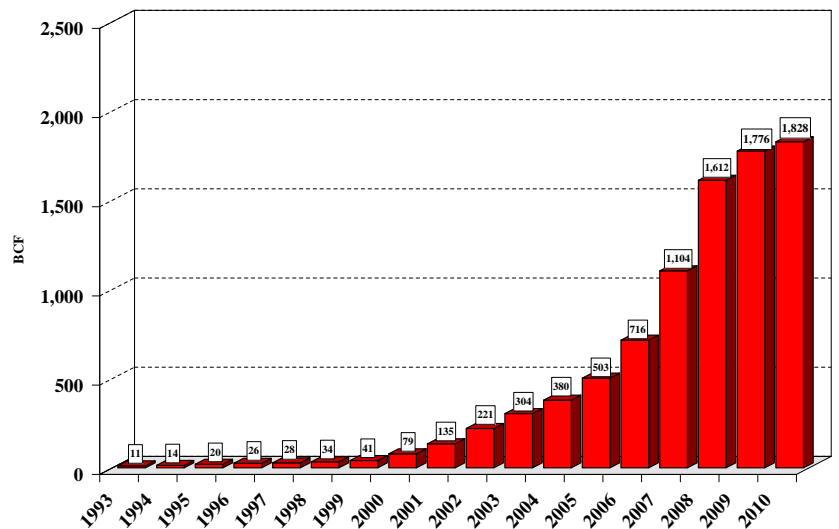
The Haynesville Shale, the fourth-largest natural gas field in the U.S., is centered in northwest Louisiana, but extends into adjacent counties in East Texas. And according to recent news reports, gas companies are making "big offers" to landowners in several counties west of Lubbock, with drilling in an as-yet unnamed shale gas formation expected to begin this summer.¹²

CURRENT REGULATIONS ARE INADEQUATE TO MEET THE PROBLEM

The spread of shale gas drilling to other parts of the state makes it particularly worrisome that Texas' current regulatory and enforcement system is woefully inadequate for protecting citizens from the risks associated with hosting such hazardous activity in their communities. This report by the Texas Oil & Gas Accountability Project (Texas OGAP) tells the stories of entire communities and of families whose concerns have been

met with official denial, complacency or bureaucratic inaction. Regulations are weak, outdated or simply don't cover the unique conditions of drilling in the Barnett Shale.

- In 2007, a state auditor's investigation of the Railroad Commission's enforcement capability found that almost half of Texas' oil and gas wells hadn't been inspected in the last five years.¹³ In October 2010, a scathing report by the state Sunset Commission recommended restructuring the agency because of conflicts of interest with the oil and gas industry, which makes hefty campaign contributions to the elected commissioners. The Sunset Commission also noted: "The (Railroad) Commission pursues enforcement action in a very small percentage of the thousands of violations its inspectors identify each year."¹⁴
- In December 2009, the nonprofit investigative news organization ProPublica surveyed the regulatory systems in 32 oil and gas producing states. The survey found that Texas had by far the most wells – almost 275,000 – but the fewest regulators to oversee them. Of 106 Railroad Commission staff at the time, 83 were inspectors, meaning each was responsible for almost 3,300 wells.¹⁵



Newark, East (Barnett Shale) gas well production 1993 - 2010.

- Through the Texas Public Information Act, Texas OGAP obtained and analyzed records of citizen complaints to the Texas Commission on Environmental Quality (TCEQ) about drilling and fracking operations in Barnett Shale counties. We found that 256 complaints – more than one a day – were filed in the first seven months of 2010, yet only three notices of violations were issued, all for the same site in Wise County.¹⁶
- In Fort Worth, the biggest city hosting the Barnett Shale boom, the Fort Worth League of Neighborhoods investigated the system of drilling regulation and enforcement and reported in February 2011 that both the city and the state are allowing gas companies to police themselves through the "honor system":

"Regulation" consists of nothing more than a permit filed [by a drilling company] with the TCEQ stating that [air] emissions will not go above a certain threshold. But no independent routine

physical verification of these permit claims is currently being done by the State or the City. This is problematic for a variety of reasons, not least of which is that the operators have a clear conflict of interest inherent in their need to maximize profits.¹⁷

In the most notorious case of the state's failure to protect citizens, in the summer of 2010 methane and other chemicals were found in the water wells of two Parker County homeowners after two gas wells were drilled nearby. Tests by the U.S. Environmental Protection Agency strongly suggested the methane came from the gas wells, but for months the Railroad Commission took no action. After EPA determined that state and local officials did not plan to do anything, in February 2011 the agency issued an emergency order against the drilling company.

But in March 2011 the Railroad Commission cleared the company of liability because federal officials couldn't point to the specific path the chemicals took from the gas wells to the water wells. As clear evidence of its bias toward industry, the Railroad Commission put the burden of proof on the EPA – and by extension, landowners – rather than holding drillers responsible for making sure their wells are safe.

Texas can – and must – do a better job of protecting Texans from the undeniable hazards posed by the proximity to homes, schools, hospitals and churches of large-scale industry that uses heavy equipment and tons of toxic and volatile chemicals on a daily basis. For public health and the environment, the stakes are too high to ignore.

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Photo by Sharon Wilson

Health and environmental impacts

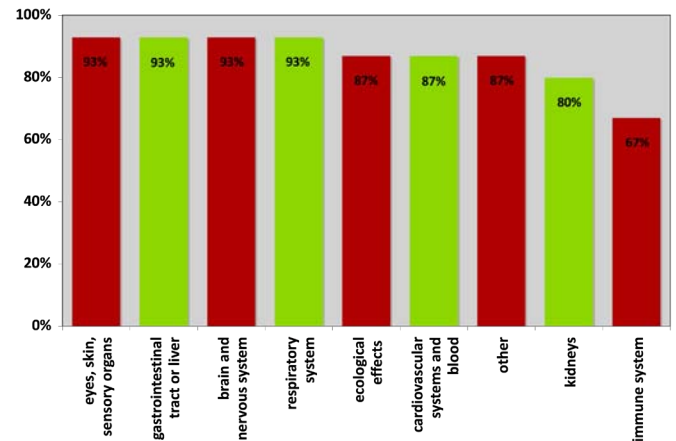
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HEALTH AND ENVIRONMENTAL IMPACTS OF DRILLING AND FRACKING

Airborne Chemicals

Some of the airborne emissions and odors experienced by citizens in oil and gas communities come from chemicals used when oil and gas wells are drilled or fracked. Other emissions and odors come from chemicals that naturally occur in oil and gas and chemicals that are created when gas is flared or when fuel is burned in engines for compressors, trucks and drilling rigs. Chemicals that have a tendency to become airborne are known as volatile organic compounds or VOCs.

In April 2009, The Endocrine Disruption Exchange (TDEX), an independent research organization based in Paonia, Colorado, analyzed health effects data for 61 chemicals found in products known to be used during oil and gas drilling or hydraulic fracturing in Texas. When drilling wastes or used fracking fluids return to the surface, they often end up in open tanks or pits. VOCs in the fluids may then be emitted to air. Approximately one-fourth of the chemicals examined were volatile, and according to TEDX "can readily become airborne and can be inhaled as well as swallowed, and can reach the skin."¹⁸ More than 90 percent of the chemicals are harmful to the brain, nerves, lungs, and digestive system; 80 or more percent can affect the heart, blood and kidneys; and 67 percent can affect the immune system.



