

# Sour Wind in West Texas

*Air Pollution From Surging Oil and Gas Industry Exceeds Health Standards*



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## ACKNOWLEDGEMENTS

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## THE ENVIRONMENTAL INTEGRITY PROJECT

The Environmental Integrity Project (<http://www.environmentalintegrity.org>) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws.

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## *Air Pollution from Surging Oil and Gas Industry Exceeds Health Standards*

The Permian Basin oil producing region encompasses about 63,834 square miles in western Texas and southeastern New Mexico, extending to 29,000 feet underground, making it one of the thickest hydrocarbon producing regions in the world.<sup>1</sup> Oil companies have been drilling in the Permian since the 1920s, but horizontal drilling and hydraulic fracturing brought a new boom to the region in the past decade. In 2015, Congress lifted the U.S. ban on the export of crude oil, further boosting domestic production. Industry insiders predict that by 2021, Permian Basin oil will account for about 40 percent of all U.S. production.<sup>2</sup> By 2023, the industry expects oil production to double from 2017 levels.<sup>3</sup> According to the International Energy Agency, U.S. crude oil will account for 80 percent of the growth in global oil supply over the next seven years, and most of that oil will come from the Permian.<sup>4</sup>

With that oil comes record-breaking production of natural gas and natural gas liquids, along with the processing, storage, and transportation that these products require. This requires a massive buildout of plants, tanks, pipes, and other infrastructure – most of which release air pollution.

According to industry reports filed with the Texas Commission on Environmental Quality (TCEQ), Permian Basin oil and gas facilities release more illegal air pollution during equipment failures, shutdowns, and other non-routine “emission events” than in any other part of the state.<sup>5</sup>

A 2018 study, published in the American Chemistry Society’s *Environmental Science and Technology*, found that health costs in Odessa (Ector County) attributable to unpermitted air pollution are greater than many of Texas’ heavily industrialized Gulf Coast counties.<sup>6</sup> This research strongly suggests that residents of sparsely populated West Texas bear a disproportionate share of health burdens from air pollution. A 2019 study of TCEQ data by the non-profit Environment Texas also concluded that the Permian Basin region leads the state of Texas in illegal (unpermitted) air pollution emissions.<sup>7</sup> These studies are remarkable



*Despite excessive levels of unauthorized pollution in the Permian Basin, the region lacks enough air quality monitors to protect public health.*

given that the Texas Gulf Coast, including the Houston Ship Channel, is home to the largest concentration of oil refineries and petrochemical plants in the nation.

Despite the excessive levels of unauthorized emissions in the Permian Basin, the region lacks enough air quality monitors to determine if the air is safe to breathe. The TCEQ's Houston region has approximately 60 active air quality monitoring stations, while the Midland-Odessa region has three.<sup>8</sup> Of these three monitors, only one measures sulfur dioxide, which is the most prevalent air pollutant in the Permian Basin. The lone sulfur dioxide air monitor in this region, which is located in Big Spring (about 60 miles east of Odessa) was activated in 2016.<sup>9</sup> It shows there is cause for concern. On at least 30 occasions between December 2016 and April 2019, hourly sulfur dioxide pollution levels measured at Big Spring exceeded the national health-based standard.<sup>10</sup> In March 2018, the Big Spring air monitor recorded 460 parts per billion of sulfur dioxide – more than six times higher than the 75 parts per billion air quality standard for one hour.



*The TCEQ Air monitoring station in Big Spring began operating Dec. 3, 2016. Sulfur dioxide air pollution levels there are frequently above federal health standards.*

Because there is only one functioning air monitoring station measuring sulfur dioxide in the Permian Basin, the Environmental Integrity Project studied the regional air quality, based on industry self-reported unauthorized releases of air pollution, which occurred mainly from flaring.

Using the Environmental Protection Agency (EPA)-approved air quality model known as AERMOD (the American Meteorological Society/Environmental Protection Agency Regulatory Model), we demonstrated the air quality impacts in Ector County resulting from the oil and gas industry's self-reported emissions of sulfur dioxide,

matching them with actual weather conditions at the time and place of the emissions incidents. We chose Ector County due to the relatively large (for West Texas) population of about 156,000 residents, including 117,000 in the county seat, Odessa.

