

Reckless Endangerment While Fracking the Eagle Ford

GOVERNMENT FAILS, PUBLIC HEALTH
SUFFERS AND INDUSTRY PROFITS
FROM THE SHALE OIL BOOM

SEPTEMBER 2013

By

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For more information on this study go to: <http://eaglefordreport.earthworksaction.org>

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For 25 years, Earthworks has been working with communities and residents living in close proximity to oil and gas development to address potential links between health impacts and oil and gas development.

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For 25 years, Earthworks has been working with communities and residents living in close proximity to oil and gas development to address potential links between health impacts and oil and gas development.¹



Introduction

Oil and gas operations in shale formations release chemicals to air, water, and soil that are hazardous to human health. When operators act irresponsibly, these releases are exceptionally severe, and nearby communities are particularly at risk.

Government bears no small share of the blame for these releases because – **without exception – rules governing oil and gas development are inadequate to protect the public.** In addition to loopholes in bedrock federal environmental laws like the Safe Drinking Water Act and Clean Air Act, these inadequacies commonly include state failure to require measures to prevent or mitigate equipment failures, accidents or human errors that can lead to emissions of hazardous chemicals.²

These insufficient rules – again, without exception – are inadequately enforced.³ By failing to consistently apply rule and statute, and to penalize violators,⁴ regulators essentially condone reckless operator behavior, thereby placing the health of residents living near oil and gas development at risk.

Industry and state government insist that state regulation of oil and gas development best protects the public. But communities know differently, as this report details.

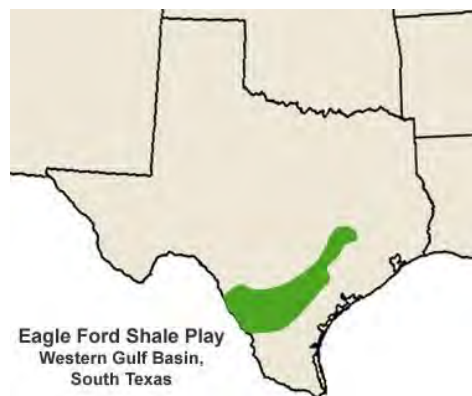
Without exception – rules governing oil and gas development are inadequate to protect the public. What rules there are, are inadequately enforced.

THE EAGLE FORD SHALE BOOM

The Eagle Ford Shale stretches from the Mexican border across South Texas and into East Texas. It is currently under intensive development because in addition to dry natural gas and natural gas liquids⁵ (also referred to as condensate), it also produces oil (which is more profitable than gas).⁶

The first Eagle Ford Shale well was drilled in 2008. By the end of April 2013, the Texas Railroad Commission (RRC) had issued 9,459 Eagle Ford drilling permits.⁷ RRC data show that oil production in the Eagle Ford Shale was approximately 130 thousand barrels per day (bpd) in 2011. As of March 2013, four times that amount was being produced from the Eagle Ford Shale (more than 500 bpd of oil).⁸ While dry natural gas and condensate liquid production are also on the rise, the increases in these products have been far less dramatic.⁹

One of the characteristics of oil and gas development in shale formations is that a high density of wells is required to sustain oil or gas production. Shale oil wells experience a dramatic, rapid decline in oil production compared to conventional oil wells. As a result, shale oil operators must intensively drill new wells to offset the loss of production from older wells.¹⁰ In the Eagle Ford Shale, some operators are beginning to drill one well per 65 or even 40 acres.¹¹



For citizens living amidst the development, forty-acre spacing means that there could be more than a dozen wells drilled within a one-mile radius of a family's home.¹² It also means: long periods of time during which wells are being drilled in close proximity to their homes; the addition of other facilities

such as oil processing and waste disposal sites nearby; and increased truck traffic to service the ever-growing number of wells.

As detailed in this report, shale oil development also brings a decrease in air quality. And as more wells and facilities come into an area, it becomes more and more likely that there will be accidental, scheduled and negligent releases of large quantities of toxic air pollutants.

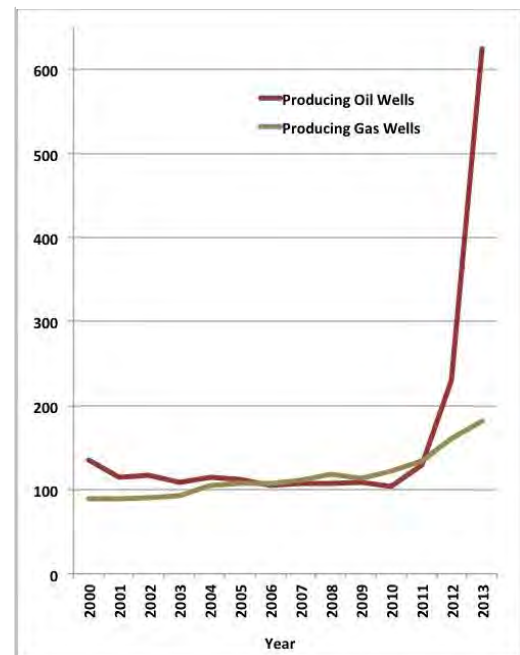
THE SHALE OIL BOOM IN KARNES COUNTY

Karnes County is within the core—the area with the most intensive oil development and potential for future growth— of the Eagle Ford Shale.¹³

There is a history of some oil and gas development in the county, but drilling has skyrocketed in the past couple of years. As seen in Table 1, oil development in Karnes County started to increase in 2011, but experienced a dramatic surge between 2012 and 2013. Development of gas wells has also increased in the past couple of years, but their growth has not been as strong as it has been for oil wells.

As of February 2013, there were 625 producing oil wells and 182 producing gas wells in Karnes County.¹⁴ Since November 2012, Karnes County has consistently been the top oil-producing county in the Texas.¹⁵

TABLE 1: Wells in Karnes County



OIL & GAS AIR POLLUTION AND ITS HEALTH IMPACTS

There are a variety of sources of air emissions common to oil and gas operations.¹⁶ Sources include:

- engines or turbines used to power pumps, drill rigs, compressors and vehicles;
- heaters and boilers
- process vents and flares from oil and gas treatment equipment (glycol dehydrators; separators; heater-treaters)
- losses during loading/unloading of oil/gas/produced water
- storage tanks for crude oil, condensate and produced water
- open-top fracturing liquid containers;
- pits/waste impoundments;
- pumps or other artificial lift equipment
- pneumatic devices

- leaks and fugitive emissions from pipelines and wellhead equipment (valves, connectors, flanges, pumps and others); separators, storage tanks);
- venting or flaring of gas during well completions and well testing.

The long-term cumulative health risks posed by the various sources of air emissions have not been studied in the Eagle Ford Shale. Early results from a long-term study in Pennsylvania suggest that air pollution from Marcellus Shale gas operations in that state may be contributing to a host of symptoms including breathing problems, headaches, dizziness and eye irritation.¹⁷

Studies from other oil and gas producing areas indicate that emissions during drilling and hydraulic fracturing operations can result in localized air quality levels that are detrimental to human health.

- In 2010, the Colorado School of Public Health published a study indicating higher risks for cancer and other health problems from poor air quality near gas wells that were hydraulically fractured. Within about a mile of these sites, researchers found elevated levels of benzene as well as chemicals that can irritate eyes and cause headaches, sore throats, or breathing difficulties.¹⁸ (To date, there have been 18 wells drilled and hydraulically fractured within a mile of the Cerny home, and 34 within 2 miles.)
- A 2012 peer-reviewed study published in *Science of the Total Environment* used air sampling data from Colorado and found that due to the toxicity of air emissions near natural gas sites, residents living within ½-mile of well sites had a greater risk of health-related impacts than those living further away.¹⁹ Additionally, the study found that the greatest health impact corresponded to the relatively short-term, but high emission, well completion period.²⁰ (There are currently three wells that are approximately ½-mile from the Cerny home.)
- A third peer-reviewed study to be published in the journal *Human and Ecological Risk Assessment*, sampled air before, during and after drilling and hydraulic fracturing of several natural gas wells on a single pad in Colorado. During the drilling and hydraulic fracturing phase, dozens of non-methane hydrocarbons were detected in the air near the well pad, including some chemicals known to harm the brain and nervous system. Of note, researchers detected PAHs at concentrations associated with developmental effects on children.²¹ (It is likely that due to the flaring of gas that contains propane, PAHs are being released from the Eagle Ford Shale.)

During the drilling and hydraulic fracturing phase, dozens of non-methane hydrocarbons were detected in the air near the well pad, including some chemicals known to harm the brain and nervous system. Of note, researchers detected PAHs at concentrations associated with developmental effects on children.

In addition to air emissions during the drilling and hydraulic fracturing phase of development, air pollution associated with gas flaring and venting during any stage of production (e.g., casinghead gas, processing facilities, fugitive emissions) “poses a significant health risk for local communities and for people who work in these oil fields.”²²

The balance of this report discusses air contaminants associated with oil and gas operations in Texas's Eagle Ford Shale, their impacts on the health of residents of Karnes County, and the failure of state regulators to protect its citizens from these impacts.

To illustrate some of the potential impacts related to the intensive development occurring in the Eagle Ford Shale, the report highlights and uses examples experienced by one family in particular.

THE CERNY FAMILY

The Cerny family lives in Karnes County, near Karnes City. Early in 2012, Myra Cerny contacted Earthworks because she, her husband Mike, and 15-year-old son Cameron were experiencing a variety of new health problems. Myra wondered if her family's deteriorating health was caused by the strong odors and fumes from shale oil and gas development surrounding her home.

In September 2012, Earthworks' visited the Cernys and found the situation alarming:

- Black smoke billowing off flares and haze hanging over the horizon;
- Dust boiling into the air from newly bladed pad sites and from trucks and heavy equipment traffic on newly created roads;
- The odor of rotten eggs, garlic, a sickly sweet smell and hydrocarbons.

On March 4 – 5, 2013, representatives of Earthworks and ShaleTest²³ traveled to Karnes City to conduct an investigation of the Cernys' complaints, take air quality samples and look for fugitive emissions of gas from Eagle Ford Shale facilities close to the Cerny family's home.

“It's not *if*, it's *when* you are going to get sick...We have a 15-year-old son and we cannot protect him [from the fumes].”

—Mother, Myra Cerny



Cameron Cerny

In 2010 and 2011, the TCEQ (Texas Commission on Environmental Quality) conducted a special inventory of air emissions from Barnett Shale operations. The TCEQ has not yet released a similar inventory of emissions from oil and gas sources in the Eagle Ford Shale. According to the Eagle Ford Shale Task Force, there is, however, an emissions inventory being developed by the Alamo Area Council of Governments with the assistance of the oil and gas industry in Eagle Ford Shale. That inventory is expected to be released by the end of 2013.

Typically, raw natural gas that emerges from an oil well is a mixture of methane and other hydrocarbons (e.g., ethane, propane, butanes, and pentanes). Depending on the location, the gas may also contain water vapor, hydrogen sulfide (H₂S), carbon dioxide (CO₂), helium, nitrogen, and other compounds. Direct venting of this gas releases a significant amount of methane into the atmosphere along with H₂S and volatile organic compounds (VOC), which include cancer-causing pollutants and air toxics such as benzene.³²

When this gas is burned or flared, it primarily produces carbon dioxide (CO₂) and carbon monoxide (CO), with smaller volumes of a variety of air pollutants such as VOCs, nitrogen oxides (NO_x), sulfur dioxide (SO₂), toxic heavy metals, and black carbon soot.³³ Flaring of propane-rich gas produces soot emissions and many polycyclic aromatic hydrocarbons (PAH) attached to soot particles, including naphthalene, acenaphthalene, fluorene, phenanthrene, fluoranthene, and pyrene.³⁴ Some of the gas flared in the Eagle Ford Shale contains propane, and so is likely to produce at least some PAHs when flared.³⁵

In 2012, the U.S. Environmental Protection Agency (EPA) enacted a new rule that requires natural gas wells to capture gas during well completions instead of venting or flaring it (“green completions”). When the rule is fully in effect in 2015, EPA estimates that VOC emissions from natural gas well completions will be reduced by 95%.³⁶ EPA was unable to quantify the health benefits, but expects the rule will reduce health effects associated with exposure to hazardous air pollutants, ozone and particulate matter.³⁷

Unfortunately for residents living in shale oil territory, oil wells like those in the Eagle Ford Shale are not subject to these new EPA regulations requiring “green completions”.³⁸

FLARED/VENTED CASINGHEAD GAS

Many oil wells also produce natural gas. This gas is referred to as casinghead gas or associated gas. Options for managing casinghead gas include building pipelines to transport the gas, flaring or venting the gas at the wellhead, or using the gas on-lease.

According to the Eagle Shale Task Force, “Flaring of casinghead gas for extended periods of time may be necessary if the well is drilled in an area new to exploration where infrastructure is limited. In existing production areas, flaring also may be necessary because existing pipelines may have insufficient capacity or are otherwise unable to take the gas.”³⁹ A recent report by the Alamo Area Council of Governments suggests that at least some “oil wells in the Eagle Ford vent casinghead natural gas.”⁴⁰

The RRC issues 45-day permits for flaring or venting of casinghead gas, but extensions can be granted to allow releases for up to 180 days.⁴¹ RRC requires operators to report casinghead gas released on a lease-by-lease basis (a lease may have more than one well), but does not require operators to specify whether the gas was flared or vented.⁴² There is also no requirement for operators to provide RRC with an analysis of the hazardous components being released in the gas.

An upcoming rule will reduce VOC air pollution from natural gas wells by 95%. Unfortunately for Eagle Ford Shale residents, this rule will not apply to shale oil wells.



Flaring from one of the many wells near the Cerny home.

As with the venting and flaring of completion gas, venting of casinghead gas releases VOCs and other components of raw gas (e.g., methane, and H2S and other air toxics, if present) into the air, while flaring releases CO2, CO, VOCs, NOX, SO2, possibly PAHs and other partially combusted hydrocarbon compounds.