Health effects related to chemicals used to drill and fracture wells in Texas.

Air Emissions in Fort Worth

In the past three years, numerous air sampling studies by public agencies, private citizens and even the natural gas industry itself have confirmed that shale gas facilities in Fort Worth – where more than 1,000 gas wells are located inside the limits of a city of more than half a million residents – are emitting concentrations of air pollutants that exceed healthy levels.

Early concerns about air emissions from gas drilling activities in North Texas were raised in 2008¹⁹ by Dr. Alfredo Armendariz of Southern Methodist University, later appointed as the EPA Region 6 administrator. He conducted a study of air pollutants that contribute to the formation of ground-level ozone, commonly known as smog. The study concluded that drilling activities were contributing more to smog than all the cars, trucks and airplanes in the Dallas-Fort Worth region.

In May and June 2009, private air tests were conducted which raised additional questions about emissions coming from gas wells within the city limits of Fort Worth. Tests were conducted on the farm of Deborah Rogers (whose story is told in Part 3) by Wolf Eagle Environmental, an environmental assessment firm from Flower Mound in Tarrant County. These brought to light other toxic compounds apart from the ozone contributors analyzed by Almendariz. The new compounds included benzene, a known carcinogen, together with toluene, ethylbenzene and m&p xylenes.²⁰ In addition, various sulfur compounds, particularly carbon disulfide, a potent neurotoxin, were detected at extremely high levels. Armendariz reviewed the findings and advised the landowner that carbon disulfide was found at levels 300 times the norm for ambient urban air.²¹

Following these alarming findings, the Texas Commission for Environmental Quality ordered its own tests to determine the extent of exposure to these newly detected compounds. These tests confirmed that benzene, toluene and carbon disulfide, among other chemicals, were indeed being emitted by gas facilities in the Barnett Shale region. In its final report on the tests, issued in January 2010, TCEQ stated that “gas production facilities can, and some cases do, emit contaminants in amounts that could be deemed unsafe.”²² TCEQ found that 21 facilities in 12 locations registered benzene above long-term healthy levels. Carbon disulfide, ethane, 1,2 dibromethane and isopentane were found in concentrations above short-term healthy levels. In all, 35 chemicals were detected at above “appropriate” short term levels.²³

In August 2010 the City of Fort Worth hired Eastern Research

Group, an air monitoring consultant in Austin, to conduct its own air quality study. Preliminary results, released in February 2011, identified benzene and carbon tetrachloride emissions from seven sites. Emissions at two sites exceeded TCEQ’s limit of 25 tons of volatile organic compounds a year. Neither the City nor the State had previously been aware of a problem at these sites.²⁴



Top: Aruba Petroleum emissions in Wise County.

Photo by Tim Ruggiero

Bottom: Red Oak Gas Operating Co. emissions in Denton County. Photo by Robert Massagli

Most recently, the Fort Worth League of Neighborhoods commissioned a study that used emissions data from a June 2011 study commissioned by the Barnett Shale Shale Energy Education Council, a public relations effort funded by gas companies operating in the region.²⁵ The data, from samples taken at two sites near Lake Arlington, showed elevated levels of carbon disulfide, in one case just below the TCEQ’s healthy level and in the other almost 2.5 times higher than the healthy level.

Scientists hired by the League of Neighborhoods then used computer modeling and more than a year’s worth of meteorological data to determine how far those levels of the chemical would disperse in relation to nearby schools. The results, released in February 2011, found that levels of carbon disulfide could reach the schools that are several times higher than the safe workplace level for adults set by the U.S. Occupational Safety and Health Administration. The League’s study concluded that to protect the health of students, drilling sites should be prohibited within one mile of schools.²⁶

Water Depletion

Amid increasing scarcity of water supplies, the immense quantities of water required for hydraulic fracturing are not sustainable. Huge volumes of water are needed to extract shale gas. Estimates range from 1.5 million to five million gallons of water per well, and wells may be refracked several times over the life of each well.²⁷ Recently, the oil and gas industry announced a new 12-stage completion method that uses over 9 million gallons of water per well.²⁸

Of the metered sources in the four-county Upper Trinity Groundwater Conservation District – only a part of the Barnett Shale formation – drillers used more than 1 billion (1,146,598,272) gallons of water in 2009.²⁹ Water was also taken from unmetered sources. Some areas of the Trinity Aquifer have already dropped hundreds of feet.³⁰

The Texas Water Development Board predicts massive increases in water used to frack shale gas, with particularly severe impacts on rural counties. By 2020 from 14% to 76% more water will be needed for gas drilling and production in Bosque, Erath, Hamilton, Hill, Jack, Montague and Palo Pinto

Counties.³¹ The Upper Trinity conservation district is fielding complaints from landowners whose wells are drying up. "Their wells might go from seven to eight gallons a minute to half that," said Executive Director Bob Patterson. He thinks fracking could be a factor.³²

Water consumption has quickly emerged as a concern in the Eagle Ford region, too. Veteran Karnes County oilman John Braudaway says: "They already know they're gonna run this area out of water; there's no ifs, ands, or buts about it." Said Larry Akers, assistant manager of the Evergreen Water Conservation District, the water planning agency for Atascosa, Frio, Karnes, and Wilson counties: "We really have no idea how much water they are pulling from our area, and it's really frustrating."³³

When the water used for hydraulic fracturing returns to the surface as "flowback" it is contaminated with fracking chemicals and impurities from the formation. This toxic soup requires permanent disposal by injecting it into deep disposal wells "sealed above and below by unbroken, impermeable strata."³⁴ Dr. Paul F. Hudak of the geography department at the University of North Texas says:

"Disposing of used water through properly operated and maintained injection well systems, into deep rock formations, essentially removes that water from the active hydrologic cycle. Conceivably, this water could return to the active hydrologic cycle at some very distant point in the future (speaking in geologic terms, well beyond human time frames)."³⁵

As technological advances increase the ability to extract more shale gas, treating water used for hydraulic fracture will be critical to its continued use. The technology exists to recycle "flowback" allowing the water to remain in the hydrologic cycle but currently this technology is used on a very limited basis.³⁶

Water Contamination

There are many pathways for water contamination from natural gas drilling, but it is difficult to determine precisely whether a given case of contamination is from spills, leaks, illegal dumping, waste pits or fracking. This is not only because of inadequate or inefficient regulation, but because the industry holds its chemical formulas and processes as closely guarded trade secrets. The Energy Policy Act of 2005 eliminated the U.S. Environmental Protection Agency's ability to monitor or regulate hydraulic fracturing and allows industry to claim chemicals used as trade secrets.³⁷ When private water wells are contaminated during or after hydraulic fracturing, the burden of proof is placed on individuals who cannot even know exactly what chemicals to test for to prove contamination.