According to the modeling results, excessive flaring from the oil and gas industry is causing dangerous levels of sulfur dioxide air pollution in and around Odessa. Pollution levels in much of Ector County exceed the hourly health-based standard set by EPA. More broadly, our study suggests that across the Permian Basin, residents, workers, and visitors are exposed to excessive air pollution as a result of excessive flaring.



### ***Summary of Findings:***

- Oil and gas operators in and around Ector County self-reported 2,564 unauthorized releases of air pollution in a four-year period from 2014-2017.
- The worst sulfur dioxide pollution for all four years studied was 3,644 micrograms per cubic meter, in 2014, near Goldsmith, northwest of Odessa. That pollution level was 18 times higher than the EPA's health-based National Ambient Air Quality Standard of 75 parts per billion.<sup>11</sup>
- The one functioning sulfur dioxide monitoring station in the Permian Basin, in Big Spring, frequently measures sulfur dioxide concentrations at levels above 75 parts per billion.
- Residents of the Permian Basin are breathing air with excessive levels of sulfur dioxide pollution, resulting from the widespread flaring of "sour gas" (gas that contains significant amounts of hydrogen sulfide).
- According to computer modeling, excessive flaring at oil and gas operations in and around Ector County result in pollution levels exceeding the national health based standard for sulfur dioxide.

### ***Recommendations:***

There is a serious and ongoing air pollution problem in the Permian Basin. Residents of the Permian Basin are bearing a heavy burden when it comes to health impacts from air pollution. Federal and state leaders should do more to protect health and safety in West Texas, where illegal pollution from oil and gas production is reaching levels of serious concern based on the federal health-based standard for sulfur dioxide.

Federal and state regulators have an important obligation to control this pollution. The EPA should investigate whether air quality in the Permian Basin meets the federal health-based National Ambient Air Quality Standards. If the most reliable available data (including air dispersion model results where monitoring does not yet exist) indicates air pollution in violation of federal standards, then EPA should designate the area as being in nonattainment for sulfur dioxide. This would trigger stricter environmental and health protections in the Permian, which would improve both air quality and human health.

Texas has laws in place that, if enforced, would help reduce this air pollution.

- The Texas Commission on Environmental Quality and the Railroad Commission of Texas (which regulates oil and gas operations) should more strictly enforce their permitting rules. These state agencies should only approve permits for facilities that can demonstrate their emissions will comply with state and federal standards.
- TCEQ should more closely scrutinize permit applications to ensure they are not authorizing dangerous levels of sulfur dioxide. The agency should not issue permits that allow flaring in violation of any federal ambient air standards.
- Texas should ramp up its enforcement in the Permian Basin by penalizing oil and gas companies for flaring emissions over permitted levels. Both the TCEQ and the Railroad Commission should assess fines at levels sufficient to create an incentive for

companies to comply with anti-waste, flare-minimization, and clean air laws. In addition to penalties, the TCEQ should order the largest emitters to establish monitoring networks upwind and downwind of their facilities.

- Texas should make a modest investment in the health of Permian Basin residents by establishing a regional air quality monitoring network to measure air quality in Midland-Odessa. Monitoring stations should measure multiple pollutants and meteorological conditions, and should be located to measure baseline and worst-case conditions.

West Texas communities that are paying the steepest price – in terms of air quality and health – should not be left at the mercy of polluters. State and federal regulators have an obligation to step in and protect the public from harmful emissions.

## Air Pollution in the Texas Permian Basin

The Permian Basin is the largest oil and natural gas-producing basin in the U.S., and is home to about 1.4 million people, according to 2017 U.S. Census estimates. As stated in the introduction, oil companies have been drilling and extracting oil from the Permian since the 1920s, but horizontal drilling and hydraulic fracturing brought a new boom to the region starting around 2010. This trend was accelerated in 2015 by Congress' approval of crude oil exports. Oil and gas producers in the Permian are now extracting more than ever.<sup>12</sup>

Oil and gas production relies on a system of interconnected infrastructure. Most of the components of this system (wells, tank batteries, pipelines, compressor stations, gas processing plants, oil refineries, petrochemical plants, and power plants) are also sources of air pollution. For that reason, oil and gas production facilities are required to have air pollution permits that comply with the federal Clean Air Act.