The following table shows that a large volume of casinghead gas has been released near the Cerny home. Data from the RRC reveal that from November 2011 to March 2013 between 4 and 21 thousand cubic feet (mcf) of casinghead gas was either vented or flared each month from wells located within 2 miles of the Cerny's home.⁴³

TABLE 3. Casinghead gas flared/vented from oil leases near the Cerny home

| Lease | Miles from Cerny home | Total Gas vented / flared (mcf) | Nov 2011 | Dec 2011 | Jan 2012 | Feb 2012 | Mar 2012 | Apr 2012 | May 2012 | Jun 2012 | Jul 2012 | Aug 2012 | Sep 2012 | Oct 2012 | Nov 2012 | Dec 2012 | Jan 2013 | Feb 2013 | Mar 2013 |
|-------------------------|-----------------------|---------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Tipton-Jonas Unit | 0.52 - 1.81 | 2,340 | | | | | | | | 259 | 333 | 661 | 351 | 736 | | | | | |
| Brysch-Adams Unit | 0.53 - 0.7 | 4,627 | | | | | | 65 | 1155 | 353 | 374 | 942 | 503 | 1235 | | | | | |
| Adams-Tipton Unit | 0.6 - 0.7 | 6,332 | | | | | | 1880 | 886 | 206 | 396 | 1037 | 525 | 1349 | | | 53 | | |
| Brysch-Jonas Unit C | 0.74 | 2,400 | | | | | | | 451 | 339 | 220 | 190 | 353 | 848 | | | | | |
| Brysch-Jonas Unit B | 0.75 | 2,244 | | | | | | | 678 | 240 | 88 | 265 | 365 | 608 | | | | | |
| Holland-Brown Unit | 0.84 | 4,302 | 488 | 430 | 257 | 71 | 319 | 403 | 248 | 99 | 209 | 487 | 248 | 1043 | | | | | |
| Holland-Opiela Unit | 0.84 | 3,798 | | 208 | 299 | 246 | 403 | 549 | 353 | 89 | 205 | 511 | 201 | 734 | | | | | |
| Culberson-Patteson Unit | 0.89 | 1,383 | | | | | | | | | | | | 1383 | | | | | |
| Brysch-Jonas Unit | 0.91 | 3,121 | 465 | 328 | 286 | 225 | 111 | 236 | 231 | 88 | 74 | 100 | 183 | 794 | | | | | |
| Gilley Unit | 0.91 - 1.81 | 4,072 | 120 | 96 | 76 | 76 | 63 | 155 | 36 | 0 | 28 | 59 | 685 | 2678 | | | | | |
| Yosko Borgfeld Unit | 1.02 | 3,703 | 566 | 428 | 488 | 10 | 127 | 374 | 254 | 57 | 57 | 74 | 183 | 1,085 | | | | | |
| Yosko Unit | 1.13 | 7,046 | 1,885 | 1,324 | 567 | 567 | 438 | 612 | 279 | 56 | 73 | 119 | 232 | 894 | | | | | |
| Buerhing Unit | 1.17 | 3,627 | 790 | 532 | 252 | 252 | 202 | 434 | 215 | 210 | 242 | 168 | 130 | 200 | | | | | |
| Yosko-Kinkler Unit | 1.2 | 2,390 | 220 | 173 | 165 | 197 | 245 | 182 | 182 | 21 | 34 | 56 | 178 | 737 | | | | | |
| Brown-Dupnik Unit | 1.24 | 3,309 | | | | | | | 218 | 278 | 442 | 883 | 437 | 1,051 | | | | | |
| Vajdos-Foegelle Unit | 1.26 - 1.5 | 4,381 | | | | | 551 | 237 | 598 | 208 | 383 | 1,316 | 519 | 569 | | | | | |
| Zaeske-Eckols Unit | 1.66 | 5,943 | | | | | | | | | | | | | | | | | |
| Davenport Unit | 1.75 | 6,937 | | | | | | 3,435 | 561 | 465 | 191 | 217 | 243 | 831 | | | | | |
| Jordan Unit | 1.75 | 18,694 | 2,604 | 1,082 | 453 | 453 | 383 | 398 | 243 | 232 | 235 | 91 | 73 | 690 | | | | | |
| Chapman-Rogers Unit | 1.77 | 4,926 | 7,530 | 3,756 | 1,691 | 1,691 | 1,192 | 1,131 | 59 | 55 | 51 | 222 | 166 | 825 | 325 | | | | |
| Kimble-Gilley Unit | 1.77 | 13,785 | 808 | 567 | 464 | 213 | 206 | 324 | 430 | 70 | 70 | 95 | 317 | 1362 | | | | | |
| Hedtke-Henke Unit | 1.87 | 4,204 | | | | | | 1675 | 3710 | 3591 | 3550 | 139 | 78 | 1042 | | | | | |
| Franke-Unit | 2.01 | 1,683 | | | | | | | | | 631 | 223 | 214 | 244 | 138 | 66 | 79 | 34 | 54 |
| TOTAL (1,000 mcf) | | 115.2 | 15.5 | 8.9 | 5.0 | 4.0 | 4.2 | 13.6 | 11.6 | 7.1 | 8.2 | 8.1 | 6.5 | 21.4 | 0.463 | 0.066 | 0.132 | 0.034 | 0.054 |

MIDSTREAM SOURCES OF POLLUTANTS

Midstream sources are facilities that transport, handle, process, and distribute oil and gas products and wastes. Examples include: compressor stations, processing facilities, cryogenic plants, tank batteries, saltwater disposal sites, and pipelines, among others. Large emission sources at midstream facilities include heater/boilers, glycol dehydrators, compressor engines, storage tanks, flares/combustors, losses during loading of condensate and wastewater, scheduled releases (blowdowns) and accidental releases and leaks (i. e., fugitive emissions).⁴⁴

Within 3 miles of their home, Facilities are allowed to emit 374 tons of VOCs per year, and 225 tons of NOx, and 16 tons of HAPs.



Below are the midstream oil and gas facilities within 3 miles of the Cerny home in the TCEQ air permits database.⁴⁵ As seen in the table, these facilities are allowed to emit up to 374 tons of VOCs per year, as well as close to 225 tons of nitrogen oxides (NOx), 170 tons of carbon monoxide (CO), 14 tons of particulate matter (PM), 23 tons of sulfur dioxide (SO₂), 0.3 tons of hydrogen sulfide (H₂S), and at least 16 tons of hazardous air pollutants (HAPs).

TABLE 5. TCEQ-permitted emissions from midstream oil and gas facilities close to the Cerny home

| Midstream Facilities | Miles from Cernys | VOC | | NO _x | | CO | | PM _{10 OR 2.5} | | SO ₂ | | H ₂ S | | HAP | |
|---|-------------------|------------|------------|-----------------|------------|-----------|------------|-------------------------|-----------|-----------------|-----------|------------------|------------|-----------|-----------|
| | | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy | lbs/hr | tpy |
| Gilley 1 Production Facility ⁴⁶ | 0.86 | 70.3 | 13.8 | 0.75 | 2.35 | 1.23 | 3.52 | 0.02 | 0.09 | 1.42 | 1.08 | 0.02 | 0.01 | ND | ND |
| Buehring 1 Production Facility ⁴⁷ | 1.21 | 105.15 | 13.8 | 0.68 | 2.98 | 0.80 | 3.53 | 0.04 | 0.19 | 0.17 | 0.75 | 0.05 | 0.01 | 6.7 | 0.99 |
| Sugarhorn Central Facility ⁴⁸ | 1.31 | 39.45 | 80.25 | 16.9 | 56.57 | 14.32 | 24.85 | 0.79 | 3.65 | 6.81 | 11.10 | 0.09 | 0.15 | 3.71 | 14.65 |
| Jordan Davenport Prod. Facility ⁴⁹ | 1.73 | 107.0 | 15.2 | 1.45 | 4.17 | 2.29 | 5.69 | 0.04 | 0.14 | 0.48 | 1.29 | 0.03 | ND | 0.56 | 0.09 |
| Kimble Gilley (emissions sources removed from site Oct. 2012) ⁵⁰ | 1.77 | 70.3 | 17.1 | 1.57 | 4.76 | 2.59 | 7.08 | 0.08 | 0.33 | 0.36 | 1.19 | 0.03 | 0.01 | ND | ND |
| East Sugarloaf Central Facility ⁵¹ | 2.62 | 17.3 | 72.4 | 11.3 | 49.0 | 6.85 | 29.3 | 0.70 | 3.07 | 0.25 | 1.09 | 0.005 | 0.020 | ND | ND |
| East Longhorn Central Facility ⁵² | 2.67 | 14 | 59.5 | 6.58 | 28.6 | 4.26 | 18.3 | 0.44 | 1.93 | 0.66 | 2.85 | 0.01 | 0.04 | ND | ND |
| Kotara Production Facility ⁵³ | 2.72 | 12.11 | 8.97 | 7.41 | 28.15 | 12.05 | 44.22 | 0.16 | 0.58 | 0.01 | 0.04 | ND | ND | 0.16* | 0.68* |
| Pfeifer No 1. Production Facility ⁵⁴ | 2.84 | 5.74 | 19.9 | 1.16 | 4.65 | 1.76 | 6.94 | 0.08 | 0.30 | 0.04 | 0.14 | <0.001 | 0.002 | ND | ND |
| North Longhorn Central Facility ⁵⁵ | 2.95 | 31.72 | 82.62 | 12.84 | 44.65 | 11.74 | 23.32 | 0.64 | 2.79 | 0.84 | 3.65 | 0.012 | 0.05 | ND | ND |
| TOTAL EMISSIONS (tons per year) | | 473 | 384 | 61 | 226 | 58 | 167 | 3 | 13 | 11 | 22 | 0.3 | 0.3 | 11 | 16 |

VOC = volatile organic compound NO_x = nitrogen oxides CO = carbon monoxide PM_{10 or 2.5} = particulate matter of 10 or 2.5 microns SO₂ = sulfur dioxide H₂S = hydrogen sulfide HAP = hazardous air pollutants ND = no data * = the only HAP was formaldehyde

Fugitive emissions and unplanned emissions events

Fugitive emissions occur when raw gas is released to the atmosphere through equipment leaks, equipment failures, or human error, such as when tank hatches are left open. Depending on where in the process the leaks occur (i.e., before or after the gas is processed), these emissions will contain methane, and may contain VOCs, H₂S and other compounds found in natural gas.⁵⁶

Residents living near oil and gas facilities are also exposed to emissions that occur during planned “maintenance, startup and shutdown” (MSS) of equipment. MSS emissions may occur due to normal operations such as regular maintenance, or result from unplanned events such as blowdowns, pipeline pigging and tank de-gassing. There are also MSS events that arise when production units break down and gases have to be vented or routed to emergency flares.⁵⁷

According to the Environmental Integrity Project (EIP), between 2009 and 2011 unplanned “emission events” at natural gas operations in Texas (e.g., compressors, processing facilities, storage tanks) released more than 36,000 tons of sulfur dioxide and 38,000 tons of smog-forming volatile organic compounds (VOCs). EIP based its analysis on industry reports filed with TCEQ.⁵⁸

As will be seen later in this report, FLIR videos taken by ShaleTest and obtained through public information requests to TCEQ indicate that there are fugitive emissions and venting from many facilities in Karnes County. These emissions were not quantified during the Earthworks field visit.

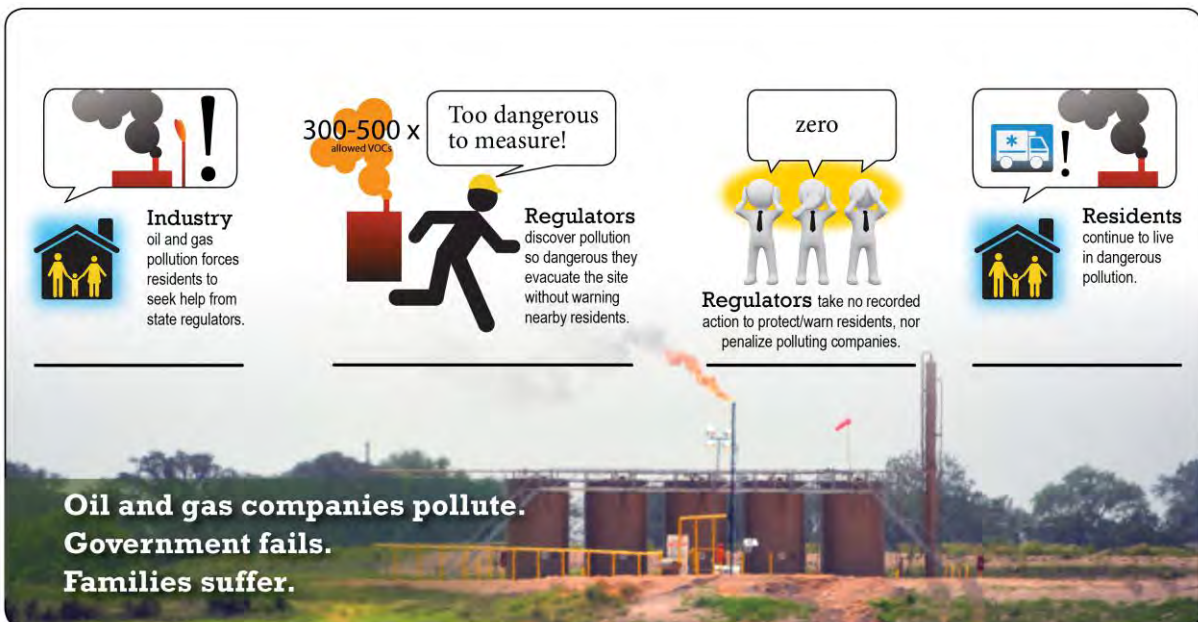


State regulators fail to protect the public

AIR QUALITY COMPLAINTS IN KARNES COUNTY

The Cernys are not alone in noticing and expressing concern about how air quality has been affected by the arrival of drilling rigs and shale oil facilities. Between 2006 and July 2013 more than 30 air complaints related to oil and gas operations in Karnes County were filed with TCEQ. (See Appendix 2.)

Citizens complained of odors, which they described as bad, terrible, sulfur-like, H₂S, rotten egg, crude, petroleum, chemical, dust, and more. In addition to odors, citizens sometimes complained that while smelling the odors they could not go outside. The complainants associated the odor events with symptoms such as headaches, nausea, rashes, vomiting, burning eyes/nose/throat, nosebleeds and other effects.



The Cernys have registered complaints with both the RRC and TCEQ on numerous occasions, and at least one of these complaints resulted in an investigation by TCEQ, and the discovery of air emissions violations.

AIR QUALITY INVESTIGATIONS NEAR THE CERNY HOME

Sugarhorn Facility—Marathon Oil EF, LLC

1. VOC readings are so high, it is unsafe for inspectors, and presumably for nearby residents

According to documents obtained by Earthworks through an Open Records request filed with TCEQ, in 2012 there were four visits by TCEQ inspectors and two additional compliance investigations at the Sugarhorn Central Facility operated by Marathon Oil EF LLC in Karnes County. The Sugarhorn facility is approximately 1.3 miles south-west of the Cerny home. (See Figure 1).

The first four site visits took place on February 3, March 1, June 15 and 30 2012. On February 3, a flare at the facility was observed to be emitting black smoke over a period of more than 15 minutes.⁵⁹ During two other visits, elevated concentrations of VOCs were measured using a Toxic Vapor Analyzer (TVA): March 1, TVA detected a maximum of 24 ppm; June 15, TVA detected 132 ppm.⁶⁰ Inspectors did not test for VOCs during the other two inspections.⁶¹

VOC levels were so high that the inspectors left the site. But they did not take further action to reduce pollution, cite the operator, nor warn residents.

According to a TCEQ investigation summary, “upwind and downwind Summa canister samples would be taken only when the TVA monitor reads 5 parts per million (ppm) or greater above background and a receptor was within a quarter of a mile.”⁶²

No canister samples were taken during these investigations, even though on two occasions VOC levels were well above 5 ppm, and there appeared to be receptors within ¼ mile. The June 15, 2012 investigation notes stated:

*“TVA measured 132 ppm VOCs downwind of the facility. Canister samples were not taken as the **VOC measurement was too high to safely obtain the samples** [emphasis added].”⁶³*

Although an exact distance to the nearest receptor was not obtained, the inspector’s notes estimated the nearest receptor was “yards” away.⁶⁴

It is not uncommon for TCEQ inspectors to leave oil wells and processing sites for safety reasons (see Yosko investigation below). This is an important precaution, as it is essential to protect TCEQ-employee safety, but it is extremely troubling that there is apparently no step taken to either warn nearby residents of the chemicals in the air, or to take canister samples at nearby receptors in order to try to determine residents’ potential exposure to the chemicals emanating from the facility.⁶⁵

2. In addition to measuring high VOCs, inspectors documented emissions at the Sugarhorn facility using a Gas Find Infrared Camera (IR camera) and observations:

- June 15, 2012: IR camera “indicates hydrocarbon emissions from the enardo valves on oil tanks, as well as condensate tanks and water tank. Generator near flare emitting smoke.”⁶⁶
- June 30, 2012: IR camera “indicated extensive hydrocarbon emissions from the two vent lines on the black production tanks that were going offsite.”⁶⁷



Sugarhorn facility, June 15, 2012 Infrared camera indicates extensive hydrocarbon emission. <http://eaglefordreport.earthworksaction.org>

Video recorded by TCEQ inspectors.

3. Inspectors find violations

On August 15 and September 5, 2012, TCEQ performed compliance investigations at the Sugarhorn facility in response to a complaint received from Myra Cerny on August 14, 2012, of sulfur and petroleum like odors from nearby oil and gas facilities. As stated in the investigation report “Complainant sees flares smoking. Family member is getting nose bleeds and complainant is suffering from rashes and eye irritants.”⁶⁸

On August 15, 2012, TCEQ inspectors used an IR camera and identified emissions coming from vents located on top of petroleum storage tanks at the facility. The investigators, however, could not get downwind of the facility to detect odors.⁶⁹

Marathon operators report emission violations 3 months later, instead of the required 24 hours.

On September 5, 2012, TCEQ inspectors documented that the enclosed barrel flare at the facility was not burning. TCEQ informed Marathon of the inoperative flare that same day.⁷⁰ Because of the wind direction, investigators could not get downwind of the facility to detect odors or record emissions using handheld monitoring devices.⁷¹

4. Excessive air pollution from Sugarhorn releases

Marathon was supposed to report the emission events within 24 hours of their occurrence, but failed to do so for more than three months.⁷² On December 20, 2012, Marathon reported to TCEQ that the August 15, 2012, emissions event at the Sugarhorn facility involved venting from petroleum storage tanks, and lasted 12 hours. As seen in Table 6, the event caused the release of various carcinogenic chemicals such as benzene, toluene, ethylbenzene and xylenes (collectively known as BTEX), more than 500 times the “maximum allowable emissions rate” of VOCs and more than 100 times the allowable emission of H₂S in Marathon’s permit.⁷³

Marathon’s report indicated hydrogen sulfide emissions 112 times the allowable rate, and VOCs at 514 times the allowable rate.