Water contamination was a consequence of Barnett Shale drilling from the beginning. The potential for the Barnett Shale was first realized in the 1980s when Mitchell Energy was experimenting in Wise County with ways to extract gas by using hydraulic fracturing. A landowner named Jim Bartlett sued Mitchell Energy in 1987 because his newly drilled water well

was contaminated with natural gas and hydrogen sulfide. As a result of the lawsuit, which did not go to trial until 1996, the Railroad Commission investigated and found that more than 100 wells in the county "didn't have enough surface casing to protect groundwater and that records about the surface casing had been falsified."³⁸

But the problem has not gone away. Larry Bisidas has 40 years of water well drilling experience in Wise County. In the past few years, he has witnessed dramatic declines in water quality and an increase in contaminated water wells. He told the

Wise County Messenger that he believes contamination occurs because operators are not running the casing pipe (the pipe, secured with cement, that holds the drill-head in place) deep enough: "[It] has to be deep enough or else it's gonna leak up through the strata. I don't know why people can't see that." His 30-year-old water wells now produce water that is too salty to drink. He buys bottled water.³⁹

In Grandview, Johnson County, three families lost their drinking water when their private water wells were contaminated soon after Williams Production-Gulf Coast Co. fracked the second of two gas wells a few hundred yards

from their homes. The water wells were contaminated with toluene, a solvent that is harmful to fetal and child development and that does not occur naturally. Shortly after Christmas in 2007, several animals died from drinking the water, one landowner asked a worker at the drill site what happened. The worker said a drilling pipe had ruptured 700 feet below the surface. The company claimed they were not responsible.⁴⁰

Range Resources in Parker County

The most controversial case of water contamination in the Barnett Shale comes from southern Parker County. In 2009, Range Resources of Fort Worth drilled two gas wells, about 120 feet from one private water well and 470 feet from another. In December 2009, four months after gas production started, one water well owner noticed that his water was effervescing, or fizzing. He began raising concerns with the Railroad Commission, in July 2010 discovered he could set the water from his garden hose on fire – a phenomenon that has been found at other fracking sites where methane has contaminated water supplies.⁴¹

In August 2010, the owners of both water wells commissioned testing which found benzene, toluene, methane and ethane. Soon afterward, both the Railroad Commission and the EPA conducted their own tests. The Railroad Commission found benzene and toluene; the EPA found the same chemicals as in the water well owners' tests, plus propane and hexane. Isotopic testing by the EPA indicated that the methane in the water was likely from the same source as methane found in the natural gas produced by Range's wells.

In November 2010, the EPA concluded that the danger of explosion was so great that it advised the owners of both water wells to stop using the water. EPA later reported:



Braden Exploration waste pit just feet from a creek that flows into Denton Creek, Wise County. Photograph by Sharon Wilson.

Chemical	Private testing, 8/8/10 (ppb)	Railroad Comm., 8/17/10 (ppb)	EPA 10/26/10 (ppb)
Benzene	3.1	6.84	4.55
Ethane	No Test	NT	5.27
Dissolved ethane	1,580	NT	NT
Hexane	NT	NT	31.7
Dissolved methane	7,810	NT	20,100
Propane	NT	NT	2,280
Tolulene	2.0	6.12	3.47

Results of testing from a water well near Range Resources' gas wells in Parker County, 2010. http://www.epa.gov/region6/6xa/pdf/range_order.pdf

*EPA has consulted with the appropriate State of Texas and local authorities, including the Railroad Commission of Texas, the Texas Commission on Environmental Quality, and the Parker County fire marshal, regarding the presence of contaminants in the source of drinking water . . . and disclosed the potential endangerment to the health of persons. . . . EPA has determined that the appropriate State and local authorities have not taken sufficient action to address the endangerment described herein and do not intend to take such action at this time.*⁴²

On Dec. 6, 2010, EPA issued an emergency order directing Range Resources to provide the water well owners with replacement water supplies, to sample all water wells within 3,000 feet of the two gas wells, to test for gas in the soil and indoor air of the homes of the owners, and to identify and remediate gas leaks into the Trinity Aquifer.

The emergency order set off a bitter public dispute between the Railroad Commission and the EPA over federal authority vs. state authority in regulating fracking and emissions. Range Resources challenged the order, saying that the chemicals more likely came from a much more shallow deposit of gas that had long been identified as a source of methane in well water, not the Barnett Shale formation the company's wells tapped. Range's lawyers made much of the fact that EPA could not identify the exact route the methane took from the gas wells several thousand feet deep to the water wells a few hundred feet deep. The company's hired expert said: "We know that the fractures (caused by process) don't grow more than a few hundred feet."⁴³ This, however, contradicts industry experts' testimony in a landmark Texas Supreme Court case, *Garza v. Coastal*, that a fracture planned for 1,000 feet might reach 2,000 feet or just 400 feet.⁴⁴ The EPA's position is that it has the legal authority "to ask a company who we believe may have caused or contributed [to water contamination] . . . to collect the data."⁴⁵

On March 7, 2011, Railroad Commission hearing examiners announced a finding that Range was not responsible for methane contamination of the water wells – in other words, the Railroad Commission issued a ruling that supports its own position and its inaction. Two weeks later, the full Railroad Commission affirmed the examiners' initial ruling. Range said it expected the EPA to withdraw the order for lack of evidence, but the Agency said it remains "confident that the natural gas that is now in the drinking water for these two homes is the natural gas that [Range] are producing from a production well nearby which [Range] hydrofracked during the summer of [2009]."⁴⁶ The U.S. Department

of Justice has filed a case in federal court to enforce EPA's emergency order under the Safe Drinking Water Act.

More Water Contamination

Additional cases of water well contamination believed to have been caused by drilling or fracking operations in the Barnett Shale include:

- Doug and Diana Harris, Denton County. Water contaminated with aluminum, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, nickel, potassium, sodium, strontium, titanium, vanadium, and zinc shortly after Devon Energy fracked a gas well near their home.⁴⁷
- Grace Mitchell, Johnson County. Water contaminated with hydrocarbons shortly after fracking by Chesapeake Energy and Encana.⁴⁸
- Jim and Linda Scoma, Johnson County. Water contaminated with benzene and hydrocarbon by products after fracking of Chesapeake Energy gas well.⁴⁹
- J.D. Johnson, Tarrant County. Water turned gold and sandy immediately following hydraulic fracturing.⁵⁰
- Carol Grosser, Edwards County. Water contaminated and water pressure issues after hydraulic fracturing of well near property. Goats gave birth to deformed kids.⁵¹
- Amber and Damon Smith, Denton County. Testing found arsenic, chromium, butanone, acetone, carbon disulfide, and strontium in well water after Devon Energy fracked gas well.⁵²
- Catherine and Brett Bledsoe, Wise County. Shortly after Aruba Petroleum fracked wells near their property, water stung their eyes and had odor. Animals refused to drink. Testing found benzene and very high levels of MTBE (a diesel fuel additive).⁵³
- Steven Brock, Montague County. Flammable water. Tests revealed high chloride levels, arsenic, chromium, barium, mercury and methane.⁵⁴