But, according to industry reports filed with TCEQ, Permian Basin oil and gas facilities also release a large amount of *unpermitted* pollution during equipment breakdowns, maintenance, and other non-routine so-called “emission events.” Because many oil and gas production facilities are interconnected to other similar facilities and to pipelines, a breakdown at one site often sparks a chain reaction, causing simultaneous releases of pollution up and down the supply chain.

In recent years, a new and disturbing trend has become evident: oil and gas production facilities, which have historically been considered to be relatively small sources of air pollution, are emitting more air pollution during unpermitted “emission events” than during routine operations, and more than their Clean Air Act permits allow.<sup>13</sup>

However, controlling air pollution in West Texas has not been a priority for the state, as evidenced by the scarcity of air pollution monitoring stations in the Permian Basin. And yet, the type of air pollution in the Permian Basin – dominated by excessive emissions of sulfur dioxide and hydrogen sulfide – is known to have serious environmental and public health consequences.

## Health Impacts of Sulfur Dioxide and Hydrogen Sulfide

**Sulfur dioxide** (SO<sub>2</sub>) forms when substances containing sulfur, including coal, oil, and gas, are burned. According to EPA, short-term exposures to sulfur dioxide can harm the human respiratory system and make breathing difficult. Children, the elderly, and those who suffer from asthma are particularly sensitive to sulfur dioxide. The pollutant also reacts with other compounds in the atmosphere to form dangerous soot-like fine particles (also known as particulate matter), which can penetrate deeply into sensitive parts of the lungs and cause additional health problems.<sup>14</sup> Studies show correlations between short-term exposure to sulfur dioxide and increased visits to hospital emergency rooms. Children, the elderly, asthmatics, and those who exercise regularly are most at risk.<sup>15</sup>

Historically, extremely high concentrations of sulfur dioxide caused – for example -- London's Great Smog of 1952, which killed at least 10,000 people and hospitalized 200,000. Since that era, better emission controls and decreased use of coal have done much to reduce atmospheric concentrations of SO<sub>2</sub>.

**Hydrogen sulfide** is best known for a rotten egg smell that is often associated with oil and gas production. At low levels this acid can cause causes headaches, breathing problems, and irritation of the eye, nose, and throat. Long-term exposure can lead to miscarriages, poor memory, and dizziness. Very high concentrations cause coma and even death.<sup>16</sup>

Natural gas fields in New Mexico, Arkansas, West Texas, and north-central Wyoming are well known for having “sour gas,” which is gas with high concentrations of hydrogen sulfide. Because this gas is heavier than air, it can pool in low-lying areas when the wind is not blowing. In February 1975, a hydrogen sulfide release killed eight people in a home near an oil and gas site in the West Texas town of Denver City.<sup>17</sup>