TABLE 6. Air emissions from two events at the Sugarhorn Central Facility (Aug. 15 and Sept. 5, 2012)

| | Emissions (lbs) | Emissions (lbs/hr) | Allowable emissions in permit (lbs/hr) | Exceedence |
|-------------------------|------------------|--------------------|--|---|
| August 15 | 12-hour period | | | |
| Benzene | 42 | 3.5 | | |
| Toluene | 58 | 4.8 | | |
| Ethylbenzene | 4 | 0.4 | | |
| Xylenes | 33 | 2.7 | | |
| Hydrogen sulfide | 1.35 | 0.1 | 0.001 | 112.5 times permitted emissions rate |
| Propane | 8,535 | 711.3 | | |
| Other VOCs | > 10,000 | > 833 | 1.62 | 514 times a permitted emissions rate |
| September 5 | 11.5-hour period | | | |
| Benzene | 27.63 | 2.4 | | |
| Toluene | 38.34 | 3.3 | | |
| Ethylbenzene | 2.76 | 0.24 | | |
| Xylenes | 21.54 | 1.87 | | |
| Hydrogen sulfide | 0.88 | 0.077 | 0.001 | 77 times permitted emissions rate |
| Propane | 5,607 | 711 | | |
| Other VOCs | > 6,600 | > 574 | 1.62 | 354 times permitted emissions rate |

According to Marathon, on September 5, 2012, the enclosed barrel flare failed to operate over a time period of 11 hours and 30 minutes. Marathon again reported releasing BTEX, hydrogen sulfide, and over 6,600 of other volatile organic compounds. This is more than 350 times the maximum allowable emissions rate for VOCs in Marathon’s permit, and more than 75 times the allowable emissions rate for H₂S.⁷⁴

5. No penalty for violations

On January 24, 2013 Marathon was issued Notices of Violation for: 1) failing to operate the facility with all air pollution emissions capture and abatement equipment working; and 2) late reporting of emissions events; exceeding emissions represented in an air permit.⁷⁵

On February 19, 2013 Marathon sent a letter to TCEQ indicating that the company had provided various awareness trainings to its employees to make sure that they knew how to operate flares properly and could recognize emissions events. According to TCEQ, these trainings resolved the violations.⁷⁶

No further enforcement action, such as issuing a fine or penalty, appears to have been taken.⁷⁷

The investigation and enforcement record at the Sugarhorn central facility raises many concerns:

- Because no canister samples were taken during any of the inspections and investigations it is not clear how these various emissions may have affected the health of the Cernys and other nearby residents.
- The August and September emissions incidents were caught by TCEQ inspectors because they were investigating the Cerny's complaint and happened to be on site to capture the emissions on IR camera. This raises the question of whether there were other periods when toxic contaminants were being vented from this site but were not caught because TCEQ was not there.
- It's clear that in addition to the August and September 2012 violations found by TCEQ there was a history of problems at this site. TCEQ documented emissions from vents, valves and storage tanks using an IR camera, and had detected high VOC readings at the site in March and June 2012. Also, the venting storage tanks from the August 15 event were found to be venting again on December 18, 2012.⁷⁸ Marathon's failure to report the emissions from the August and September events within the required 24-hour reporting period shows a disregard for the law and for public safety. Even after TCEQ met with Marathon about the emissions events, it took the company two months to file the required reports.⁷⁹ These behaviors suggest an ongoing pattern of inattention by Marathon regarding emissions from this facility. Yet TCEQ chose to not penalize the company for its non-compliance.

Kimble-Gilley Facility—Marathon Oil EF, LLC

In response to the Cerny's complaint made August 14, 2012, TCEQ investigators visited Marathon Oil EF LLC's Kimble Gilley facility on September 5, 2012. The site is located approximately 1.8 miles from the Cerny home. During the visit, TCEQ investigators noted "very light sour crude type odors" intermittently, at the facility gate. The investigators wrote that, "with southerly winds this facility could contribute or be a possible source of odors detected by the complainant."⁸⁰

1. Violations noted

Investigators observed emissions coming from a barrel flare and from different vents located on top of the petroleum storage tanks. The investigators concluded that "The enclosed barrel flare located at the Kimble Gilley Production Facility was not burning and was releasing unburned hydrocarbons," in violation of the 30 Texas Administrative Code 116.110(a).⁸¹

2. No penalty for violation

Marathon did not receive any fines/penalties for this violation. TCEQ concluded that, "this violation is resolved since the equipment at the Kimble Gilley Production Facility has been removed."⁸²

- 3. To repeat:** the company was allowed to violate TCEQ rules and pollute the air, but was not penalized because the company removed the offending equipment. Yet nearby neighbors were not only inconvenienced, but were likely exposed to unhealthy levels of air contaminants. Also, it does not appear that Marathon ever reported this emissions event, so there is no information on the duration of the event, or the amount of toxic pollution released into the air.

Yosko Number 1 Production Facility—Marathon Oil EF, LLC

On January 30, 2012, a complaint of a “rotten egg” odor and mist that burned the eyes and nasal area was registered with TCEQ. The source of the odors/mist was not known. Investigators from TCEQ visited a number of facilities on February 3, but did not detect any odors.

On March 1, 2012 investigators visited several sites including the Yosko Number 1 Production Facility, which had not been visited on February 3. The No. 1 site is approximately 1.13 miles northeast of the Cerny home. (See Figure 1.) The complaint was filed by a landowner living 0.73 miles southwest of the well.⁸³

1. VOC levels unsafe for inspectors and presumably for nearby residents

At this site, the Toxic Vapor Analyzer detected 1,100 ppm near a piece of equipment called a separator. The leak was also visible with the IR camera. According the investigation report:

“The Recon team evacuated the area quickly to prevent exposure...This facility is located less than a mile from the Complainant’s residence.”⁸⁴

It is unclear whether nearby residents were in danger because TCEQ inspectors did not record VOC levels at nearby residences. The complainants residence was 0.73 miles away. The closest residence was approximately 400 feet.



Winds from the northeast would have transported the chemicals directly to the closest home. It is unclear how long the Yosko site had been leaking VOCs. The initial complaint was filed on Jan. 30, 2012, but TCEQ did not find the leak at the Yosko site until March 1st.

3. No violation issued

Despite the fact that a leaky valve created VOC concentrations that forced TCEQ employees to evacuate the site, no violation was issued for this pollution event. TCEQ sent an email to Marathon on March 2 stating that, "Repair, replacement, or shut down of this unit should occur as soon as possible, as the alternative shall be recommendation of a nuisance violation." On March 5, Marathon responded stating that the leak had been repaired on March 1.

The investigation report concluded by stating that, "No nuisance was verified by the investigator during this investigation at this time... although no nuisance violation was verified, it is possible that the leak around the valve near the pneumatic controller at the Yosko Number 1 Production Facility...may have created a nuisance odor situation."⁸⁵

Despite the fact that a leaky valve created VOC concentrations that forced TCEQ employees to evacuate the site, no violation was issued for this pollution event.

Earthworks and Shale Test Investigation

METHODS

In order to identify the presence of pollutants that might be linked to both shale oil development and health symptoms being experienced by the Cerny family, air tests and monitoring were conducted using:

Summa Canisters – air samples were taken using stainless steel Summa canisters. The canister samples were collected March 4, 2013, and analyzed by Columbia Analytical Services on March 14, 2013. The laboratory used U.S. Environmental Protection Agency-approved methods, which analyzed for methane (method TO-3) and a wide range of Volatile Organic Compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene (BTEX chemicals) and others (method TO-15). See Appendix 3 for limitations of canister testing.

FLIR GasFindIR Camera – this camera enables detection of methane and other volatile organic compounds. When gases are detected through the infrared imaging, they appear as ‘smoke’. The camera does not provide information on the volume of gas escaping, or the chemical make-up of the gas.⁸⁶

SUMMA CANISTER RESULTS

SAMPLE 1: Kotara-Ridley/Love Crews Facility

A small sign identified the site as Kotara-Ridley/Love Crews, operated by Plains Exploration and Production. According to the RRC map of wells, there is no oil or gas well on this location. Also, the site does not appear to have an air permit. When the TCEQ permit database was searched, a permitted facility named “Kotara Production Facility” was found in Karnes County, but its permit described more equipment than what was observed at this location, and the facility is located a couple of miles from this canister sampling location.



Sample 1 canister location: Kotara-Ridley/Love Crews facility.

Photo by Wilma Subra

Earthworks and ShaleTest staff observed various types of equipment on site, including what looked like a separator, dehydrator and storage tanks. This site smelled overpoweringly of hydrogen sulfide (rotten eggs) and hydrocarbons when they installed the canisters at this site. All participants except one who was wearing protective breathing gear experienced health symptoms that included: headache, sore throat, and burning eyes and nasal passages.

The canister was placed outside of the gate, north of the facility, at approximately 8:00 p.m. on March 4, 2013. A grab sample was obtained at this location.

SAMPLE 2: Cerny Home

The second canister sample was set up in the Cerny's back yard, at approximately 8:45 p.m. on March 4, 2013. At the time of canister set-up, there were no odors. Over the 12-hour sampling period, the wind was coming primarily from the south and southeast,⁸⁹ so it is possible that chemicals emitted from the Kotara-Ridley/Love Crews site, located approximately 1.5 miles southeast of Cernys, may have been carried to the Cerny home.

As seen in Table 7, the first Summa canister near the Kotara-Ridley/Love Crews facility captured a total of 14 VOCs, as well as methane. The second canister, located outside of the Cerny home, detected methane and six of the same VOCs that were found near the Kotara-Ridley/Love Crews site.

TABLE 7. VOCs in ambient air canister samples

| Volatile Organic Compound (VOC) | Units | Sample 1: Kotara-Ridley/Love Crews | Sample 2: Cerny Home | TCEQ AMCV- Short Term | TCEQ AMCV- Long Term |
|---------------------------------|-------|------------------------------------|----------------------|-----------------------|----------------------|
| Benzene | ppbV | 28 | 0.7 | 180 | 1.4 |
| Toluene | ppbV | 38 | 0.3 | 4,000 | 1,100 |
| Ethylbenzene | ppbV | 1.0 | | 20,000 | 450 |
| m&p-Xylenes | ppbV | 13 | | 1,700 | 140 |
| o-Xylene | ppbV | 2.2 | | 1,700 | 140 |
| Dichlorodifluoromethane | ppbV | 0.47 | 0.49 | 10,000 | 1,000 |
| Trichlorofluoromethane | ppbV | 0.22 | 0.19 | 5,000 | 500 |
| 1,3,5-Trimethylbenzene | ppbV | 0.47 | | 250 | 25 |
| 1,2,4-Trimethylbenzene | ppbV | 0.51 | | 250 | 25 |
| n-Heptane | ppbV | 8.4 | 0.38 | 850 | 85 |
| n-Hexane | ppbV | 37 | 2.6 | 1,800 | 190 |
| Cyclohexane | ppbV | 7.4 | | 1,000 | 100 |
| n-Octane | ppbV | 1.7 | | 750 | 7.5 |
| n-Nonane | ppbV | 0.38 | | 2,000 | 200 |
| Methane | ppmV | 13 | 4.1 | | |

TCEQ AMCV – Texas Commission on Environmental Quality, Air Monitoring Comparison Values.⁹⁰

While none of the chemical concentrations exceeded TCEQ's short-term Air Monitoring Comparison Values (AMCV), benzene at the Kotara Ridley site was 20 times the acceptable long-term AMCV limit set by TCEQ.

It is important to remember that these canister samples provide information on air quality for one short period of time. It is likely that during periods of calmer winds, or winds from different directions, that the chemical concentrations at the sampling locations could be much lower or much higher. (See Appendix 3 – Limitations of Canister Testing)

While none of the chemical concentrations exceeded TCEQ's short-term Air Monitoring Comparison Values (AMCV), benzene at the Kotara Ridley site was 20 times the acceptable long-term AMCV limit set by TCEQ.

Recently, when ShaleTest measured benzene levels in the Barnett Shale that exceeded TCEQ long-term AMCVs, TCEQ stated that it is not appropriate to compare short-term tests against long-term thresholds. TCEQ assured the public that it was monitoring air in the Barnett shale using a network of monitors that constantly test for dozens of chemicals, so that the agency would be able to determine if chemicals were exceeding their long-term air quality thresholds.⁹¹

No similar network of monitors has been established in the Eagle Ford Shale. So TCEQ does not know whether sites like Kotara Ridley, or the other locations where they have found high VOC readings (e.g., Yosko No. 1 Production Facility, Sugarhorn Central Facility, etc.) are creating concentrations of chemicals in Karnes County air that exceed TCEQ's long-term AMCV values.

FLIR CAMERA RESULTS

On March 4 and 5, 2013, ShaleTest documented fugitive emissions from numerous facilities in Karnes County using a FLIR GasFind IR camera.

The first example, below, shows emissions from the Sugarhorn Central Facility taken by TCEQ during its September 5, 2012 investigation of the site when large volumes of VOCs were being emitted due to an inoperative flare.⁹² This is compared to a FLIR video taken by ShaleTest at the Sugarhorn facility on March 4, 2013. On that date, there were major emissions from the same sources as those recorded by TCEQ during the September 2012 emissions event (photos taken from a different perspective). It appears that during the ShaleTest visit, this facility may have had an inoperative flare, which is a violation of the company's permit.

FLIR VIDEOS

TCEQ FLIR VIDEO **Sugarhorn Central Facility**

August 15 and September 5, 2012
<http://eaglefordreport.earthworksaction.org>



SHALETTEST FLIR VIDEO **Sugarhorn Central Facility**

Operator: Marathon Oil EF LLC
Location: Lat 28.83075, Long -97.95397
Date: March 4, 2013
Distance from Cernys: 1.3 mi
<http://eaglefordreport.earthworksaction.org>



In addition to venting at the Sugarhorn facility, ShaleTest recorded FLIR images showing gaseous emissions from other oil and gas facilities located in fairly close proximity to the Cernys. (ShaleTest also took FLIR videos of numerous other facilities in Karnes County that had significant gaseous emissions, but they are not included in this report, as they were located farther away from the Cerny residence.)

As mentioned previously, FLIR videos do not provide information on the exact chemical make-up of the gaseous emissions. The gases venting or leaking from oil and gas facilities, however, would contain methane, as well as various VOCs.

FLIR VIDEOS

SHALETTEST FLIR VIDEO Best-Beard Unit

Operator: Marathon Oil EF LLC
Location: Lat 28.83075, Long -97.95397
Date: March 4, 2013
Distance from Cernys: 1.3 mi
<http://eaglefordreport.earthworksaction.org>



Notes:

- hydraulic fracturing occurring on two wells
- cattle grazing nearby

SHALETTEST FLIR VIDEO High Roller Karnes Salt Water Disposal Well

Operator: High Roller LLC.
Location: Lat 28.87346, Long -97.91729
Date: March 4, 2013
Distance from Cernys: 3.5 mi
<http://eaglefordreport.earthworksaction.org>



Notes:

- vents on tanks emitting gas

SHALETTEST FLIR VIDEO OF Kotara-Ridley/Love Crews Facility

Operator: Plains Exploration and Production
Location: Lat 28.83075, Long -97.95397
Date: March 5, 2013
Distance from Cernys: 1.46 mi
<http://eaglefordreport.earthworksaction.org>



Notes:

- site of Canister Sample 1
- strong, bad odors

SYMPTOM AND AIR TESTING CORRELATIONS

The air canister tests were conducted at a time when there was no drilling or fracturing occurring in the immediate area, so they do not represent the range of chemicals that may have already been inhaled by the Cerny family during the year of intense drilling activity close to their home.

Nonetheless, many of the chemicals detected in the canister samples are known to be associated with both oil and gas operations and with the health symptoms being experienced by the Cerny family members.