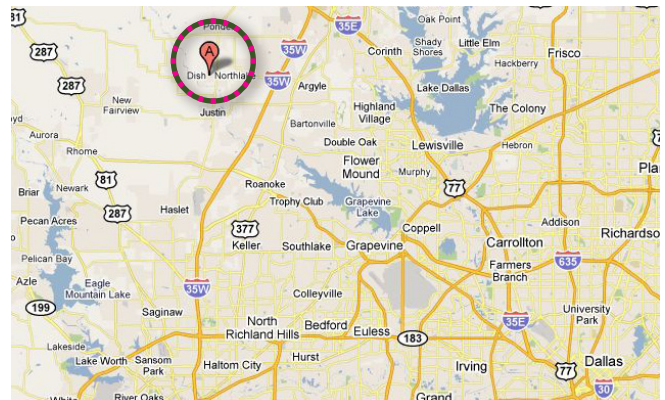
Case studies: poisoned communities

2

CASE STUDIES: POISONED COMMUNITIES

Dish, Texas

Dish is a town of about 200 in southern Denton County. The town is the site of a sprawling complex of oil and gas facilities, pipelines and gas wells. Almost a dozen large natural gas compressor stations are located next to each other, several gas metering stations are just west of the compressor stations and a large battery of condensate tanks is located less than a mile away.⁵⁵ These facilities are very close (100 feet or less in some cases) to residences.⁵⁶ For years, Dish residents who live near the compressors have experienced headaches, dizziness, and many other health symptoms. A number of surveys and investigations have tried to determine the potential health effects that could be linked to the industrial oil and gas facilities located in Dish.



Subra Company

In October and November of 2009 environmental chemist Wilma Subra – recipient of a MacArthur “genius” award for her work with communities threatened by toxics – conducted a health survey of the residents of Dish on behalf of Texas OGAP.⁵⁷

In addition to dozens of odor complaints, a total of 165 medical symptoms and diseases were reported by the 31 individuals who responded to the survey. There were 23 conditions frequently reported by the 31 individuals. The most prevalent health conditions included: sinus problems, throat irritation, allergies, weakness and fatigue, eye irritation, nasal irritation, joint pain, muscle aches and pains, breathing difficulties, vision impairment, severe headaches, sleep disturbances,

swollen and painful joints, frequent irritation, skin irritation, wheezing, frequent nausea, ringing in ears, decreased motor skills, loss of sexual drive, bronchitis, easy bruising and difficulty in concentrating.

Wolf Eagle Environmental

On August 17 and 18, 2009, Wolf Eagle Environmental, an environmental services and consulting company from nearby Flower Mound, sampled the ambient air from seven locations in Dish.⁵⁸ The air samples were analyzed for substances classified as volatile organic compounds (VOC), hazardous air pollutants (HAP), tentatively identified compounds (TIC) and nitrogen oxides (NOX). The sampling confirmed the presence of high concentrations of some cancer-causing chemicals (carcinogens) and neurotoxin compounds in air near or on residential properties in Dish.⁵⁹

A number of these compounds exceeded both short and long-term effects screening levels (ESL) established by the TCEQ.⁶⁰ For example, benzene, a known human carcinogen, exceeded the short-term at one site and the long-term level at three sites. Fourteen other chemicals that exceeded short- or long-term ESLs included: m,p-xylene, dimethyl disulfide, methyl ethyl disulfide, ethyl-methylethyl disulfide, trimethyl benzene, diethyle benzene, methyl-methylethyl benzene, tetramethyl benzene, naphthalene, 1,2,4-trimethyl benzene, carbonyl sulfide, carbon disulfide, methyl pyridine and dimethyl pyridine.⁶¹ Sixty-one percent of the health effects experienced by Dish residents who responded to the Subra Company's health survey match the known health effects of the chemical Wolf Eagle detected in Dish's air excess of above state ESL levels.

These air pollutants almost certainly came from natural gas infrastructure located in and around Dish. Hazardous air pollutants can be released from oil and gas well sites, compressor stations, gas dehydrators, oil/condensate tanks, pressure relief valves, well drilling, hydraulic fracturing, gas processing plants, pipelines, and vehicle and engine exhaust.⁶² According

to the Wolf Eagle Environmental report, Dish has virtually no heavy industry other than oil-and-gas related facilities. There are no other industrial activities with the capability to produce the volume of air toxins present within miles of the town.⁶³

In October 2009, TCEQ reviewed the Wolf Eagle report and expressed concern that "the monitored concentrations of benzene at several of the sampling locations could pose a long-term health risk to residents if representative of normal and prolonged ambient conditions."⁶⁴ TCEQ has since been conducting its own sampling, but has not measured benzene concentrations as high as those found by Wolf Eagle Environmental.

Texas Department of Health Services

In October 2009, the Texas Department of State Health Services (DHS) was asked by the mayor of Dish to test people in the community for contaminants that had been identified in the community's air.⁶⁵ In January 2010, DHS staff collected blood and urine samples from 28 adults, as well as tap water samples from 27 of the residents' homes.⁶⁶ To provide a control population, blood and urine samples were also taken from five DHS staff members who collected the samples.

If a volatile organic compound (VOC) is detected in blood or urine, it indicates the person is currently being or has recently been exposed to the chemical. According to DHS, "VOCs only stay in the body for a short time (several

hours); therefore these measurements only reflect ongoing or recent exposures, and not historical exposures."⁶⁷ A high level does not necessarily mean that a person will experience health effects, nor does a lower concentration indicate that there will be no health effects. Individuals are not equally susceptible to a particular chemical⁶⁸ – some are more sensitive, some may be exposed to many chemicals at the same time, and these chemicals may interact or the effects add up to cause an impact to a person's health. DHS compared concentrations of VOCs in



Glass of water from the Smith's tap in Dish, Texas after Devon Energy completed nearby fracturing operation.

Photo by Sharon Wilson

61%

Health effects reported by the DISH community were associated with toxics measured in excess of TCEQ screening levels

- Abnormal EEG
- Brain disorders
- Bronchitis
- Chronic Eye Irritation
- Decreased Motor Skills
- Depression
- Dizziness
- Eyes Burning
- Falling, Staggering
- Frequent Irritation
- Frequent Nausea
- Increased Fatigue
- Irregular/Rapid Heart Beat
- Muscle Aches & Pains
- Nasal Irritation
- Pre-Cancerous Lesions
- Severe Anxiety
- Severe Headaches
- Sinus Problems
- Throat Irritation
- Tired
- Weakness
- Allergies
- Difficulty in Concentrating
- Easy Bruising
- Nervous System Impacts

- Benzene
- Carbon Disulfide
- 1,2,4-Trimethylbenzene
- Xylene
- Naphthalene
- Carbonyl Sulfide
- Trimethyl Benzene
- Methyl-Methylethyl Benzene
- Tetramethyl Benzene
- Methyl Pyridine
- Dimethyl Disulfide
- Methyl Ethyl Disulphide
- Ethyl-Methylethyl Disulfide
- Diemethyl Pyridin
- Diethyl Benzene

16

Chemicals measured in DISH' ambient air above TCEQ screening levels

Over 60 percent of health effects of Dish residents match effects associated with chemicals detected in air.