## Environmental Impacts of Pollutants

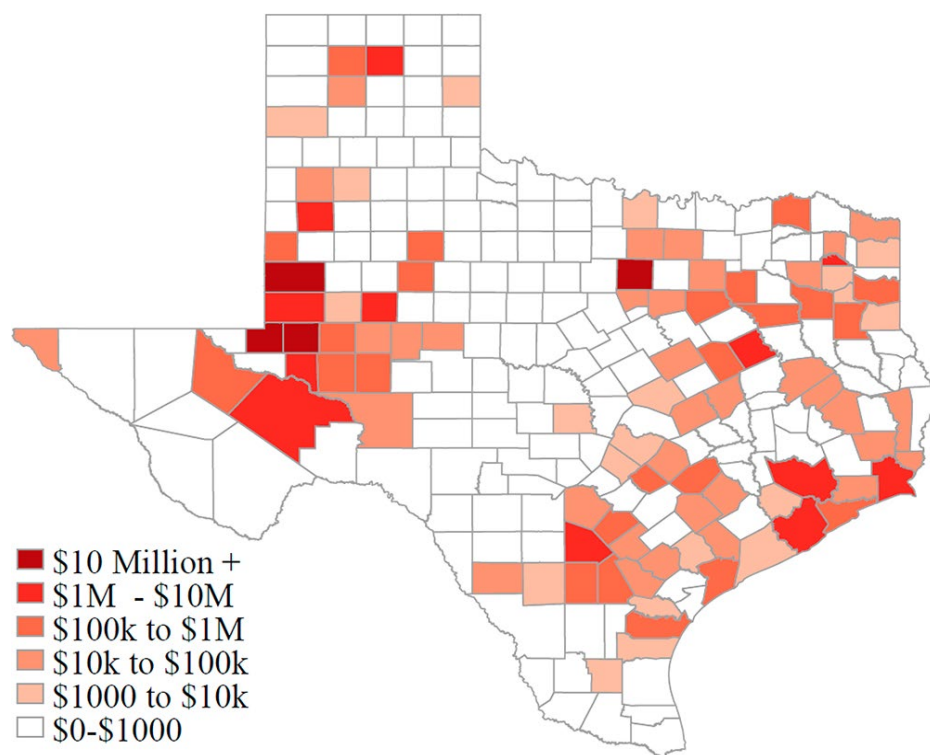
Sulfur dioxide and hydrogen sulfide are not only dangerous for people, but can also acidify soils and water. The pollutants harm trees and plants by decreasing growth and damaging foliage. Sulfur dioxide and hydrogen sulfide also react with other compounds in the air to form haze that reduces visibility in national parks and wilderness areas.<sup>18</sup> Sulfur dioxide is also one of the key pollutants that forms acid rain, which can leach aluminum particles from soil and clay, killing fish, insects, and plants.

Other wildlife is harmed by sulfur dioxide and hydrogen sulfide in much the same ways as people are, primarily through respiration. Hydrogen sulfide acts such the same way on all vertebrate species that breathe, such as in migratory birds, mammals, and certain reptiles and amphibians.<sup>19</sup>

## West Texas Residents Bear a Heavy Health Burden

An article published in the *Journal of Environmental Science and Technology* on January 27, 2018, estimates that air pollution “emission events” in Texas cause \$150 million per year in health costs.<sup>20</sup> The authors acknowledge that this cost is likely an underestimation, because it is based only on premature deaths from fine particle pollution. Figure 1 shows the distribution of the health costs, with some of the highest in the Permian Basin.

**Figure 1: Distribution of Health Costs From Unpermitted Emissions Across Texas**



*This map shows the distribution of estimated health costs due to unpermitted emissions from industrial facilities based on a 2018 study in the *Journal of Environmental Science and Technology*. The highest concentration of dark red zones – showing highest costs – are in the Permian Basin in West Texas.*

Sulfur dioxide is the most prevalent air pollutant released by facilities in the Permian Basin, according to Texas’ database of unauthorized emission events.

The Clean Air Act requires EPA to protect human health from this pollutant by setting maximum limits on the amount of sulfur dioxide that can be present in outdoor air. These limits, called primary National Ambient Air Quality Standards, are based on short- and long-term exposure. The current health-based standard is 75 parts per billion (which is equivalent to 196 micrograms per cubic meter) based on the 3-year average of the 99th percentile of the yearly distribution of 1-hour daily maximum concentrations.<sup>21</sup>



A total of 258 facilities in Texas' Permian basin reported releasing 27 million pounds of unauthorized sulfur dioxide (SO<sub>2</sub>) in 2017. See table below.

**Table 1: Unauthorized SO<sub>2</sub> Emissions Reported in Permian Basin Counties, 2017**

County	2017 Population Estimate	# Facilities that Reported Unpermitted SO <sub>2</sub> Releases	# of Events Reported	Total Unauthorized SO <sub>2</sub> Releases (lbs)
Ward	11,472	7	64	8,281,725
Ector	157,087	109	782	5,335,754
Andrews	17,722	26	299	4,234,912
Gaines	20,638	18	212	3,161,380
Crane	4,740	36	320	3,041,220
Yoakum	8,568	10	77	862,064
Howard	36,040	10	99	706,390
Hockley	23,088	3	29	532,136
Pecos	15,634	4	86	331,249
Reagan	3,710	3	38	271,003
Winkler	7,574	5	47	154,422
Reeves	15,281	2	41	146,052
Scurry	17,050	4	6	73,700
Dawson	12,813	3	31	51,950
Kent	763	2	13	36,504
Glasscock	1,348	2	9	21,915
Mitchell	8,468	4	12	10,137
Cochran	2,851	1	7	6,716
Martin	5,626	3	4	4,013
Crockett	3,564	1	4	3,852
Garza	6,528	1	3	2,444
Coke	3,306	1	1	798
Upton	3,663	3	10	126
<b>Total:</b>	<b>387,534</b>	<b>258</b>	<b>2194</b>	<b>27,270,462</b>