In June 2013, the Cerny family filled out a health survey provided by Earthworks. They reported that since development of the Eagle Ford Shale started occurring in their area they have developed a myriad of new health problems. The symptoms are parallel to what Earthworks found in its survey of more than 100 residents living near Marcellus shale gas operations in Pennsylvania.⁹³

The following table includes some of the health symptoms experienced by all three Cerny family members, and compares them to the top ranked symptoms among Pennsylvania survey participants. For example, the five health symptoms most frequently reported in the Marcellus shale health surveys were increased fatigue, nasal irritation, throat irritation, sinus problems and eye burning. All three Cerny family members experienced these same symptoms.

Health problems experienced by the Cerny family are in close agreement to health effects from chemicals known to be released from nearby oil and gas operations, and correlate to the same effects as people living in the Marcellus shale formation.

TABLE 8. Comparison of Cerny symptoms to those experienced by Marcellus shale residents

| Symptom experienced by all three Cernys | Ranking of the same symptom in the Pennsylvania surveys |
|---|---|
| Increased fatigue | 1 |
| Nasal irritation | 2 |
| Throat irritation | 3 |
| Sinus problems | 4 |
| Eye burning | 5 |
| Joint pain | 7 |
| Severe headaches | 9 |
| Difficulty breathing | 14 |
| Skin rashes | 20 |
| Depression | 20 |

In addition to the symptoms listed in the table, all three of the Cernys also experienced tension, agitation, dry eyes, persistent cough, and ringing in ears.

There are symptoms experienced by the Cerny's 15-year-old son that one would not expect to see in a young adult, such as joint pain and severe headaches. These symptoms were also experienced by

some of the young adults in the Marcellus health survey study. The young Cerny also had frequent nosebleeds, again, a common symptom among the children and young adults who filled out surveys in Pennsylvania.

As mentioned previously, the shale oil and gas facilities surrounding the Cernys are allowed to release hundreds of tons of air pollutants on an annual basis, including VOCs, hazardous air pollutants, NOx, particulate matter, carbon monoxide, sulfur dioxide and hydrogen sulfide.

Facilities are permitted by the RRC to vent or flare casinghead gas. RRC does not require companies to report the names or quantities of toxic pollutants or methane released from casinghead gas emissions. Nor are the emissions from drilling and hydraulic fracturing reported.

RRC does not require companies to report the names or quantities of toxic pollutants or methane released from casinghead gas emissions, nor from drilling and hydraulic fracturing.

Some data are available on the chemicals released from processing facilities. For example, when Marathon failed to properly flare gas at its Sugarhorn facility, a variety of chemicals were vented directly to the atmosphere (benzene, C9+ compounds, ethane, ethyl benzene, heptanes, hexanes, hydrogen sulfide, i-butane, i-pentane, methane, n-butane, n-pentane, octanes, propane, toluene and xylenes). During a 12-hour period, the site emitted thousands of pounds of these volatile chemicals.

As shown in Table 9, health problems experienced by the Cerny family are in close agreement to health effects from chemicals known to be released from nearby oil and gas operations. Several of these chemicals were detected in the air samples collected by Earthworks.

TABLE 9. Health effects of chemicals detected in Karnes County air samples (after Colborn et al.⁹⁴)

| Chemical name | Sensory | Respiratory System | Gastro-intestinal | Brain / Nervous | Immune System | Kidney | Cardio/Blood | Cancer/Tumor | Geno-toxic | Endo-crine | Liver/Met | Other |
|-----------------------------|---------|--------------------|-------------------|-----------------|---------------|--------|--------------|--------------|------------|------------|-----------|-------|
| Benzene | | | | | | | | | | | | |
| Toluene | | | | | | | | | | | | |
| m-Xylene | | | | | | | | | | | | |
| p-Xylene | | | | | | | | | | | | |
| 1,2,4-Trimethylbenzene | | | | | | | | | | | | |
| n-Heptane | | | | | | | | | | | | |
| n-Hexane | | | | | | | | | | | | |
| Cyclohexane | | | | | | | | | | | | |
| n-Octane | | | | | | | | | | | | |
| n-Nonane | | | | | | | | | | | | |
| Methane | | | | | | | | | | | | |
| Overlap with Cerny symptoms | ✓ | ✓ | ✓ | ✓ | | | ✓ | | | | ✓ | ✓ |

Sensory = skin/eye/sensory organ; Brain/Nerv = brain/nervous system; Immune = immune system; Kidney = kidney; Card/Blood = cardiovascular/blood; Cancer/Tumor = cancer/tumorigen; Geno-toxic = genotoxic; Endocrine = endocrine system; Liver/Met = liver/metabolic;



Additionally, it is important to specifically mention hydrogen sulfide, which is known to be associated with shale oil and gas development in the Eagle Ford area. Information from RRC shows that hydrogen sulfide is present in all three of the major Eagle Ford Shale fields, including the Eagleville (or Eagle Ford 2) field being developed around the Cernys.⁹⁵

The Eagleville (Eagle Ford 2) field has an average concentration of 431 parts per million (ppm) H₂S and a maximum concentration of 10,000 ppm.⁹⁶ One well within a mile of the Cerny home reported an H₂S concentration in gas of 900 ppm. As discussed in Table 10, a release of gas with more than 500 ppm H₂S will lead to unconsciousness and possibly death. (See Appendix 1 for concentrations of H₂S in shale oil and gas operations reported from wells and facilities near the Cernys.)

The Earthworks health survey asked whether symptoms occurred in conjunction with odor events. The Cernys associated the following symptoms with either petroleum or hydrogen sulfide odor, and indicated that typically most symptoms would last for a few hours after exposure:

- Nausea:** H₂S, petroleum
- Dizziness:** petroleum
- Headache:** H₂S, petroleum.
- Eye/vision problems:** H₂S, petroleum
- Difficulty breathing:** H₂S, petroleum
- Nose/throat irritation:** H₂S, petroleum
- Confusion, anxiety:** petroleum
- Rapid heart beat:** petroleum

Many of the Cerny's symptoms correspond to the health effects known to be related to H₂S exposure. As seen in the table below, at low to moderate concentrations, H₂S produces symptoms such as eye and throat irritation and difficulty breathing, which are symptoms experienced by the Cernys when they smell H₂S. All three Cernys have experienced increased fatigue since shale oil development began. And Mr. Cerny, who works in the oilfields, has experienced a loss of sense of smell, which may be due to H₂S exposure.⁹⁷



Scenes from the Eagle Ford Shale.

TABLE 10. Physiological Responses to H2S exposure.⁹⁸

| Symptom experienced by all three Cernys | Ranking of the same symptom in the Pennsylvania surveys |
|---|--|
| 10 ppm | Beginning eye irritation |
| 50-100 ppm | Slight conjunctivitis and respiratory tract irritation after 1 hour exposure |
| 100 ppm | Coughing, eye irritation, loss of sense of smell after 2-15 minutes. Altered respiration, pain in the eyes and drowsiness after 15-30 minutes followed by throat irritation after 1 hour. Several hours exposure results in gradual increase in severity of these symptoms and death may occur within the next 48 hours. |
| 200-300 ppm | Marked conjunctivitis and respiratory tract irritation after 1 hour of exposure |
| 500-700 ppm | Loss of consciousness and possibly death in 30 minutes to 1 hour |
| 700-1000 ppm | Rapid unconsciousness, cessation of respiration and death. |
| 1000-2000 ppm | Unconsciousness at once, with early cessation of respiration and death in a few minutes. Death may occur even if individual is removed to fresh air at once. |

Increasingly, more attention is being paid to the potential health effects of exposure to low concentrations of H₂S in the air. According to a 2007 review of low-level exposure to H₂S, “much of the data, as well as the recommendations from [the U.S. Environmental Protection Agency, the U.S. Agency for Toxic Substances and Disease Registry and the World Health Organization], suggest toxicity from long-term exposure is likely to exist below the odor threshold. This suggests that an individual should not be exposed long term to any level of hydrogen sulfide that one can smell.”¹⁰⁰

Recommendations by the EPA and other agencies suggest that individuals should NOT be “exposed long term to any level of hydrogen sulfide that one can smell.”



Note the home on the left directly downwind of the flaring. The windsock (circled center) is used by the well operators to indicate wind direction so they can stay clear of the fumes of VOCs and hydrogen sulfide emissions. Of course homes and families cannot move themselves to a safer location. Another home is on the right, circled.

Conclusions

Evidence from TCEQ and Earthworks/ShaleTest investigations indicate that air pollution from oil and gas development in the Eagle Ford Shale definitely threatens, and likely harms, the health of Karnes County Texas residents, including the Cerny family. Despite these findings, no action has been taken by regulators to rein in irresponsible operations, or otherwise protect area residents. Specifically:

HEALTH THREATS

- 1. TCEQ discovered air pollution from oil and gas development operations in Karnes County, close to the Cernys and other residents, so dangerous that TCEQ evacuated its onsite investigators.**
- 2. Canister samples detected chemicals of concern close to an Eagle Ford Shale facility and the Cerny home.**
 - Canister samples are important tools for determining short-term exposure to chemicals. For example, when there are known emissions events, canisters and handheld monitors can and should be deployed by TCEQ to determine concentrations at nearby homes.
 - Because canister samples determine chemical concentrations at a particular moment or period of time, they do not adequately gauge the concentrations of chemicals that people are exposed to on a continuous and long-term basis. Permanent, stationary monitoring equipment should be established by TCEQ to determine longer-term exposures of residents living in the Eagle Ford Shale region.
- 3. FLIR camera videos revealed that numerous facilities in Karnes County, including facilities close to the Cerny home, have gaseous emissions.**
 - Although emissions have often been detected, they have not always been quantified. TCEQ should be monitoring fugitive emissions more closely, and when emissions are found, find out how these emissions are affecting air quality at homes of the nearest residents.
- 4. There are many sources of permitted and unpermitted pollution from oil and gas facilities close to the Cerny family.**

TCEQ is thoroughly aware of dangerous emission levels, and has not taken steps to measure or mitigate.

While the TCEQ has carried out a few investigations, the agency has failed to address how this pollution is affecting the health of the Cernys and others like them. Often, samples are not taken because chemicals are at a concentration that threatens TCEQ employee safety. Due to a lack of data, there are many questions that will remain unanswered:

- What was the baseline air quality before the drilling boom hit?
- What were the concentrations of air toxics, including H₂S, at the Cerny or other nearby homes when Sugarhorn was releasing thousands of pounds of contaminants into the air? Or when the leak at the Yosko well forced TCEQ investigators to evacuate that site?

- What were the concentrations or air contaminants at the Cerny home when, for months on end, drilling and hydraulic fracturing rigs were running diesel engines, and flaring or venting gas during well completions?
- What were the concentrations at the Cerny home when the wells were venting/flaring casinghead gas for months on end?

5. Hydrogen sulfide is present in the Eagle Ford Shale at concentrations that may pose a threat to public health.

- Although there have been numerous complaints from the Cerny family and other residents in the Eagle Ford Shale related to hydrogen sulfide, it appears that very few attempts have been made by TCEQ to measure H₂S concentrations in Karnes County air. Long-term monitoring of H₂S in ambient air in the Eagle Ford Shale, as well as site-specific monitoring at oil and gas well and processing sites with H₂S in gas,¹⁰¹ should be conducted to ensure that concentrations are at levels that do not pose a risk to citizens in that area.

REGULATORY FAILURES

1. Despite finding oil and gas air pollution too dangerous for its own investigators, TCEQ did not act to protect the public.

- TCEQ took no meaningful action to protect the public after discovering hazardous air pollution, such as warning area residents or evacuating them, immediately stopping the violating operation (e.g., by shutting in wells), or stopping the hazardous activity at the violating operation.

2. TCEQ did not take any meaningful steps to penalize the operator or prevent future violations.

- Operations causing the hazardous pollution were not stopped.
- Operators responsible for the pollution were not penalized.
- One operation was observed in violation later the same year for the same issue.
- Although TCEQ has publicly announced that it would install air monitoring facilities similar to what is now in place in the Barnett Shale (see sidebar), as of July 2013, there is no information on the TCEQ web site to indicate that any continuous air quality monitors have been installed in the Eagle Ford Shale.¹⁰² Communication with TCEQ suggests that one monitoring station will be installed in Wilson County during the summer of 2013.¹⁰³ It's unclear whether this monitor is close to active Eagle Ford Shale development and/or affected citizens.

These conclusions highlight a lack of attention and concern for the citizens by government regulators to even try to understand and prevent the impacts of Eagle Ford Shale development on public health.

By failing to measure and monitor toxic emissions from shale oil facilities in the Eagle Ford Shale, the TCEQ, RRC and industry are treating the Cernys as guinea pigs, and are endangering the health of many residents living amidst this shale oil boom.

Recommendations

As exemplified in this report, state agencies -- repeatedly and across the United States -- have failed in their charge to protect the public from irresponsible oil and gas development.

Furthermore, although existing data strongly indicate that the public needs to be concerned about the public health impacts from exposure to air pollution from oil and gas development, regulators are not taking this public health threat seriously – as expressed in their lack of oversight, and in their inaction when problems are brought to their attention.

Such inaction helps explain why communities across the nation are considering bans to fracking-enabled oil and gas development.

To put communities first, Earthworks recommends the state of Texas take the following actions:

PROTECT AFFECTED COMMUNITIES

Recommendation 1:

Regulators must be required to act quickly to protect the public.

- TCEQ should implement a 12-hour response time for odor complaints, especially those that involve health concerns, in the Eagle Ford Shale.
- TCEQ employees should have personal protective equipment (such as gas masks) that enable them to safely remain on site long enough to carry out air canister sampling when handheld devices indicate elevated concentrations of VOCs or H₂S.
- If a site is deemed too dangerous for regulatory staff to inspect or sample, regulators must act immediately to force the operator to fix the problem, or shut down the entire operation; and nearby residents must be immediately informed of the potential health and safety risks.
- Extreme violations, or threat of imminent public harm under which regulators would be forced to act, should be defined in rule or statute.

Recommendation 2:

- TCEQ should immediately set up a network of long-term air quality monitoring sites in the Eagle Ford Shale. This is important for determining the potential for residents to be exposed to hazardous air pollutants. This should include:
- Continuous, long-term air monitoring should be conducted both at oil and gas facilities and at people's homes. Sites should be installed prior to drilling/hydraulic fracturing of new wells, and near processing and storage facilities.
- Sampling should include VOCs, as well as PAHs, formaldehyde and other combustion products, and the highly toxic hydrogen sulfide.
- When emissions are observed by TCEQ via FLIR imaging or detected via handheld VOC and H₂S monitors, canister samples and handheld monitor readings should be taken by TCEQ at nearby homes.

- All information, such as canister samples, infrared videos (FLIR), and continuous air monitoring results should be made freely and publicly available, in the same manner as the Barnett Shale data, which have been posted online.¹⁰⁴

Recommendation 3:

The state of Texas, working with appropriate federal agencies (e.g, the Agency for Toxic Substances and Disease Control or Center for Disease Control and Prevention) or others, must rigorously investigate¹⁰⁵ the current and future health impacts of oil and gas development in the Eagle Ford Shale. That investigation should include:

- Baseline health data collection in Eagle Ford Shale counties, and
- A comparative health analysis with a similar population not impacted by oil and gas development.
- A prospective analysis of the impacts of expanded operations in the area.

FIX REGULATORY FAILURES

Recommendation 4:

Regulation and enforcement of oil and gas development must be overhauled so as to deter potential violators and prevent repeat violations, including¹⁰⁶:

- Establishing binding criteria for taking enforcement actions and levying penalties;
- Increase the use of enforcement actions to deter would-be violators;
- Increase the use of severances and seals to encourage compliance with field rule violations.
- Increase penalties to exceed the economic value that oil and gas operators gain from noncompliance with rules or statutes;
- Publish online in an easily searchable and downloadable format, comprehensive oil and gas enforcement data (complaints, inspections, violations, enforcement actions taken, penalties levied/collected, etc).

RECOGNIZE OIL & GAS DEVELOPMENT IS NOT SACROSANCT

Recommendation 5:

Until the state can demonstrate that it can adequately oversee oil and gas development and protect public health, the state must not permit new development. Currently, Texas regulators are putting industry economic interests before public health.