DISH residents' blood to what is known as a 95% reference value for each chemical – 95% of the U.S. population has concentrations below that level.⁶⁹ If a chemical is found at a higher concentration than the reference level, it means the person has recently been exposed to an unusually large amount of the chemical compared to the rest of the population.

Blood from the Dish residents was tested for 33 different VOCs. Some of the chemicals are known to be present in cigarette smoke (2,5-dimethylfuran, styrene and BTEX chemicals – benzene, toluene, ethylbenzene, xylenes), so results were tallied separately for smokers and non-smokers. Major findings:

- A total of 15 VOCs were detected in the residents' blood. Most frequently found were toluene (detected in 18 residents), m-/p-xylene (15 detections) and styrene (13 detections). A total of 14 VOCs were detected in non-smoking residents. The only chemical not found in the blood of at least one non-smoking resident was 2,5-dimethylfuran. This chemical is a biomarker known to be present in cigarette smoke and is generally undetectable in nonsmoking adults.⁷⁰ Three VOCs known to be present in cigarette smoke were also found in non-smokers: toluene was found in 13 non-smokers, ethylbenzene in four, o-xylene in three and m-/p-xylenes in 10 non-smokers. If these residents were not exposed to these chemicals from smoking cigarettes, what are other sources of these chemicals? Natural gas, especially gas that has condensate associated with it,⁷¹ contains the BTEX chemicals, and these can be released to the air when gas is vented from compressor stations, pipelines, condensate tanks, well sites or gas processing plants. By comparison, only six VOCs were found in the blood of the DHS staffers who were non-smokers.⁷² In other words, approximately twice as many chemicals were detected in non-smokers from Dish than non-smokers from DHS staff.

- Some Dish residents have been exposed to VOCs at higher levels than 95% of the U.S. population. Of the chemicals detected in residents' blood, 15 VOCs were found in at least one resident at a level that is higher than 95% of the U.S. general population. Three of the chemicals found in Dish non-smokers (bromoform, chloroform and dibromochloromethane) might be coming from the town's water supply – they are known to be formed when chlorine is added to public water systems as a disinfectant.⁷³ But nine other VOCs found at extremely high levels in the blood of non-smoking residents of Dish cannot be linked to chlorinated tap water. Again, DHS staff did not have VOCs in their blood in concentrations as high as residents. Only one chemical – dibromochloromethane, likely from drinking chlorinated water – was found in DHS staff at a level higher than 95% of the general population.

Dish residents also provided urine samples to DHS staff. These samples were analyzed for breakdown products (known as metabolites) of four VOCs: PMA, a metabolite of benzene; DHBM, a metabolite of 1,3-butadiene; BMA, a metabolite of toluene; and AMCA, a metabolite of N,N-dimethylformamide, also known as DMF. All residents and DHS staff had urinary metabolites of 1,3-butadiene, toluene, and DMF. Three residents also had metabolites of benzene (two smokers, one non-smoker). None of the urine samples from DHS staff contained metabolites of benzene. Residents also had higher levels of the metabolite of N,N-dimethylformamide than DHS staff and levels found in published research, but DHS staff could offer no reason for the high levels found in residents.⁷⁴ Although there are no recognized standards to determine safe levels in urine, the tests confirmed that residents of Dish are being exposed to benzene, toluene, 1,3-butadiene and N,N-dimethylformamide or other VOC chemicals.⁷⁵

VOCs FOUND IN AIR, WATER AND RESIDENTS (BLOOD SAMPLES) IN DISH, TX					
	Range of levels found in DISH air (ug/m3)	Detected in air (# of sites)	Found in DISH tap water (# of sites)	Range of levels (ug/m3) detected in blood of non-smokers (# of non-smokers)	Range of levels (ug/m3) detected in blood of smokers (# of smokers)
benzene	1.91 – 247.88	7	No (0)	ND* – 0.027 (1)	0.045 – 1.45 (5)
ethylbenzene	ND – 93.21	6 of 7	Yes (14)	ND – 0.124 (4)	ND – 1.437 (4)
toluene	2.76 -523.03	7 of 7	Yes (1)	ND – 0.839 (13)	0.174 – 3.25 (5)
M/p-xylene	3.56 – 366.3	7 of 7	Yes (15)	ND – 0.389 (10)	0.084 – 1.32 (5)
o-xylene	ND – 170.8	5 of 7	Yes (17)	ND – 0.118 (3)	ND – 0.186 (4)
styrene	1.64 – 5.44	3 of 7	Yes (16)	ND – 0.068 (8)	0.045 – 0.525 (5)
trichloroethene	ND - 2.16	1 of 7		ND – 0.013 (1)	ND (S: 0)

* ND: not detected

Air data from Wolf Eagle Environmental. Sept. 15, 2009. Town of DISH, Texas Ambient Air Monitoring Analysis. Final Report. <http://www.bseec.org/sites/all/pdf/airquality/13.pdf>. Blood and water data from TxDSHS Exposure Investigation. Tables 1 b. and 4. ⁷⁶



Source of the Chemicals

Many of the chemicals found at high concentrations in the blood of Dish residents have previously been found in air samples in and around Dish. Some of these chemicals were also detected at low levels in tap water samples from the homes of the residents involved in the DHS biomonitoring study.

Since many of the chemicals found in residents' blood were also found in air samples, it seems a reasonable assumption that natural gas drilling and facilities are the source of at least some percentage of the chemicals in blood – especially since Dish has no heavy industry other than oil-and-gas related facilities that could produce the high volumes of air toxins found.⁷⁷ But the DHS report concluded that because not all residents had high concentrations of the same VOCs in their blood, the investigation “did not indicate that community-wide exposures from gas wells or compressor stations were occurring in the same population.”⁷⁸ Instead, the report suggested that other possible sources of high concentrations in residents' blood such as cigarette smoking, the presence of disinfectant by-products in drinking water, and consumer or occupational/hobby related products could explain many of the findings.⁷⁹ Perhaps the highest levels of benzenes, ethylbenzene, toluene and xylene found in residents' blood can be attributed to smoking, but there were cases where non-smokers had higher concentrations than smokers. And there were cases where non-smokers had higher concentrations in their blood than 95% of the general population.⁸⁰

There are other possible reasons why not all 28 residents had the same VOCs known to be associated with gas wells and

compressors in their blood. First, the blood collected from the residents represented a snapshot in time. Depending on the wind and atmospheric conditions it is possible that not all residents were being exposed to chemicals from oil and gas facilities on the day when their blood was sampled. Also, some residents may have had higher exposures if they spent more time outside or had windows open when the chemicals were in the air. And if people were being exposed to chemicals through water as well as air, concentrations in blood would vary depending on how much contact they had with these chemicals through inhalation, ingestion or contact with skin.