As the data indicate, the largest emissions occurred in Ward, Ector, Andrews, Gaines, and Crane counties. Facilities in each county reported releasing between 3 million and 8.2 million pounds of unauthorized SO<sub>2</sub> in 2017. Ector County, which has the highest population of these counties, had the second highest number of unauthorized releases.

A large number of facilities that reported unauthorized emissions are owned or operated by a small handful of companies, as shown in Table 2 below. For example, Occidental Permian owns 74 facilities that released 10.6 million pounds of sulfur dioxide during 500 incidents in 2017. XTO Energy (an Exxon subsidiary) owns 42 facilities that reported releasing nearly 2.4 million pounds of unauthorized sulfur dioxide during 359 incidents.

**Table 2: Ten Companies Responsible for the Most Unauthorized SO<sub>2</sub> Releases in the Permian Basin, 2017**

Company	# Facilities	# Events Reported	Unauthorized SO <sub>2</sub> (lbs)
Occidental Permian Ltd. (CN600755086)	74	500	10,618,267
Chevron U.S.A. Inc. (CN600132484)	6	76	5,015,784
XTO Energy Inc. (CN600601348)	42	359	2,387,124
ConocoPhillips Co. (CN601674351)	37	315	1,863,664
Hess Corp. (CN600132245)	3	20	1,760,370
James Lake Midstream, LLC (CN604509893)	1	106	1,214,775
DCP Operating Co. LP (CN601229917)	11	76	923,794
OXY USA Inc. (CN604677401)	9	52	559,618
Burlington Resources Oil & Gas Co. LP (CN602989436)	18	170	531,261
Kinder Morgan Production Co. LLC (CN603227380)	4	21	412,371

Some of the companies responsible for the most unauthorized SO<sub>2</sub> emissions own or operate large gas processing plants and acid gas disposal wells. For example, Canyon Midstream (James Lake Midstream), operator of the James Lake Gas Plant in Ector County, reported 106 events that resulted in the release of 1.2 million pounds of sulfur dioxide. According to state reports, nearly all of these emissions were associated with flaring due to problems with the facility's acid gas injection well.

The 10 facilities that reported the most unauthorized sulfur dioxide pollution in 2017 are listed below.

**Table 3: Facilities that Reported the Most Unauthorized SO<sub>2</sub> in the Permian Basin, 2017**

Company	Site	County	# Events	Total Unauthorized SO <sub>2</sub> (lbs)
Occidental Permian Ltd.	Sealy Smith Clearfork Satellite 7	Ward	10	6,759,756
Chevron U.S.A. Inc.	Mabee Ranch CO <sub>2</sub> Plant	Andrews	29	2,925,848
Hess Corp.	Seminole Gas Processing Plant	Gaines	18	1,680,384
Chevron U.S.A. Inc.	J.T. McElroy 202 TB	Crane	17	1,483,836
James Lake Midstream LLC	James Lake Gas Plant	Ector	106	1,214,775
DCP Operating Co. LP	Goldsmith Gas Plant	Ector	36	792,238
Occidental Permian Ltd.	Sealy Smith Clearfork Satellite 3	Ward	13	538,448
Chevron U.S.A. Inc.	McElroy Section 199 Emergency Flare	Crane	14	505,427
Occidental Permian Ltd.	Sealy Smith Clearfork Satellite 8	Ward	12	478,356
XTO Energy Inc.	Goldsmith CO <sub>2</sub> Pilot Phase II Facility	Ector	8	468,752

Seven of these 10 facilities listed in the above chart have state air pollution control permits (called "Permits-by-Rule") that are intended for small sources that emit no more than 25