APPENDIX 1

List of oil and gas facilities within approximately 2 miles of the Cerny home. Data as of Sept. 1, 2013.

| Miles from Cernys | Facility name: Oil/gas lease or processing facility | Well No | API Number / Air permit | Operator | Type of Facility | Spud Date | Date Drilling Completed | Hydraulic Fracture Date | H2S Field | H-9 avail. on-line? | H2S in gas (parts per million) |
|-------------------|---|---------|-------------------------|----------------------|------------------|-----------|-------------------------|-------------------------|-----------|---------------------|--------------------------------|
| 0.52 | TIPTON-JONAS UNIT | 2H | 25532554 | MARATHON OIL EF LLC | Oil well | 7/12/12 | 9/2/12 | 11/19/12 | YES | NO | |
| 0.53 | BRYSCH-ADAMS UNIT | 1H | 25532249 | MARATHON OIL EF LLC | Oil well | 2/13/12 | 2/29/12 | 3/10/12 | YES | NO | |
| 0.53 | TIPTON-JONAS UNIT | 1H | 25532250 | MARATHON OIL EF LLC | Oil well | 3/11/12 | 4/25/12 | 5/19/12 | YES | NO | |
| 0.63 | TIPTON-JONAS UNIT | 3H | 25532557 | MARATHON OIL EF LLC | Oil well | 9/6/12 | 9/27/12 | 12/7/12 | YES | NO | |
| 0.64 | TIPTON-JONAS UNIT | 4H | 25532558 | MARATHON OIL EF LLC | Oil well | 9/28/12 | 10/15/12 | 10/18/12 | YES | | |
| 0.67 | ADAMS-TIPTON UNIT | 1H | 25532350 | MARATHON OIL EF LLC | Oil well | 3/4/12 | 3/21/12 | 4/7/12 | YES | NO | |
| 0.67 | ADAMS-TIPTON UNIT | 3H | 25532810 | MARATHON OIL EF LLC | Oil well | No data | No data | 8/5/13 | YES | NO | |
| 0.68 | ADAMS-TIPTON UNIT | 2H | 25532809 | MARATHON OIL EF LLC | Oil well | No data | No data | 8/5/13 | YES | NO | |
| 0.69 | BRYSCH-ADAMS UNIT | 2H | 25532550 | MARATHON OIL EF LLC | Oil well | 8/28/12 | 9/19/12 | 11/3/12 | YES | NO | |
| 0.70 | ADAMS-TIPTON UNIT | 4H | 25532984 | MARATHON OIL EF LLC | Oil well | 2/14/13 | 3/3/13 | 3/19/13 | YES | NO | |
| 0.70 | BRYSCH-ADAMS UNIT | 3H | 25532553 | MARATHON OIL EF LLC | Oil well | 9/20/12 | 10/15/12 | 11/11/12 | YES | NO | |
| 0.74 | BRYSCH-JONAS UNIT C | 1H | 25532271 | MARATHON OIL EF LLC | Oil well | 3/16/12 | 4/14/12 | 5/2/12 | YES | YES | 900 |
| 0.75 | BRYSCH-JONAS UNIT B | 1H | 25532260 | MARATHON OIL EF LLC | Oil well | 1/14/12 | 3/13/12 | 5/14/12 | YES | NO | |
| 0.84 | HOLLAND-BROWN UNIT | 1H | 25531924 | MARATHON OIL EF LLC | Oil well | 9/8/11 | 9/29/11 | Pre-FF | YES | NO | |
| 0.84 | HOLLAND-OPIELA UNIT | 1H | 25531925 | MARATHON OIL EF LLC | Oil well | 8/18/11 | 9/7/11 | 10/7/11 | YES | NO | |
| 0.86 | GILLEY 1 PROD. UNIT | | 101405 | MARATHON OIL EF LLC | Processing | | | | | | up to 500 |
| 0.89 | CULBERSON-PATTESON UNIT | 1H | 25532580 | MARATHON OIL EF LLC | Oil well | 6/23/12 | 7/11/12 | 7/21/12 | YES | NO | |
| 0.91 | BRYSCH- JONAS UNIT | 1H | 25532001 | HILCORP ENERGY CO | Oil well | 6/27/11 | 8/3/11 | Pre-FF | YES | YES | 50 |
| 0.91 | GILLEY UNIT | 1H | 25531757 | MARATHON OIL EF LLC | Oil well | 11/20/10 | 5/4/11 | Pre-FF | | NO | |
| 1.02 | YOSKO BORGFELD UNIT | 1H | 25532022 | MARATHON OIL EF LLC | Oil well | 7/11/11 | 8/11/11 | Pre-FF | YES | YES | 60 |
| 1.13 | YOSKO UNIT | 1H | 25531792 | MARATHON OIL EF LLC | Oil well | 12/22/10 | 4/8/11 | Pre-FF | YES | NO | 85 |
| 1.18 | BUEHRING UNIT | 1H | 25531833 | HILCORP ENERGY CO | Oil well | 2/7/11 | 4/5/11 | Pre-FF | YES | NO | |
| 1.2 | YOSKO-KINKLER UNIT | 1H | 25532049 | HILCORP ENERGY CO | Oil well | 8/19/11 | 9/4/11 | Pre-FF | YES | NO | |
| 1.21 | BUEHRING PROD. UNIT | | 11040 | MARATHON OIL EF LLC | Processing | | | | | | up to 66 |
| 1.24 | BROWN-DUPNIK A UNIT | 1H | 25532347 | MARATHON OIL EF LLC | Oil well | 3/22/12 | 4/15/12 | 5/9/12 | YES | NO | |
| 1.26 | VAJDOS-FOEGELLE UNIT | 1H | 25532246 | MARATHON OIL EF LLC | Oil well | 12/29/11 | 1/26/12 | 2/13/12 | YES | YES | 15 |
| 1.31 | SUGARHORN CENTRAL FAC. | | 99763 | MARATHON OIL EF LLC | Processing | | | | | | up to 100 |
| 1.46 | KOTARA-RIDLEY | | Not found | PLAINS EXPL. & PROD. | Processing | | | | | | |
| 1.50 | VAJDOS-FOEGELLE UNIT | 2H | 25532684 | MARATHON OIL EF LLC | Oil well | 8/8/12 | 8/26/12 | 9/30/12 | YES | NO | |
| 1.50 | VAJDOS-FOEGELLE UNIT | 3H | 25532691 | MARATHON OIL EF LLC | Oil well | 8/27/12 | 9/11/12 | 9/30/12 | YES | NO | |
| 1.66 | ZAESKE-ECKOLS UNIT | 1H | 25532222 | MARATHON OIL EF LLC | Oil well | 1/17/12 | 2/5/12 | 2/17/12 | YES | NO | |
| 1.73 | JORDAN DAVENPORT PROD. | | 99028 | MARATHON OIL EF LLC | Processing | | | | | | up to 500 |
| 1.75 | DAVENPORT UNIT | 1H | 25531876 | HILCORP ENERGY CO | Oil well | 4/4/11 | 6/11/11 | Pre-FF | YES | YES | 65 |
| 1.75 | JORDAN UNIT | 1H | 25531817 | HILCORP ENERGY CO | Oil well | 1/28/11 | 5/24/11 | Pre-FF | YES | NO | |
| 1.77 | CHAPMAN-ROGERS UNIT | 1H | 25531960 | MARATHON OIL EF LLC | Oil well | 7/30/11 | 9/12/11 | Pre-FF | YES | NO | |
| 1.77 | KIMBLE GILLEY UNIT | 1H | 25532296 | MARATHON OIL EF LLC | Oil well | 2/17/12 | 4/3/12 | 3/21/12 | YES | NO | |
| 1.79 | GILLEY UNIT | 2H | 25532365 | MARATHON OIL EF LLC | Oil well | 7/13/12 | 7/28/12 | 8/6/12 | YES | NO | |
| 1.87 | HEDTKE-HENKE UNIT | 1H | 25532323 | MARATHON OIL EF LLC | Oil well | 2/20/12 | 3/12/12 | 4/10/12 | YES | NO | |
| 1.99 | BUEHRING UNIT | 2H | 25532989 | MARATHON OIL EF LLC | Oil well | No data | No data | 7/9/13 | YES | NO | |
| 2.00 | JORDAN UNIT | 3H | 25532740 | HILCORP ENERGY CO | Oil well | 10/3/12 | 10/20/12 | 11/2/12 | YES | NO | |
| 2.01 | FRANKE UNIT | 3H | 25532462 | PLAINS EXPL. & PROD. | Oil well | 5/11/12 | 7/4/12 | 6/21/13 | YES | YES | 60 |
| 2.01 | SALGE-KINKLER | 2H | 25532858 | MARATHON OIL EF LLC | Oil well | 11/30/12 | 12/17/12 | 1/1/13 | YES | NO | |
| 2.06 | KALEB BREWER SWD | | 25531958 | EAGLE FORD DISP. LLC | Injection | 4/27/12 | 5/12/12 | 5/12/12 | | | |



| Miles from Cernys | Facility name: Oil/gas lease or processing facility | Well No | API Number / Air permit | Operator | Type of Facility | Spud Date | Date Drilling Completed | Hydraulic Fracture Date | H2S Field | H-9 avail. on-line? | H2S in gas (parts per million) |
|---|---|---------|-------------------------|---------------------|------------------|-----------|-------------------------|-------------------------|-----------|---------------------|--------------------------------|
| Wells sites permitted but not yet drilled as of Sept. 1, 2013 | | | | | | | | | | | |
| 2.02 | WHITLEY MEJOR UNIT | 3H | 25533252 | MARATHON OIL EF LLC | | | | | YES | | |
| 2.02 | WHITLEY MEJOR UNIT | 4H | 25533230 | MARATHON OIL EF LLC | | | | | YES | | |
| 2.03 | WHITLEY MEJOR UNIT | 1H | 25533228 | MARATHON OIL EF LLC | | | | | YES | | |
| 2.03 | WHITLEY MEJOR UNIT | 2H | 25533229 | MARATHON OIL EF LLC | | | | | YES | | |

Data Notes:

Miles from Cernys: Determined by entering latitude and longitude for all facility locations into a mapping program called BatchGeo.¹⁰⁷ BatchGeo calculates the distance from a site to a particular location – in this case, the Cerny residence. Latitude and longitude data for wells from RRC data.¹⁰⁸

Facility Name: Obtained from RRC (for wells) and TCEQ (for processing facilities).

Well Number: There are often several wells associated with one lease, so this number was included for clarity.

API/Air permit: An API number is a unique, permanent, numeric identifier assigned to each oil and gas well drilled in the U.S. The number was obtained from the W-1 forms for each well. The TCEQ air permit number was obtained from the technical review documents for the well permits (by searching for the facilities in Karnes County via the TCEQ air permit search site¹⁰⁹).

Operator: Obtained from W-1 forms for each well.

Type of Facility: Either an oil/gas well or a site where oil/gas is processed (e.g., oil, gas and water are separated; gas is dehydrated and compressed; waste gas is flared; and hydrocarbon products and wastewater are held onsite until removed by truck or pipeline).

Spud Date: this is the date when drilling commences. Data are from the W-1 reports for each well. These are obtained by searching the RRC "Drilling Permit (Form W-1) Application Query."¹¹⁰ As seen in the Table, FracFocus contains data for some wells fractured in July and August of 2013, but RRC had not yet posted data on spud date (or drilling completion date).

Drilling completion date: the date when drilling is completed. Obtained through the W-1 search (see Spud Date).

Fracture date: the date when hydraulic fracturing begins. Obtained from the FracFocus web site¹¹¹ (Searched by API number). Pre-FF (preFracFocus) means that wells were fractured prior to February 2012, the date when Texas operators had to begin reporting fracturing information to FracFocus.

H2S – information on whether or not a well is located in an H2S field can be obtained from the on-line W-1 reports. Under the Section entitled "Field Restrictions," wells in H2S fields are identified by Code 02, which states: "This is a hydrogen sulfide field. Hydrogen Sulfide Fields with perforations must be isolated and tested per State Wide Rule 36 and a Form H-9 filed with the district office."

H-9 available: H-9s, also known as a "Certificate of Compliance Statewide Rule 36," are filed with district offices. Some H-9s were found online in the documents that accompany an RRC "Oil and Gas Completions" Query for a particular well.¹¹² But not all H-9s are available electronically, so data on H2S concentrations is not included for all well sites. H-9 forms certify that operators will comply with Statewide Rule 3.36 "Oil, Gas, or Geothermal Resource Operation in Hydrogen Sulfide Areas."¹¹³ The H-9 forms provide information on the concentration of H2S that may be released at the site, and the expected "radius of exposure" around the well for 100 and 500 parts per million (ppm) H2S. It also indicates if the 500-ppm radius of exposure includes part of a public road.¹¹⁴

H2S in gas: for oil/gas wells, this is the concentration of H2S at each site as reported in H-9 reports (except for Yosko Unit. That information came from a TCEQ air permit.¹¹⁵). For processing facilities, this is the concentration of H2S expected in the oil/gas to be processed at the facility. That information is contained in TCEQ air permit review documents for the facility.



Appendix 2

TCEQ: Eagle Ford Shale air-related complaints in Karnes County.¹¹⁶

| Complaint Date | Complaint Summary (Operator and location included when mentioned in complaint). ¹¹⁷ | Enforcement action? (ND = no data) |
|----------------|--|---|
| 6/12/2013 | Complainant is getting odors from nearby oil and gas facilities. Company is drilling and may be fracking to the south. Complainant and family are being impacted by odors . Complainant's son is suffering from nose bleeds and has to use an inhaler. . . June 8, 2013 it was bad. ¹¹⁸ | ND |
| 5/21/2013 | The complainant states that he has been getting a chemical taste in the air due to heavy flaring with thick black smoke from the RE. States that the flaring happens a lot at night. Also . . . getting a lot of dust from all the truck traffic from the facility. ¹¹⁹ | ND |
| 03/21/2013 | Complainant indicated they are experiencing bad H2S and crude odors at their house. Stated the odors gave him a headache today. They cannot open windows or stay outside long when winds are out of south. ¹²⁰ | ND |
| 3/11/2013 | SUGARHORN CENTRAL FACILITY. Complainant is getting heavy hydrogen sulfide odors at their house and they note the flare at the Sugarhorn is burning black. Complainant was air sampled using sumacanister. ¹²¹ | No NOV/NOE has been issued. ¹²² |
| 02/19/2013 | MARATHON OIL EF LLC. EAST LONGHORN CENTRAL FACILITY. Complainant alleged that a flare at an oil and gas production facility was smoking . ¹²³ | ND |
| 2/14/2013 | ENAUQA OPERATING LLC. CAT KENEDY SWD FACILITY. Complainant states that saltwater disposal facility and cement plant are creating bad odor and dust nuisance. ¹²⁴ | <u>NOV issued 07/08/13.</u> ¹²⁵ |
| 10/03/2012 | FREEMPORT-MCMORAN OIL & GAS LLC. PATTON TRUST SOUTH PRODUCTION FACILITY. Continuing noise/smells . . . Date is approximate to beginning drilling from PXP wells. Pumping station was installed late Spring, 2012. Issues are documented from June, 2012. ¹²⁶ | <u>NOV issued 1/22/13.</u> <u>Resolved 3/26/13.</u> ¹²⁷ |
| 09/18/2012 | EOG RESOURCES INC. LAZY OAK UNIT 5H OIL WELL. "...they are drilling very near their house and the smell is so bad they can not be outside for long periods of time. . . what can be done to eliminate the fumes/odors coming from the drilling platform and the accompany sludge pit that was excavated near the drilling site and is located near the family's home." ¹²⁸ | No NOV/NOE has been issued. ¹²⁹ |
| 09/11/2012 | HIGH ROLLER WELLS LLC. Caller is getting bad dust from construction next door where a disposal well is about to be drilled. . . dust is keeping family inside and is covering a field where goats are eating. The house and cars are covered in dust. ¹³⁰ | No NOV/NOE has been issued. ¹³¹ |
| 9/10/2012 | Complainant is getting a lot of dust from two sources: a 10-acre piece of land leased by Catarina, and County Road 165. . . Catarina has supposedly drilled a well in the back and brought in tanks in preparation for a saltwater disposal well. . . About six weeks ago they subleased property to concrete company who is mixing concrete there and hauling it off, causing more truck traffic and dust. ¹³² | No NOV/NOE has been issued. ¹³³ |
| 08/14/2012 | MARATHON OIL EF LLC. KIMBLE GILLEY PRODUCTION FACILITY. Complainant is getting odors from the oil and gas facilities all around her (rigs, waste disposal sites, flares, etc.). It smells like sulfur and petroleum . She sees flares continuing to smoke . Her son is getting nose bleeds and she gets rashes and eye irritation. . . dust from a road on her neighbor's property who lets the trucks drive on it to get to a rig. ¹³⁴ | <u>NOV issued 2/15/13.</u> <u>Resolved 2/08/13.</u> ¹³⁵ |
| 06/19/2012 | Complainant states that Marathon is building a drilling pad across the road from their home. The dust is unbearable and the south wind blows it directly onto their property. They are having respiratory issues. The large trucks speed down the road creating huge dust clouds off Farm To Market 99 Road west of Karnes City. ¹³⁶ | Investigation data not avail. until approved by management ¹³⁷ |
| 05/14/2012 | Complainant states that from Thursday night through Saturday night, a drilling facility next to the residence was fracking and emitting chemical fumes . The complainant said it smelled like a mixture of skunk and hair perm. The complainant and one member of the family had to leave the residence due to respiratory and other health issues. . .No odors could be confirmed at the time of the investigation. ¹³⁸ | No NOV/NOE has been issued. ¹³⁹ |