DHS admitted that its study “was a one-time sample event; thus it could not consider external factors that could have affected results such as season, temperature, wind conditions, and variations in the natural gas operations.”⁸¹ DHS staff also acknowledged the presence of odors in the community, and recommended that if sampling from the TCEQ indicated possible environmental exposures, additional sampling should take place in the summer, “when temperatures are higher and when people indicate that odors are the greatest.”⁸²

Argyle and Bartonville, Texas

Until 2010, the affluent Denton County communities of Argyle (pop. 3,600) and nearby Bartonville (pop. 1,600) had only a few gas wells. Today, the communities have a major gas processing facility, tank farms, pipelines and multiple wells within one square mile of the homes of approximately 2,000 people. Residents are especially concerned about the approval of two well pads, gathering lines and pipelines under development on either side of the Argyle Intermediate School.⁸³ The area has had poor air quality for some time, but that only shows how strong the impact of drilling has been: Before the boom, complaints to TCEQ were almost non-existent; more than 100 complaints were issued in 2010.

But prior to the boom, citizens also organized to conduct “baseline” testing to measure the quality of their air before large-scale development took hold. In baseline testing, only seven of the 84 air contaminants typically tested for by TCEQ showed up in Argyle-Bartonville air samples.⁸⁴ As tank farms, compressor stations, pipeline and additional oil and gas facilities have moved into the area the Argyle-Bartonville Communities (ABC) Alliance began documenting individual health effects.⁸⁵ And TCEQ’s most recent testing — on the high school band practice lot — detected up to 65 of the 84 air contaminants usually tested for by the agency.⁸⁶

In October 2010, parents spoke at an Argyle school board meeting voicing their concerns about their children’s health. The day of the meeting, the ABC Alliance released a detailed account of students’ recent health problems, such as one who complained of unusual chest pains after running around the high school track.⁸⁷

“It’s ruining us,” Bartonville resident Kelly Gant told *The New York Times* in February 2011. She said her 14-year-old daughter and 11-year-old son have had severe asthma attacks, dizzy spells and headaches since a compressor station and a gas well were set up near her house about two years ago. “I’m not an activist,

an alarmist, a Democrat, environmentalist or anything like that,” Ms. Gant said. “I’m just a person who isn’t able to manage the health of my family because of all this drilling.”⁸⁸

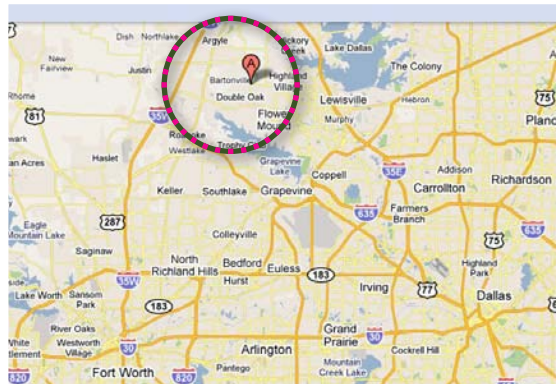
Members of the ABC Alliance began to keep track of the unusual health complaints they were experiencing since the increase in drilling activity. They noticed the timing of health complaints coincided with environmental events at the natural gas facilities in the area. They combined the health log information into a detailed list of incidents and the combined health effects were prepared, which in late 2010 Texas OGAP presented to the U.S. Environmental Protection Agency.⁸⁹

Residents reported a wide range of health effects, including abnormal menstrual bleeding and nosebleeds, rashes, chest pains and difficulty breathing, asthma attacks and an adult onset asthma diagnosis in a 40-year-old non-smoker, difficulty concentrating and overwhelming fatigue. In just one eight-day period – Nov. 13-21, 2010 – ten people in the neighborhood reported symptoms including coughing, sore throat, headache, nosebleed, burning or watering eyes, vomiting and joint pain.

Besides the health impacts, property values in Argyle and Bartonville are plummeting. One residence that was valued at \$361,000 on the 2009 tax rolls was valued at \$95,000 on the 2010 tax rolls.⁹⁰

The Argyle school district signed leases to allow gas drilling on its property and according to the *Denton Record Chronicle*, has received more than \$680,000 from the leases. But Susan Knoll, a Bartonville parent, pointed out that the royalties received would not even cover the cost of treating one child with a case of leukemia.

“You can’t put a price on keeping our kids healthy,” Knoll said.⁹¹



Top: Williams Energy Gulf Coast LP’s Argyle Central Facility 100 feet from residence. Photo by Susan Knoll

Bottom: Argyle and Bartonville residents protest as Argyle Central Facility is installed.

Case studies: poisoned families

3

CASE STUDIES: POISONED FAMILIES

Bob and Lisa Parr, Wise County

Bob and Lisa Parr and their 7-year-old daughter, Emma, live in the Allison community of eastern Wise County. Their 40 acres are graced with immense pecan trees, green pasture, a creek – and are surrounded by 21 gas wells.

Shortly after moving to the area in August 2007, Lisa Parr's previously excellent health began to deteriorate. She began having breathing difficulties, nausea and headaches. She had angry red rashes from the top of her head to the bottoms of her feet that have left her body scarred with pockmarks. She had oozing welts on her scalp and four ping-pong-ball-sized lumps on her neck. Eight doctors treated her over the course of a year. None could find an illness to blame her symptoms on, until a specialist suggested she might be suffering from environmental exposures.⁹²

She visited her neighbor, Christine Ruggiero (whose story follows), and compared her medical records with Ruggiero's log of spills, releases and air testing from the gas wells on their property. Her medical episodes coincided with the gas well activity.

On July 25, 2010, she called TCEQ complaining of strong odors of natural gas chemicals around her home causing dizziness and burning nasal passages. TCEQ investigator Damon Armstrong noted in his report that the operator, Aruba Petroleum, was in the process of using nitrogen to clear drilling fluids from the wellhead of a nearby rig. The emissions coming from the frack tank were visible to the naked eye and "were of such concentration and duration to affect the health of the investigator."

According to his report, while on the property Armstrong suffered from dizziness and a sore throat. A toxic vapor analyzer registered an average reading of over 2,500 parts per million. Armstrong collected air samples and detected concentrations of 20 chemicals, including benzene, at concentrations exceeding TCEQ's safe level for long-term health effects. Five were at concentrations exceeding safe levels for short-term health effects.⁹³

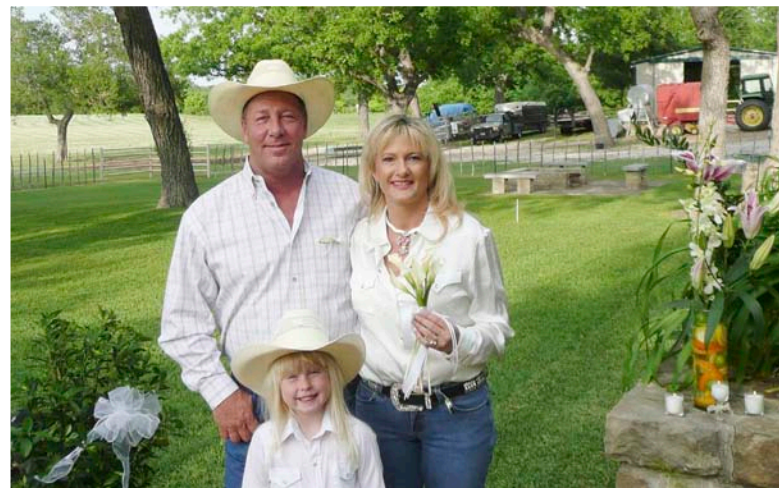
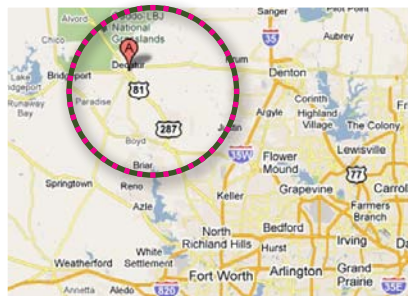
Four days later, Dr. William Rae of the Environmental Health Center in Dallas tested Lisa Parr's blood and lungs. In her blood and lungs he found more than 20 chemicals, including six that matched the VOCs detected by TCEQ's air sampling of the well site.⁹⁴

Lisa's husband and daughter are also having symptoms that may be related to gas drilling activity. Bob Parr has experienced loss of balance and neurological symptoms. He said he'd rarely had a nosebleed in his life, but in the last year had about three a week. Emma, too, had rashes and frequent nosebleeds: "She'd wake me up at 6 a.m., crying, covered in blood," said her mother.⁹⁵ Emma was recently diagnosed with asthma.

The Parrs contracted for private testing of their home and again found numerous chemicals matching the profile of the nearby well. The concentration of methane in her daughter's room, Lisa said, "was at asphyxiation levels." She later told the Wise County Messenger what happened next:

She showed the results to her doctor, who told her to leave her home within 48 hours.

"The doctor told me right then . . . I had to move immediately.



Bob, Lisa, and Emma Parr at their home in Wise County.

Used with permission by Lisa Parr.

Compound	Concentration (parts per billion)	Over short-term health AMCV	Over long-term health AMCV
1,2,4-trimethylbenzene	54	No	Yes
2,3-dimethylbutane	100	No	Yes
2-methylpentane	1100	Yes	Yes
2-methylheptane	260	No	Yes
2-methylhexane	500	No	Yes
3-methylheptane	230	No	Yes
3-methylhexane	420	No	Yes
3-methylpentane	730	No	Yes
Benzene	120	No	Yes
n-butane	13000	Yes	Yes
cyclohexane	460	No	Yes
n-heptane	900	Yes	Yes
n-hexane	1700	No	Yes
Isobutene	6800	No	Yes
Isopentane	3700	Yes	Yes
methylcyclohexane	720	No	Yes
methylcyclopentane	410	No	Yes
n-octane	520	No	Yes
n-pentane	3600	Yes	Yes
m & p-xylene	200	No	Yes

Chemicals found in the air near Aruba Petroleum well near Parr residence, July 25, 2010.

Because if I did not, we would have to spend more time and money on hospitalization, on chemotherapy and morticians for my whole family.⁹⁶

The Parris are now living at Bob's office in Denton, where there is no drilling nearby. Their health is greatly improved.

Tim and Christine Ruggiero, Wise County

On September 16, 2009, with no prior notice, Aruba Petroleum cut the fence around Tim and Christine Ruggiero's horse pasture, drove bulldozers onto their property and began building a pad site to drill two wells on their 10 acres in Allison, Wise County.

Six weeks later, Christine Ruggiero saw black, smoky liquid shooting out from the drilling rig, "across the waste pit and into the neighbor's trees." A week later, Christine and her 10-year-old daughter Reilly walked out of the house and found a "heavy cloud of diesel exhaust" coming from the drilling rig, surrounding their home and stretching out along the horizon for miles. Christine made a complaint to the TCEQ and escaped with her daughter to stay at a hotel that night. The TCEQ inspection report stated: "Continuous operations of three diesel engines greater than 400 horsepower at this site resulted in significant emissions of nitrogen oxides. An estimate of maximum nitrogen oxide concentration over one hour on the complainant's property was predicted to be 380 parts per billion."⁹⁷ No enforcement action was taken.

On January 10, 2010, as the Ruggiero family left for church, they saw men shoveling sand onto the drill site from a truck. Later that day, an anonymous caller informed them that Gilbow Oilfield Services had spilled approximately 9,000 gallons of wastewater the day before. Christine reported the spill to the Railroad Commission. The inspection report said the spill covered an area 30 by 60 feet, and ordered Aruba to immediately remove any fluids, excavate the area and "initiate and complete remedial clean-up operations." The Ruggieros never observed that the ordered remediation took place and the regulators did not follow up to enforce it.

After the second spill, the Ruggieros contracted with Wolf Eagle Environmental to test the spilled wastewater, the spilled drilling mud and the air around their property. Fifteen chemicals were found in the wastewater and mud, including benzene and toluene, in concentrations ranging from a trace to 1,500 parts per billion. Of the air samples, Wolf Eagle reported:

...numerous hydrocarbons indentified as Recognized and Suspected human carcinogens and neurotoxins. ...The compounds identified are known to emanate from processes related to the natural gas industry. The laboratory results confirmed fugitive air emissions exceeding TCEQ Effects-Screening Levels (ESLs) for Benzene (Long-Term), and Propane (Short-Term and Long-Term). In addition, concentrations of Methane were identified in levels that exceed ambient air background concentrations.⁹⁸

A week after the second spill, Christine Ruggiero noticed "a heavy chemical odor similar to propane" and complained to TCEQ. Two weeks after that, they filed a similar complaint. On both occasions, TCEQ staff took air samples with summa canisters and a GasFindIR infrared camera. They detected more than two dozen VOCs, including benzene, toluene and vinyl chloride. All but one of the compounds were in concentrations exceeding TCEQ's 1-hour safety limit for short-term health effects.⁹⁹



Christine Ruggiero and her thoroughbred mare, Sweetheart.

Photograph by Tim Ruggiero

Aruba has vented natural gas at the wells and brought in "workover rigs" numerous times.

There have been at least two more wastewater spills. In the spring of 2010, the Ruggieros observed bubbles rising from a wastewater pit or from puddles in their pasture, and discovered they could set the bubbles aflame with a lighter. In March 2010, the Railroad Commission inspected, and in April told the Ruggieros "The bubbles are believed to be a natural occurrence caused by a settling and compaction of the soil due to water saturation."¹⁰⁰



Ruggiero's home and property. Photo by Tim Ruggiero

In September 2010, the Wise County Appraisal Board devalued their property by 75 percent. Originally on the 2010 tax rolls for \$257,330, their home and 10-acre horse property are now worth \$75,240.¹⁰¹ "I wouldn't sell it for \$78,000," said Patsy Slimp, a board member and former real estate agent. "I could not sell this house in a clear conscience."¹⁰² The *Denton Record Chronicle* reported:

After the meeting, Tim and Christine Ruggiero had tears in their eyes.

Christine Ruggiero said she knew the day the drilling rig arrived that their property was lost, so the acknowledgement by the appraisal review board was not happy news.

They know they need to move in order to protect their daughter's health, Tim Ruggiero said, and that it's possible their credit could be ruined.

"The bank could call the note on our home tomorrow," he said, in which case he'd probably hand them the keys to the house.