| Complaint Date | Complaint Summary (Operator and location included when mentioned in complaint). ¹¹⁷ | Enforcement action? (ND = no data) |
|----------------|---|---|
| 03/26/2012 | The complainant is alleging odors and dust from oil and gas facilities. The problems was described as this: "At times there is a chemical odor similar to the smell in the insecticide department at Walmart. It makes your nose burn. Frequently, there is also dust ." ¹⁴⁰ | No NOV/NOE has been issued. ¹⁴¹ |
| 02/22/2012 | MARATHON OIL EF LLC. NORTH LONGHORN CENTRAL TANK BATTERY. Complainant states that tank battery across road from house is stinking bad smells like sour gas . Flares are burning and emitting black smoke . She has rash all over her face, arms, legs (areas of body where exposed) has been to four different doctors. Cannot stay outside due to odors, cannot garden or enjoy outdoors. On February 27, 2012, April 5, 2012, May 24, 2012, June 25, 2012, August 29, 2012, September 6, 2012, and October 22, 2012, Ms. Salazar conducted odor complaint investigations. Air canister samples were taken during this investigation. ¹⁴² | <u>NOV issued 12/20/12.</u> Resolved 1/30/13. ¹⁴⁵ |
| 1/30/2012 | MARATHON OIL EF LLC. YOSKO 1 PRODUCTION FACILITY. "At our property 3.6 miles out on Farm Road 99 I often smell a terrible odor accompanied by a wet mist that burns my eyes and my nasal area and tightens my chest. This has happened four times in the past month at around 2 a.m. when I wasn't able to sleep. I have also noticed strange symptoms on my drive home from my evening job just as I near the Paul Jauer's Home on Farm Road 99. My eyes begin to water, nose begins to run and throat burns and becomes hoarse. My windshield appears to have a fine mist of some sort on it as well. . . happened to me nightly Tuesday, January the 24 through Friday the 27th of this past week." ¹⁴⁴ | No NOV/NOE has been issued. ¹⁴⁵ |
| 12/22/2011 | BURLINGTON RESOURCES. ARMSTRONG UNIT 1A. Black smoke billowing from flare, we have flares all around us and it smells TERRIBLE . ¹⁴⁶ | No NOV/NOE has been issued. ¹⁴⁷ |
| 06/14/2011 | Pad for compressor site being built across FM1144 from complainant. Dust is created by truck traffic and equipment at pad site which is southeast of complainant. ¹⁴⁸ | No NOV/NOE has been issued. ¹⁴⁹ |
| 12/14/2010 | Oil Drilling Company traffic is creating dust to come on to their property. Her father is being impacted at his home and the dust is bothering the cattle and cattle will not eat the dust covered grass. . . drilling company traffic travels above the speed limit of 35 mph. ¹⁵⁰ | No NOV/NOE has been issued. ¹⁵¹ |
| 10/10/2010 | PLAINS EXPL. & PRODUCTION. NIESCHWIETZ UNIT 1H WELL. Bad odor coming from oil production equipment for three days . . . Odor is strong and very unpleasant. It has oily characteristic that may also be harmful to health. ¹⁵² | No NOV/NOE has been issued. ¹⁵³ |
| 08/30/2010 | Complainant states that trucks from unknown drilling company creating terrible dust clouds on County Road 220 which is dirt. His home and business (next to one another) are covered in dust; all surrounding vegetation is also covered in dust. These trucks travel down this road (the long way) to reach drilling site on Cemetery Road (which is paved). ¹⁵⁴ | No NOV/NOE has been issued. ¹⁵⁵ |
| 8/17/2010 | The complainant is concerned about an easement that runs parallel to his property that is being used by Pioneer Oil Drilling to set up a drill rig. He states that dust is being kicked up constantly and he's afraid they will be putting herbicide along his fence line. ¹⁵⁶ | No NOV/NOE has been issued. ¹⁵⁷ |
| 01/03/2010 | The first complainant stated that trucks from Pioneer Drilling Company creating terrible dust clouds on County Road 220 which is dirt. . . The second complainant stated that trucks from Pioneer Drilling Company creating terrible dust . . . His home is covered in dust; all surrounding vegetation is also covered in dust and may be affecting the cattle. ¹⁵⁸ | No NOV/NOE has been issued. ¹⁵⁹ |
| 12/07/2008 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. Complainant alleges that he has been getting hydrogen sulfide odors since October 2007 when he moved into his house. In the past, the odor was so bad it woke him up during the night and he began vomiting and had to leave his home. It also sometimes burns his nose. He needs a southeast wind to be downwind of the alleged source. ¹⁶⁰ | No NOV/NOE has been issued. ¹⁶¹ |
| 01/04/2008 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. The compressor gas station located off Cty Rd. 211 is emitting sulphur like odors in the late evening around 6-8:00 pm. Odor goes away in the mornings. ¹⁶² | No NOV/NOE has been issued. ¹⁶³ |



| Complaint Date | Complaint Summary (Operator and location included when mentioned in complaint). ¹¹⁷ | Enforcement action? (ND = no data) |
|----------------|--|---|
| 01/29/2007 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. The complainant alleged that the smell was bad the evening before (May 14). She claimed the odor was coming from the compressor station located south of her. . . She added that there was a lot of flaring going on Sunday (May13) and this morning. Contact was made that same day with Will Yenke, EHS Coordinator for Regency Gas . . . He later reported that a third engine was being installed at the site and that blowdowns were done on the other two engines, which resulted in more flaring. ¹⁶⁴ | Investigation Data not Available Until Approved by Management. ¹⁶⁵ |
| 01/29/2007 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. Complaint No. 1: at 7:00 this morning it stunk outside like rotten eggs . Complainant No. 2: This complainant said the stink was unbearable this morning just before 7:00. . . She said she is worried about her children. She believes the odor was coming from the nearby gas plant. She said she has seen a very large flame on the flare periodically (before Christmas). ¹⁶⁶ | No NOV/NOE has been issued. ¹⁶⁷ |
| 11/21/2006 | H2S odor from recently drilled wells near the residence . . . has been going on for about three weeks, but this morning it was especially bad. The complainant has called the field operator, but the odor continues. A new well has been drilled about 1.5 miles north of the residence. ¹⁶⁸ | No NOV/NOE has been issued. ¹⁶⁹ |
| 11/05/2006 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. RN105001671. Complaint No. 1: reported getting a bad odor from the gas plant on CR 211 and that the plant was making a horrible noise. Complaint No. 2: reported that the odor from the compressor station is so bad . ¹⁷⁰ | No NOV/NOE has been issued. ¹⁷¹ |
| 10/03/2006 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. RN105001671. She notices the smell from the gas plant. It is worse at night around midnight when she gets home from work. Smells like rotten egg . She did notice any odors before. She also complained about the noise. ¹⁷² | No NOV/NOE has been issued. ¹⁷³ |
| 9/11/2006 | REGENCY FS LP. KUNKLE COMPRESSOR STATION. RN105001671. Compressor Site started up south of Falls City and odor was bad and may have been poisonous. One evening . . . could not sit outside because of odor. . . also objecting to the loud metallic noises.. ¹⁷⁴ | No NOV/NOE has been issued. ¹⁷⁵ |

Appendix 3

LIMITATIONS OF CANISTER TESTING

For this investigation, the wind conditions were not ideal for collecting canister samples. On the date when the canister samples were taken (evening of March 4 to morning of March 5, 2013), the wind was blowing between 10 and 20 miles per hour (mph) for most of the sampling period.¹⁷⁶ Research by Colborn and others found that the detection of hydrocarbons near natural gas drilling sites was highest during times when winds were calm (less than 1 mile per hour).¹⁷⁷

Also, it is important to note that the concentrations found in our study represent a snapshot in time. The sample at the Cerny home was taken at a time when the closest drilling/hydraulic fracturing activity was approximately 3 miles away.¹⁷⁸ Ideally, the sample would have been taken at a time when odors were present, to gauge whether or not odors were associated with higher concentrations of certain air contaminants. Unfortunately, Earthworks representatives were only in the region for a limited time, and while they were there the Cernys were not experiencing the odors that sometimes make them feel ill.

Finally, the chemicals sampled in our project were limited to a selection of VOCs. The analytical methods used did not test for some chemicals known to be associated with oil and gas facilities such as:

- PAHs, created during combustion of hydrocarbons.¹⁷⁹
- Formaldehyde, commonly emitted from natural gas compressors, such as those located on some of the production facilities near the Cernys. Exposure to formaldehyde may cause eye, nose, and throat irritation, skin rashes and other symptoms.¹⁸⁰
- Hydrogen sulfide, a known toxic compound associated with many of the health effects documented in this project, is associated with oil and gas development in Karnes County. Testing for PAHs, formaldehyde and H₂S would have required different types of air sampling methods than applied here.¹⁸¹

ENDNOTES

¹ In 2009, Earthworks Oil and Gas Accountability Project (OGAP) worked with residents in DISH, Texas to perform air quality monitoring (1); in 2010, OGAP conducted health surveys with local residents in Pavillion, Wyoming, and analyzed results in relation to contaminants identified through water quality investigations (2); in 2011 OGAP developed case studies of residents who reported health problems while living in close proximity to Barnett Shale gas facilities in several counties in Texas (3); and in 2012, Earthworks conducted health surveys and air and water monitoring in several counties affected by Marcellus Shale drilling in Pennsylvania (4). (Sources: (1) Earthworks OGAP, 2009. *Community Health Survey of Current and Former Residents of DISH, Texas*. <http://earthworksaction.org/publications.cfm?pubID=438>;(2) Earthworks OGAP. 2010. *Community Health Survey Results of Pavillion, Wyoming*. http://earthworksaction.org/PR_PavillionHealthSurvey.cfm; (3) Earthworks' OGAP, 2011. *Natural Gas Flowback: How the Texas gas boom affects community health and safety*. http://www.earthworksaction.org/library/detail/natural_gas_flowback; and 4) Earthworks OGAP, 2012. *Gas Patch Roulette: How Shale Gas Development Risks Public Health in Pennsylvania*. http://www.earthworksaction.org/library/detail/gas_patch_roulette_full_report#.UeW3OIOGE1I

² Earthworks. 2011. *Loopholes for Polluters*. http://www.earthworksaction.org/library/detail/loopholes_for_polluters#.UiUD_7yw7jE

³ Earthworks. 2012. *Breaking All the Rules – The Crisis in Oil and Gas Regulatory Enforcement*. <http://www.earthworksaction.org/files/publications/FINAL-US-enforcement-sm.pdf>

⁴ In a 2012 report, Earthworks research showed that the Texas Railroad Commission (RRC), which oversees oil and gas development in the state, is failing to enforce oil and gas regulations at many existing oil and gas facilities. For example, in 2011, an estimated 296,000 active Texas oil and gas wells went uninspected. (Earthworks. 2012. *Enforcement Report - RRC: Public should not have confidence that oil and gas development is occurring responsibly in Texas*. http://www.earthworksaction.org/issues/detail/texas_oil_gas_enforcement#.UeW1AIOGE1I)

⁵ EIA: http://www.eia.gov/dnav/ng/TblDefs/ng_prod_ngpl_tbldef2.asp

⁶ Texas Railroad Commission (hereafter referred to as RRC) web site: *Eagle Ford Information*, <http://www.rrc.state.tx.us/eagleford/>

⁷ RRC web site: *Texas Eagle Ford Shale Drilling Permits Issued*, <http://www.rrc.state.tx.us/eagleford/EagleFordDrillingPermitsIssued.pdf> Accessed May 28, 2013.

⁸ RRC web site: *Eagle Ford Shale oil production statistics*. <http://www.rrc.state.tx.us/eagleford/EagleFordOilProduction.pdf> Accessed May 28, 2013.

⁹ Between 2011 and March 2013, production of natural gas increased from 1,200 to 1,945 bpd and condensate increased from 77,350 to 96,952 bpd. (RRC web site. *Eagle Ford Shale natural gas production statistics*. (RRC. "Texas Eagle Ford Shale Total Natural Gas Production. 2008 through April 2013." <http://www.rrc.state.tx.us/eagleford/EagleFordGWGProduction.pdf> and "Texas Eagle Ford Shale condensate Production. 2008 through April 2013" <http://www.rrc.state.tx.us/eagleford/EagleFordCondensateProduction.pdf>. Accessed May 28, 2013)

¹⁰ Hughes, J. David. 2013. *Drill, Baby, Drill: Can Unconventional Fuels Usher in a New Era of Energy Abundance?* <http://www.postcarbon.org/reports/DBD-report-FINAL.pdf>

¹¹ Maugeri, L. 2013. *The Shale Oil Boom: A U.S. Phenomenon*. Discussion Paper 2013-05, Belfer Center for Science and International Affairs, Harvard Kennedy School. pp. 4, 7. <http://belfercenter.ksg.harvard.edu/publication/23191>

¹² One well per 40 acres equates to 16 vertical wells per square mile. With horizontal drilling, the number of wells drilled per 40 acres depends on the length of the horizontal leg of the well bore. (NTC Consultants. 2011. *Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in Marcellus Shale and Other Low-Permeability Gas Reservoirs*. Prepared for the New York State Energy Research and Development Authority. p. 7. <http://www.nysrerda.ny.gov/Publications/Research-and-Development-Technical-Reports/Other-Technical-Reports/-/media/Files/Publications/PPSER/NYSERDA/ng/ntc.ashx>)

¹³ Other sections of the core area include: sections of the core area in Dewitt, Gonzales, Atascosa, and Live Oak counties. (Alamo Area Council of Governments. August 1, 2012. *Oil and Gas Emission Inventory Improvement Plan*, Eagle Ford. Draft Technical Proposal. p. 1-4. <http://www.aacog.com/DocumentCenter/View/8286>)

¹⁴ RRC web site: "Well Distribution by County." <http://www.rrc.state.tx.us/data/wells/wellcount/index.php>

¹⁵ RRC web site: See the "Texas Monthly Oil and Gas Statistics" available as Railroad Commission of Texas Press Releases. <http://www.rrc.state.tx.us/pressreleases/>

¹⁶ For example, a fact sheet on the Barnett Shale Area Special Inventory provides links to documents that list various sources of air emissions. Not all of these emissions were included in the Barnett shale emissions inventory. (TCEQ. "Barnett Shale Area Special Inventory." Fact Sheet. <http://www.tceq.texas.gov/assets/public/implementation/air/ie/pseiforms/Barnett%20Shale%20Area%20Special%20Inventory.pdf> Accessed July 18, 2013.)

¹⁷ Begos, K. August 25, 2013. "Fracking health projet puts numbers to debate," *Associated Press*. <http://bigstory.ap.org/article/fracking-health-project-puts-numbers-debate>

¹⁸ Witter R, McKenzie, L., Towle, M., Stinson, K. Scott, K., Newman, L. and Adgate, J. September 2010. *Health Impact Assessment for Battlement Mesa, Garfield County Colorado*. Colorado School of Public Health, University of Colorado Denver. Available: <http://tinyurl.com/6hrcwrpz> Accessed June 26, 2013.