Deborah Rogers, Fort Worth

Deborah Rogers lives in Westworth Village, a tiny municipality inside Fort Worth city limits, where more than 15 gas wells are located in one square mile. When Chesapeake Energy Corp. began drilling near her home, she reported bothersome odors to the TCEQ hotline but the response time was unsatisfactory because the emissions usually subsided by the time an inspector arrived hours later. She found it curious that just as TCEQ called to say they were on their way, the odors disappeared, so the inspector found nothing: "It was as though someone had shut off a valve, simple as that. That's when I knew these odors can be contained at will."¹⁰³

Rogers – a dairy owner, former financial analyst and member of the advisory board for the Federal Reserve Bank of Dallas – was likely the first person to ever conduct air testing around gas wells in North Texas. In May and June 2009, private environmental consultants and labs detected the following toxic air contaminants on her property: benzene, dichlorodifluoromethane, chloroform, m&p xylene, o xylene, 1,2,4 trichlorobenzene, toluene, carbon disulfide, dimethyldisulfide, methyl ethyl disulfide, methyl propyl disulfide, diethyl disulfide, ethyl, methylethyl disulfide, dimethyl trisulfide and ethyl n-propyl disulfide.¹⁰⁴ All of the sulfur-based compounds were found at levels above short-term and long-term TCEQ Effects Screening

Levels. The level of carbon disulfide was 300 times higher than U.S. EPA's normal limit for ambient urban air. Further testing confirmed the results, at slightly lower levels.¹⁰⁵

Rogers has experienced nausea from the strong odors and two massive nose bleeds that began with severe headaches. "The nosebleeds," she said, "are spontaneous and very frightening because the blood flows copiously and within seconds you are covered in blood. I have never had nose bleeds in my life either."

The same evening the first air sampling was conducted on her property, several of Deborah's perfectly healthy baby animals – two baby goats and six baby chicks – died of asphyxiation. After looking at the test results, Dr. E. Murl Baily, Jr., senior veterinary toxicologist at Texas A&M University, wrote a letter of concern to the mayor of Westworth Village concluding that the compounds were problematic to animals and human health as they move up the food chain in milk and meat.¹⁰⁶

In June 2009, Dr. David Sterling, Chair of Environmental and Occupational Health at UNT Health Science Center reviewed air testing results taken during flaring of a well near Deborah's farm. He wrote:

The compounds found range from those with acute primarily irritation issues, to oxygen deficiency potential (i.e. heavier than air and may accumulate low to the ground and in gulleys, displace oxygen, with potential asphyxiation), to chronic organ toxicity and known or suspect carcinogens. The levels during flaring exceeded in most cases the Texas Commission on Environmental Quality (TCEQ) effects screening levels, both long and short term, which are State levels of exposure to air toxins which can trigger adverse health effects.



Deborah Rogers,
owner of Deborah's
Farmstead.

Photo by Lee Chastain

Conclusion and RECOMMENDATIONS

The findings of the Texas Oil and Gas Accountability Project's investigation have implications for both state and national oil and gas policies and regulations. Too often citizen testimonies of health effects or evidence gathered by citizens are dismissed as anecdotal evidence; and as long as each case is treated as an isolated incident the larger pattern is ignored. But when so many citizens across almost two dozen counties report similar complaints and symptoms associated with gas drilling, something is wrong. More thorough research is needed if drilling and fracking can be done more safely and under what conditions and locations they should or should not be permitted. At the same time, immediate action is warranted to protect public health and the environment. Texas can, and must, do better.

Several state legislators have offered policy reforms in the 82nd Texas Legislature to protect citizens, the environment and public health. Promising legislation includes:

- SB 1049, by Sen. Wendy Davis, would require disclosure of chemicals used in hydraulic fracturing fluids to property owners and water users.
- SB 772, also by Davis, would require that fracking fluids contain tracer elements that could be used to identify the source of water contamination.
- HB 1226, by Rep. Lon Burnham, would reduce toxic air emissions by requiring vapor recovery units on storage tanks in the Barnett Shale.
- HB 1556, also by Burnham, would prohibit gas wells within 1,200 feet of public schools.

RECOMMENDATIONS:

- The Texas Commission on Environmental Quality must significantly step up its currently inadequate efforts to protect public health by strictly enforcing emission limits from oil and gas exploration and production equipment. TCEQ must require more facilities and units to meet emission limits and issue meaningful penalties for violations.

Several state legislators have offered policy reforms in the 82nd Texas Legislature to protect citizens, the environment and public health.



Photo by Kathy Chruscielski

- We heartily endorse the Sunset Commission's recommendation to replace the Texas Railroad Commission with an appointed oil and gas commission – in light of the Railroad Commission's shameful record, it is hard to imagine a single change that would mean greater protection for Texas landowners. In the meantime, the Railroad Commission must

also significantly step up its efforts. The Railroad Commission must adopt rules that ban the injection of diesel fuel in drilling operations and provide the public with full public disclosure of oil and gas drilling and stimulation fluids, including chemical constituencies and amounts. The Commission must implement a reporting requirement for hydraulic fracturing operations that documents the volumes of fracturing fluids used and recovered, as well as critical information relating to actual pressures used in fracturing operations, and estimated fracture sizes and extents.

- The Railroad Commission must step up its currently inadequate efforts to protect surface and groundwater resources from oil and gas contaminants. The Commission must implement rules requiring closed-loop drilling systems and water-based drilling fluids.
- The Texas Water Development Board must exercise its authority to evaluate groundwater resources and the impact that hydraulic fracturing withdrawal is having on groundwater resources. The agency must implement rules that require recycling of flowback water.

The EPA must identify the sources of methane contaminants in groundwater.

- Authority to regulate air emissions from oil and gas exploration and production equipment should be overseen by the U.S. Environmental Protection Agency. The EPA should oversee permitting of existing and future point sources through a federal advisory commission that includes citizen representation.

Endnotes

- Pickering Energy Partners, Inc. Oct. 2005. *The Barnett Shale – Visitors Guide to the Hottest Gas Play in the US*. Appendix B – Comparison of Organic Shales in the U.S. p.46. <http://www.tudorpickering.com/pdfs/TheBarnettShaleReport.pdf>
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- According to Armendariz reports that benzene, toluene, ethylbenzene and xylene, as well as trimethylpentane, n-hexane, were identified in a 2006 study that looked at air emissions from condensate tanks in Denton and Parker counties in the Barnett Shale. Concentrations were higher from Barnett Shale condensate tanks than from oil fields in other parts of Texas. (Source: Armendariz, A. Jan. 26, 2009. *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements*. Report prepared for Environmental Defense Fund. pp. 15-16. http://www.edf.org/documents/9235_Barnett_Shale_Report.pdf).
- Nine VOCs were found in the TxDSHS staff. But the TxDSHS samples were not identified by smokers vs. non-smokers. Looking at the date, one of the TxDSHS staff members was a smoker, because the chemical 2,5-dimethylfuran (a biomarker for smoking according to TxDSHS) was found in that person's blood. There were two other chemicals, benzene and ethylbenzene that were only detected in the blood of one of the TxDSHS staff. These two chemicals are known to be present in cigarette smoke. So, out of a total of 9 chemicals detected in TxDSHS staff, it's quite likely that only 6 were detected in non-smokers. (See Table 2, p. 28 of the TxDSHS Investigation).
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