¹⁹ McKenzie, L.M., Witter, R.Z., Newman L.S., Adgate J.L. May 2012. "Human Health Risk Assessment of Air Emissions from Development of Unconventional Natural Gas Resources." *Science of the Total Environment*. 1;424:79-87. Available at: <http://cogcc.state.co.us/library/setbackstakeholdergroup/Presentations/Health%20Risk%20Assessment%20of%20Air%20Emissions%20From%20Unconventional%20Natural%20Gas%20-%20HMcKenzie2012.pdf> Accessed June 26, 2013



- ²⁰ Interview with the study author. (Kelly, D. March 19, 2012. "Study shows air emission near fracking sits may pose health risks," University of Colorado Newsroom. <http://www.ucdenver.edu/about/newsroom/newsreleases/Pages/health-impacts-of-fracking-emissions.aspx>
- ²¹ In an air quality study conducted in 2010, and accepted for publication by *Human and Ecological Risk Assessment: An International Journal*, Theo Colborn and her colleagues sampled air quality in rural western Colorado before, during and after drilling and hydraulic fracturing of a new natural gas well pad. (Source: Colborn, T., Schultz, K., Herrick, L. and Kwiatkowski, C. (In Press) "An exploratory study of air quality near natural gas operations," *Human and Ecological Risk Assessment: An International Journal*. Available at: <http://www.endocrinedisruption.com/chemicals.air.php> Accessed July 17, 2013.
- ²² Buzcu-Guven, B., Hariss, R. and Hertzmark, D. 2010. *Gas Flaring and Venting: Extent, Impacts and Remedies*. Energy Forum of the James Baker III Institute for Public Policy. p. 11. <http://www.bakerinstitute.org/publications/CARBONFlaring%20paper%20Birnur%20FINALwith%20cover%20secured.pdf>
- ²³ Shaletest.org ShaleTest is a non-profit organization that collects environmental data and provides testing to lower income families and communities that are negatively impacted by shale oil and gas extraction.
- ²⁴ Texas Commission on Environmental Quality. (Hereafter, TCEQ). "Barnett Shale Special Inventory." Fact Sheet. <http://www.tceq.texas.gov/assets/public/implementation/air/ie/pseiforms/Barnett%20Shale%20Area%20Special%20Inventory.pdf>
- ²⁵ The Eagle Ford Task Force was created under the directive of Texas Railroad Commissioner David Porter in 2011 to promote economic activity and establish best practices across the play. <http://eaglefordshale.com/eagle-ford-task-force/>
- ²⁶ Eagle Ford Shale Task Force. March 2013. *Eagle Ford Shale Task Force Report*. p. 84. http://www.rrc.state.tx.us/commissioners/porter/reports/Eagle_Ford_Task_Force_Report-0313.pdf
- ²⁷ Pers. Comm. With Peter Bella, AACOG. July 18, 2013. For more information about the inventory, see: Alamo Area Council of Governments. August 1, 2012. *Oil and Gas Emission Inventory Improvement Plan, Eagle Ford. Draft Technical Proposal*. pp. iii and iv. <http://www.aacog.com/DocumentCenter/View/8286>
- ²⁸ Data Sources for Table 2: Well drilling spud date and drilling completion dates are from the Texas Railroad Commission. Information on each well is available by entering the well permit (API) number into the "Drilling Permit Application Query." Available at: <http://webapps.rrc.state.tx.us/DP/initializePublicQueryAction.do>. (See Appendix 1 for API numbers for these wells). Information on well fracturing start-date obtained by entering well API into the FracFocus search engine (<http://www.fracfocusdata.org/DisclosureSearch/MapSearch.aspx>). Texas operators are required to report fracturing information for wells drilled as of February 1, 2012, but some operators have reported information on wells drilled prior to that date. FracFocus doesn't provide information on the length of time required to complete fracturing.
- ²⁹ Armendariz, A. Jan. 26, 2009. *Emissions from Natural Gas Production in the Barnett Shale Area and Opportunities for Cost-Effective Improvements*. Prepared for Environmental Defense Fund. Austin, Texas. p. 18. Available at: http://www.edf.org/sites/default/files/9235_Barnett_Shale_Report.pdf
- ³⁰ RRC web site: "Flaring Regulation – Frequently Asked Questions." <http://www.rrc.state.tx.us/about/faqs/flaringfaq.php#4>
- ³¹ Alamo Area Council of Governments. August 1, 2012. *Oil and Gas Emission Inventory Improvement Plan, Eagle Ford. Draft Technical Proposal*. p. 5-20. <http://www.aacog.com/DocumentCenter/View/8286>
- ³² Buzcu-Guven, B., Hariss, R. and Hertzmark, D. 2010. *Gas Flaring and Venting: Extent, Impacts and Remedies*. Energy Forum of the James Baker III Institute for Public Policy. p. 10. <http://www.bakerinstitute.org/publications/CARBONFlaring%20paper%20Birnur%20FINALwith%20cover%20secured.pdf>
- ³³ Ibid.
- ³⁴ Kostiuk, L.W., Johnson, M.R. and Thomas, G.P. 2004. *University of Alberta Flare Research Project Final Report November 1996 – September 2004*. University of Alberta, Department of Mechanical Engineering. pp. 180, 234. <http://www.mece.ualberta.ca/groups/combustion/flare/papers/Final%20Report2004.pdf>
- ³⁵ For example, large volumes of propane were released from the Sugarhorn processing facility when gas was being vented instead of flared. (See section on Air quality investigations near the Cerny home).
- ³⁶ U.S. EPA. "Summary of Requirements for Processes and Equipment at Natural Gas Well Sites. Fact Sheet. <http://www.epa.gov/airquality/oilandgas/pdfs/20120417summarywellsites.pdf>
- ³⁷ U.S. EPA. April 2012. *Regulatory Impact Analysis. Final New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry*. p. 1-3. http://www.epa.gov/ttn/ecas/regdata/RIAs/oil_natural_gas_final_neshap_nsps_ria.pdf
- ³⁸ Eagle Ford Shale Task Force. March 2013. *Eagle Ford Shale Task Force Report*. p. 82. http://www.rrc.state.tx.us/commissioners/porter/reports/Eagle_Ford_Task_Force_Report-0313.pdf
- ³⁹ Ibid. p. 76.
- ⁴⁰ Alamo Area Council of Governments. August 1, 2012. *Oil and Gas Emission Inventory Improvement Plan, Eagle Ford. Draft Technical Proposal*. p. 5-21. <http://www.aacog.com/DocumentCenter/View/8286>
- ⁴¹ RRC web site: "Flaring Regulation – Frequently Asked Questions." <http://www.rrc.state.tx.us/about/faqs/flaringfaq.php#4>
- ⁴² RRC's Production Report system indicates why the gas was flared/vented, but does not specify whether the gas was flared or vented. (RRC Online System. Production Reports. PR Queries Home. Production by Lease. <http://webapps.rrc.state.tx.us/PR/publicQueriesMainAction.do>)
- Selected oil lease, use lease number. Data are the same as the Production Data Query, but include information on why gas was flared/vented (Disposition Code 04). The most common reason is "Compressor Maint Dow".
- ⁴³ RRC Online System. Production Data Query. Specific Lease Query. <http://webapps2.rrc.state.tx.us/EWA/specificLeaseQueryAction.do>



Selected oil leases, because all of the wells close to the Cernys are oil wells. Entered lease number, District 02, date range Jan. 2010 to May 2013. The table labeled "Disposition Details" provides a monthly account of the volume of casinghead gas used on-site, delivered to pipeline or processing plant, injected, or used for other purposes. Volumes are reported in thousands of cubic feet (MCF) per month. Gas vented/flared the disposition code 4.

⁴⁴ Alamo Area Council of Governments. August 1, 2012. *Oil and Gas Emission Inventory Improvement Plan*, Eagle Ford. Draft Technical Proposal. p. 7-1. <http://www.aacog.com/DocumentCenter/View/8286>.

⁴⁵ TCEQ Air Permits Remote Document Server. Available at: <https://webmail.tceq.state.tx.us/gw/webpub>

⁴⁶ "...the H2S content of the produced gas has been adjusted to 500 ppmv (0.050 mol %) as measured by the stained tube method." (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 101405. Gilley 1 Production Facility. Reviewed by John Gott, TCEQ, May 16, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: Gilley TRV 101405 Marathon)

⁴⁷ "Natural gas at the site contains up to 66 parts per million volume (ppmv) hydrogen sulfide..." (Technical Review: Air Permit by Rule (PBR). PBR Registration No. 11040. Buehring 1 Production Facility. Reviewed by John Gott, TCEQ, June 21, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: Buehring PBR 101440 Marathon)

⁴⁸ HAPs are benzene only. (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 99763. Sugarhorn Central Facility. Reviewed by Margaret Schell, TCEQ, March 1, 2013. Available at: <https://webmail.tceq.state.tx.us/gw/webpub/3169a952744940bfe8a53c5fa0429a5860c51070/GWDOC/DREF/tnrdm3.dms3apo.ansrp01/462186/Official/webacc/GWContentRoot/TRV%2099763%20Marathon%20%28620%29?action=Document.ViewNative&User.context=3169a952744940bfe8a53c5fa0429a5860c51070>) The most recent TRV did not include H2S concentration. Previous TRV dated said company conservatively estimated a maximum of 100 ppmv H2S in the gas being processed at the facility. (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 99763. Sugarhorn Central Facility. Reviewed by John Gott, TCEQ, July 25, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub/e07e8a1768a4aa3442a5a5c15a7f1b190d81e8c/GWDOC/DREF/tnrdm3.dms3apo.ansrp01/442789/Official/webacc/GWContentRoot/TRV%2d%2d99763%2d%2dMARATHON%20OIL%20EF%20LLC%2d%2d6002?action=Document.ViewNative&User.context=e07e8a1768a4aa3442a5a5c15a7f1b190d81e8c>)

⁴⁹ "The H2S concentration has been adjusted to 500 ppmv to be conservative." (Technical Review: Air Quality Standard Permit for Oil and Gas Handling and Production Facilities. Permit No. 99028. Jordan Davenport Production Facility. Reviewed by John Gott, TCEQ, June 19, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: TRV 99028 Marathon)

⁵⁰ Certified emissions associated with the Kimble Gilley Production Facility Permit By Rule Registration (Registration No. 103753) Oct. 30, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: Kimble Gilley PBR 103753 Marathon) Accessed July 16, 2013. But in TCEQ investigation it was reported the tanks were removed from the facility on Dec. 18, 2012 (TCEQ Investigation Report 1030412. August 15, 2012 Marathon Oil EF LLC's Kimble Gilley Production Facility. p. 5. Obtained by Earthworks through an Open Records request)

⁵¹ "This facility is expected to process a maximum of 50 MMSCF of sour natural gas (200 ppmv H2S)." (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 100493. East Sugarloaf Central Facility. Reviewed by John Gott, TCEQ, April 25, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: East Sugarloaf TRV 100493 Marathon)

⁵² "Gas is sour and co. used a max 100 ppmv H2S to estimate sulfur emissions." (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 99759. East Longhorn Central Facility. Reviewed by John Gott, TCEQ, August 3, 2013. Available at: <https://webmail.tceq.state.tx.us/gw/webpub/3169a952744940bfe8a53c5fa0429a5860c51070/GWDOC/DREF/tnrdm3.dms3apo.ansrp01/443550/Official/webacc/GWContentRoot/TRV%2d%2d99759%2d%2dMARATHON%20OIL%20EF%20LLC%2dM002%20Revision?action=Document.ViewNative&User.context=3169a952744940bfe8a53c5fa0429a5860c51070>)

⁵³ "H2S content of inlet gas: 50." Technical Review: Air Permit by Rule. Permit Registration No. 102437. Plains Exploration and Production Co. Kotara Production Facility. Reviewed by Guillermo Reyes, TCEQ, Aug. 23, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: Kotara TRV Plains

⁵⁴ "Slightly sour gas (40 ppmv) will be produced at the site." (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 99876. Pfeifer No. 1 Production Facility. Reviewed by John Gott, TCEQ, Jan. 13, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: Pfeifer TRV Marathon)

⁵⁵ "...handles natural gas that may contain more than 24 ppmv H2S (company is now claiming 400 ppmv H2S)." (Technical Review: Air Quality Standard Permit for Installation and/or Modification of Oil and Gas Facilities. Permit No. 99778. North Longhorn Central Facility. Reviewed by John Gott, TCEQ, June 3 2013. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search North Longhorn TRV 99778 Revision Marathon)

⁵⁶ At gas processing facilities different pieces of equipment remove some of the hazardous compounds. For example, amine or sweetening units remove hydrogen sulfide from the gas stream, so if the leak occurs after the sweetening unit there should not be H2S emitted. If, however, the leak is from a tank containing oil, condensate or produced water, the H2S has not yet been removed and so would be released to the atmosphere.

⁵⁷ TCEQ. 2012. "Oil and Gas Site Planned Maintenance, Startup, and Shutdown." <http://www.tceq.texas.gov/assets/public/permitting/air/Guidance/NewSourceReview/og-plan-mss.pdf>

⁵⁸ Environmental Integrity Project. July 2012. Accident Prone: Malfunctions and "Abnormal" Emissions Events at Refineries, Chemical Plants and Natural Gas Facilities in Texas, p. 1. 2009. http://www.environmentalintegrity.org/news_reports/documents/20120718AccidentProneFinal.pdf

⁵⁹ TCEQ Investigation Report 987182. Feb. 3, to March 1, 2012. Yosko 1 Production Facility. p. 2. (Obtained by Earthworks through an Open Records request).



⁶⁰ Sources: TCEQ Investigation Report 987182. Feb. 3, to March 1, 2012. Yosko 1 Production Facility. p. 3; and TCEQ Investigation Report 1022281 June 15, 2012. Eagle Ford Recon Karnes City. (Documents obtained by Earthworks through an Open Records request).

⁶¹ No odors were detected on Feb. 3, just smoke. (TCEQ Investigation Report 987182. Feb. 3, to March 1, 2012. Yosko 1 Production Facility. p. 3). On June 30, 2012 investigators could not get a TVA reading due to wind direction and fence lines (TCEQ Investigation Report 1023402. June 30, 2012. Eagle Ford Recon Karnes City. p. 2.) (Documents obtained by Earthworks through an Open Records request).

⁶² TCEQ Investigation Report 1022281. June 15, 2012. Eagle Ford Recon Karnes City. p. 2. (Obtained by Earthworks through an Open Records request).

⁶³ TCEQ Investigation Report 1022281. June 15, 2012. Eagle Ford Recon Karnes City. p. 4. (Obtained by Earthworks through an Open Records request).

⁶⁴ Inspector's field notes said: ". . .receptor very near to holding pond but readings too high to obtain distance from receptor to facility.. . Nearest Receptors: yards." (From: "Field Notes. Site Assessment Recon (RECON) Investigation No. 1022281. Investigator: Felischa Cullins. Date of Investigation: June 15, 2012. Site ID: K-EFS-307. p. 3 of 4. (Documents obtained by Earthworks through an Open Records request).

⁶⁵ There was no documentation that the inspectors went to the nearest receptor to warn them to stay indoors, or to take canister samples.

⁶⁶ From: "Field Notes. Site Assessment Recon (RECON) Investigation No. 1022281. Investigator: Felischa Cullins. Date of Investigation: June 15, 2012. Site ID: K-EFS-307. p. 3 of 4. (Documents obtained by Earthworks through an Open Records request).

⁶⁷ TCEQ Investigation Report 1023402. June 30, 2012. Eagle Ford Recon Karnes City. p. 2. (Obtained by Earthworks through an Open Records request)

⁶⁸ TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC's Sugarhorn Central Facility. p. 2. (Obtained by Earthworks through an Open Records request)

⁶⁹ TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC's Sugarhorn Central Facility. p. 2. (Obtained by Earthworks through an Open Records request)

⁷⁰ TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC's Sugarhorn Central Facility. p. 3. (Obtained by Earthworks through an Open Records request)

⁷¹ In the Kimble-Gilley investigation report, there is a description of the Sugarhorn investigation, which states that "EIs drove north on County Road 209 to the Sugarhorn Central Production Facility. . . Because of the wind direction we could not get down-wind of the facility to detect odors or record emissions using the MiniRae or the QRae." (TCEQ Investigation Report 1030412. August 15, 2012 Marathon Oil EF LLC's Kimble Gilley Production Facility. p. 2. Obtained by Earthworks through an Open Records request)

⁷² "Emissions events that occurred on August 15, 2012 and September 5, 2012 were not reported until December 20, 2012." (TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC's Sugarhorn Central Facility. p. 4. Obtained by Earthworks through an Open Records request)

⁷³ VOCs: 10,000 pounds divided by 12 hours = 833 pounds per hour. The allowable emissions rate was 1.62 pounds per hour. 833 lbs/hr divided by 1.62 lbs/hr = 514.

H2S: 1.35 pounds divided by 12 hours = 0.117 pounds per hour. 0.1125 lbs/hr divided by 0.001 lbs/hr = 112.5 times the allowable emission rate.

Data from the TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC's Sugarhorn Central Facility. p. 11. (Obtained by Earthworks through an Open Records request). See also July 2012 permit which was valid at time. Allowable VOC and H2S emissions from Marathon's permit. See FLARE-O1 in the Maximum Allowable Emission Rates Table (MAERT). (Technical Review: Air Quality Standard Permit for Oil and Gas Handling and Production Facilities. Permit No. 99763. Sugarhorn Central Facility. Reviewed by John Gott, TCEQ, July 25, 2012. Available at: <https://webmail.tceq.state.tx.us/gw/webpub/c7e01193737a7d638db4c92dc1946e6749971a3a/GWDOC/DREF/tnrdom3.dms3apo.ansrp01/442789/Official/webacc/GWContentRoot/TRV%2d%2d99763%2d%2dMARATHON%20OIL%20EF%20LLC%2d%2d6002?action=Document.ViewNative&User.context=c7e01193737a7d638db4c92dc1946e6749971a3a>)

⁷⁴ VOCs: 6,660 pounds divided by 11.5 hours = 574 pounds per hour. The allowable emissions rate was 1.62 pounds per hour. 574 lbs/hr divided by 1.62 lbs/hr = 354.

H2S: 0.88 pounds divided by 11.5 hours = 0.77 pounds per hour. 0.77 lbs/hr divided by 0.001 lbs/hr = 77 times the allowable emission rate.

Data from the TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC's Sugarhorn Central Facility. p. 7. (Obtained by Earthworks through an Open Records request).

⁷⁵ Violations included: Violation of General Condition 8 of Permit 99764 and listed in 30 Texas Administrative Code Section 116.615(9) which states the facility may not be operated unless all air pollution emissions captures and abatement and equipment maintained in good working order and working properly during normal facility operations. (TCEQ Investigation Report 1060291. March 28, 2013. Marathon Oil EF LLC's Sugarhorn Central Facility. p. 4. (Obtained by Earthworks through an Open Records request)

⁷⁶ TCEQ Investigation Report 1060291. March 28, 2013. Marathon Oil EF LLC's Sugarhorn Central Facility. p. 4. (Obtained by Earthworks through an Open Records request)

⁷⁷ Reviewed "All administrative orders issued since September 1, 1998," "Court orders issued since September 1, 1998," and "All pending enforcement cases" on TCEQ's web site. (<http://www.tceq.texas.gov/enforcement/penenfac/index.html>) There was no mention of a penalty being issued to Marathon Oil in Karnes County. Also, TCEQ's complaint investigation tracking web site show that "No NOV/NOE has been issued" for the Sugarhorn Central Facility Investigation done on February 5, March 21, April 3, 2013 and May 8, 2013. (<http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.investigation&invid=766289452013114>)



⁷⁸ “On December 18, 2012, the EI returned to the area of the complaint. . . A video taken at the Sugarhorn Central Facility was sent to Marathon. The flare was working, but emissions could be seen coming from vents on top of the storage tanks.” (TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC’s Sugarhorn Central Facility. p. 3. Obtained by Earthworks through an Open Records request)

⁷⁹ The company was informed by TCEQ of the emissions events on Sept. 5. By law, they should have reported the events within 24 hours, but did not. Marathon met with TCEQ on Oct. 24, 2012, where the company “acknowledged the events,” yet still did not report the events until December 20, 2012, more than 3 months after the events occurred. (TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC’s Sugarhorn Central Facility. pp. 3,4. Obtained by Earthworks through an Open Records request)

⁸⁰ TCEQ Investigation Report 1030412. August 15, 2012 Marathon Oil EF LLC’s Kimble Gilley Production Facility. p. 3. (Obtained by Earthworks through an Open Records request)

⁸¹ TCEQ Investigation Report 1030412. August 15, 2012 Marathon Oil EF LLC’s Kimble Gilley Production Facility. p. 4. (Obtained by Earthworks through an Open Records request)

⁸² In October 2012 Marathon informed TCEQ that the Kimble Gilley facility would be removing storage tanks and flares from the site, and be rerouting products to the East Sugarloaf Production Facility. By December the tanks were no longer in use. So TCEQ considered the violation resolved. (TCEQ Investigation Report 1030412. August 15, 2012 Marathon Oil EF LLC’s Kimble Gilley Production Facility. pp. 3,5. Obtained by Earthworks through an Open Records request)

⁸³ Email from Carol McGrath (TCEQ) to Vijay Kurki (Marathon Oil). May 4, 2012. The email pertains to the Yosko No. 1 Production Facility. Handwritten note on email reads: 0.73 miles to Complainant, 3843.61 feet to complainant.” Email obtained as part of documentation for Air Complaint Investigation 98182 obtained by Earthworks through an Open Records request (Attachment 1, p. 18 of 25). Also, documentation of the investigation indicates that the Yosko facility was “0.73 miles NE of complainant’s home.” (Attachment 1, p. 10 of 25) (TCEQ Investigation Report 987182. Feb. 2 to March 3, 2012 Marathon Oil EF LLC’s Yosko 1 Production Facility. “Attachment 1 – Documentation for Air Complaint Investigation 987182 of Marathon Oil Company Yosko 1 Production Facility, Karnes City, Karnes County, Texas.” Obtained by Earthworks through an Open Records request)

⁸⁴ TCEQ Investigation Report 987182. Feb. 2 to March 3, 2012 Marathon Oil EF LLC’s Yosko 1 Production Facility. pp. 3, 4. Obtained by Earthworks through an Open Records request)

⁸⁵ TCEQ Investigation Report 987182. Feb. 2 to March 3, 2012 Marathon Oil EF LLC’s Yosko 1 Production Facility. p. 5. Obtained by Earthworks through an Open Records request)

⁸⁶ FLIR web site: “Thermal imaging cameras for optical gas imaging.” <http://www.flir.com/cs/apac/en/view?id=41663>

⁸⁹ Weather History for Beeville, Texas (the closed weather station to Karnes City). Monday March 4, 2013. <http://www.wunderground.com/auto/kvii/history/airport/KBEA/2013/3/4/DailyHistory.html>

⁹⁰ TCEQ web site: “Air Monitoring Comparison Values.” http://www.tceq.state.tx.us/cgi-bin/compliance/monops/agc_amcvs.pl

⁹¹ Fuquay, J. Jan.2 23, 2013. “Benzene levels at Fort Work, Dish gas compressor stations questioned.” *Star-Telegram*. <http://www.star-telegram.com/2013/01/23/4570536/benzene-levels-at-fort-worth-dish.html>

⁹² According to a TCEQ investigation report, “While conducting a comalint investigation on September 5, 2012, it was discovered wit the use of the GasFind IR Camera that the enclosed barrel flare, EPN FLARE-01 was not working.” This resulted in the venting of large volumes of benzene (27 lbs.), propane (5,606 lbs) and other VOCs (6,600 lbs). As discussed previously, the emissions at that time were found to be in violation of Marathon Oil EF’s air permit. (TCEQ Investigation Report 1027204. August 15, 2012 Marathon Oil EF LLC’s Sugarhorn Central Facility. pp.3, 4. Obtained by Earthworks through an Open Records request)

⁹³ Steinzor, N., Subra, W. and Sumi, L. 2013. “Investigating Links between Shale Gas Development and Health Impacts Through a Community Survey Project in Pennsylvania.” *New Solutions*. 23:1:55-83. Available at: <http://www.newsolutionsjournal.com/index.php/newsolutionsjournal/issue/view/19>

⁹⁴ The table is excerpted from a peer-reviewed article soon to be published in *Human and Ecological Risk Assessment: An International Journal*. In an air quality study conducted in 2010, and accepted for publication by *Human and Ecological Risk Assessment: An International Journal*, Theo Colborn and her colleagues sampled air quality in rural western Colorado before, during and after drilling and hydraulic fracturing of a new natural gas well pad. As part of the study, Colborn and her colleagues performed an in-depth literature search of potential health effects related to chemicals found in an air sampling study near a natural gas pad in rural western Colorado (Colborn, T., Schultz, K., Herrick, L. and Kwiatkowski, C. (In Press) “An exploratory study of air quality near natural gas operations,” *Human and Ecological Risk Assessment: An International Journal*. Table 4. Available at The Endocrine Disruption Exchange web site: <http://www.endocrinedisruption.com/chemicals.air.php>. References for health effects can be found in supplemental material posted at: <http://www.endocrinedisruption.com/files/HERA12-137Table4References.pdf>

⁹⁵ RRC web site: “Active Eagle Ford fields.” Shows that the Eagleville (Eagle Ford 1 and Eagle Ford 2) and Brisco Ranch (Eagleford) fields all contain H2S. http://www.rrc.state.tx.us/eagleford/EagleFord_Fields_and_Counties_201306.xls Accessed July 17, 2013.

W-1 data for wells close to the Cernys shows that most if not all are in the Eagleville (Eagle Ford 2) field. Searched RRC “Drilling Permit Application Query.” <http://webapps.rrc.state.tx.us/DP/initializePublicQueryAction.do> Searched by API for wells in Appendix 1 of this report.

⁹⁶ RRC web site: “Hydrogen Sulfide (H2S) Fields and Concentration Listing.” District 2. June 2013. <http://www.rrc.state.tx.us/data/fielddata/h2s/dist2.php> Accessed July 17, 2013.

⁹⁷ The odor of hydrogen sulfide is often described as “rotten egg,” but at higher concentrations it can have a sweet odor, and above 100 ppm it can paralyze the olfactory nerves, causing the loss of the sense of smell. (Simonton, S. and Spears, M. Oct. 3, 2007. “Human health effects from exposure to low-level concentrations of hydrogen sulfide,” *Occupational Health and Safety*. <http://ohsonline.com/Articles/2007/10/Human-Health-Effects-from-Exposure-to-LowLevel-Concentrations-of-Hydrogen-Sulfide.aspx?Page=1>)



⁹⁸ The table was prepared by the Michigan Department of Environmental Quality, based on information excerpted from the American National Standards Institute standard: Z37.2-1972 Acceptable Concentrations of Hydrogen Sulfide. Available at: http://www.michigan.gov/deq/0,1607,7-135-3311_4111_4231-9162--00.html#2. What are the effects?

¹⁰⁰ Simonton, S. and Spears, M. Oct. 3, 2007. "Human health effects from exposure to low-level concentrations of hydrogen sulfide," *Occupational Health and Safety*. <http://ohsonline.com/Articles/2007/10/Human-Health-Effects-from-Exposure-to-LowLevel-Concentrations-of-Hydrogen-Sulfide.aspx?Page=1>

¹⁰¹ The RRC H-9 reports include information on the concentration of H₂S in gas.

¹⁰² TCEQ's web page "Automated gas chromatograph (AutoGC)" lists sites where air quality monitoring stations have been installed. It includes a section on the Barnett Shale Monitoring Network, but there is no mention of the Eagle Ford Shale. See: <http://www.tceq.texas.gov/airquality/monops/agg> Accessed June 16, 2013.

¹⁰³ Pers. Comm. Keith Sheedy, TCEQ. July 2, 2013.

¹⁰⁴ TCEQ web site: "Barnett Shale Geological Area." <http://www.tceq.texas.gov/airquality/barnettshale> NOTE: This is being done in the Barnett Shale, with the exception of video from the infrared monitoring cameras (FLIR) that reveal emissions invisible to the naked eye are not freely publicly available. FLIR video should also be freely publicly available.

¹⁰⁵ Center for Disease Control and Prevention web site: "The different types of health assessments." http://www.cdc.gov/healthyplaces/types_health_assessments.htm

¹⁰⁶ For a comprehensive assessment of Texas oil and gas oversight: http://www.earthworksaction.org/issues/detail/texas_oil_gas_enforcement

¹⁰⁷ Batchgeo web site: <https://batchgeo.com/>

¹⁰⁸ Note: Lat/long can be found in plats filed by the company with RRC (via a W-1 search). For some locations, lat/longitude data had to be obtained by using the RRC public map viewer, entering the well's API, and scrolling over the surface (not downhole) location for the well. (RRC Public GIS Map Viewer for Oil, Gas, and Pipeline Data: <http://gis2.rrc.state.tx.us/public/startit.htm>)

¹⁰⁹ TCEQ. <https://webmail.tceq.state.tx.us/gw/webpub>

¹¹⁰ RRC web site: "Drilling Permit Application Query." <http://webapps.rrc.state.tx.us/DP/initializePublicQueryAction.do>

¹¹¹ FracFocus web site: "Find a well." <http://www.fracfocusdata.org/DisclosureSearch/MapSearch.aspx>

¹¹² RRC web site: "Completions Query." <http://webapps.rrc.state.tx.us/CMPL/publicSearchAction.do?formData.methodHndlr.inputValue=init&formData.headerTabSelected=home&formData.pageForwardHndlr.inputValue=home>

¹¹³ View statewide rule 3.36 at: [http://info.sos.state.tx.us/pls/pub/readtac\\$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=16&pt=1&ch=3&rl=36](http://info.sos.state.tx.us/pls/pub/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=16&pt=1&ch=3&rl=36)

¹¹⁴ For example, see the H-9 filed for the Brysch-Jonas Unit C, 1H well. <http://webapps.rrc.state.tx.us/dpimages/r/1775844>

¹¹⁵ Technical Review: Air Permit by Rule. Permit No. 97998. Hilcorp Energy Company. Yosko 1 Production Facility. Reviewed by Jeffrey Voorhis, TCEQ, Aug. 29, 2011. Available at: <https://webmail.tceq.state.tx.us/gw/webpub> Search: TRV 97998

¹¹⁶ TCEQ web site: "Search for the status of a complaint." Searched Karnes County. Checked to make sure that complaint "effect" stated Eagle Ford Shale. <http://www2.tceq.texas.gov/oce/waci/index.cfm>

¹¹⁷ Operator found by looking up the regulated entity (RN) number associated with the complaint. <http://www12.tceq.state.tx.us/crpub/index.cfm?fuseaction=regent.RNSearch>

¹¹⁸ Complaint 184004. <http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.complaint&incid=184044>

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¹²⁰ Complaint 180822. <http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.complaint&incid=180822>

¹²¹ Complaint 184955. <http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.complaint&incid=184955>

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¹²⁶ Complaint investigation details for 174327. <http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.complaint&incid=174327>

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¹²⁸ Complaint 173742. <http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.complaint&incid=173742>

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¹³¹ Complaint investigation details for 173359, <http://www2.tceq.texas.gov/oce/waci/index.cfm?fuseaction=home.investigation&invid=460580732012275>

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- ¹⁷⁸ Earthworks representatives observed and took FLIR footage at the Best-Beard Unit site, where two wells were being hydraulically fractured. According to FracFocus, fracking started on the site on February 21, 2013 (Searched FracFocus, API #: 42-255-32694 and 42-255-32660 <http://www.fracfocusdata.org/DisclosureSearch/MapSearch.aspx>). The Best-Beard Unit is approximately 3 miles from the Cerny home. As seen from Appendix 1, only one well within a 2-mile radius of Cernys was undergoing hydraulically fracturing in March 2013. The Adams-Tipton 4H well was fracturing on March 15, 2013 (as noted on the FracFocus web site. Searched API #42-255-32984.) This was after the canister samples were taken.
- ¹⁷⁹ US Geological Survey web site: "Polynuclear Aromatic Hydrocarbons (PAHs)." Toxic Substances Hydrology Program. <http://toxics.usgs.gov/definitions/pah.html>
- ¹⁸⁰ U.S. EPA web site: "Formaldehyde." <http://www.epa.gov/iaq/formaldehyde.html>
- ¹⁸¹ ALS-Columbia Analytical web site: "Air Sampling Instructions." <http://www.caslab.com/Air-Sampling-Instructions/>



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