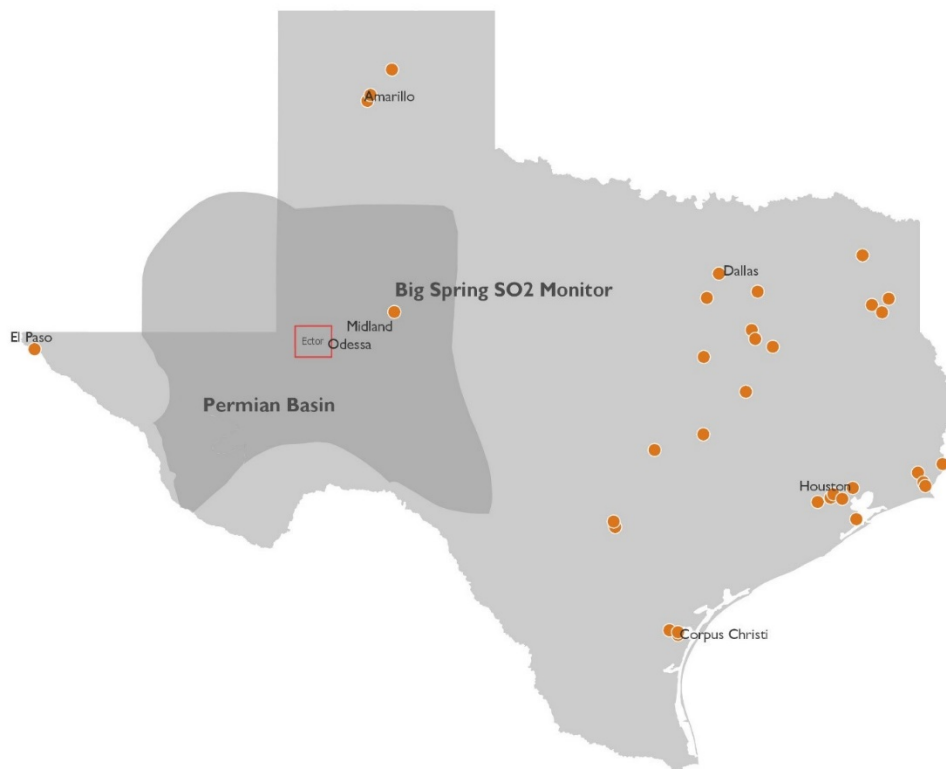
tons per year of sulfur dioxide. However, as shown in Figure 4 on page 12, these seven plants released far in excess of the 25-ton limit in 2017. This means that the emissions were illegal and that Texas should require these plants to obtain and follow stricter air pollution control permits.

## Texas Lacks Adequate Air Monitors in the Permian Basin

The federal Clean Air Act requires states to monitor ambient air quality to protect public health. EPA regulations require states to monitor sulfur dioxide levels in areas that satisfy certain population and emission level requirements. Monitors are also required near large emitters (>2,000 tons per year of SO<sub>2</sub>). Due to the small population in the Permian Basin (approximately a quarter of a million people live in Midland-Odessa), neither Texas nor EPA has seen fit to monitor sulfur dioxide levels associated with Permian Basin oil and gas production.<sup>22</sup>

The closest sulfur dioxide air monitor to Odessa is located in Big Spring, over 60 miles to the northeast of Odessa, and that monitor was established to measure air quality adjacent to a particular oil refinery. Even so, between December 2016 and April 2018, that monitor recorded 30 hours in which sulfur dioxide concentrations reached levels above the federal 1-hour standard of 75 ppb. Recorded concentrations during these times ranged from just over 75 ppb to as high as 460 ppb.

**Figure 3: Locations of Active Sulfur Dioxide Monitoring Stations in Texas**



*The red dots indicate the locations of sulfur dioxide monitoring stations across Texas in December 2018. Although the oil and gas industry is booming in the Permian Basin (marked in darker gray), air quality monitoring there is sparse – with only one SO<sub>2</sub> monitor.*

## Modeling Shows Ector County is Flunking Air Quality Standard for Sulfur Dioxide

Because there are no sulfur dioxide air pollution monitors in Ector County,<sup>23</sup> the Environmental Integrity Project used an EPA-approved air dispersion model to determine the effects of oil and gas emissions on local air quality. We modeled industry reported emission events in Ector County between 2014 and 2017. EIP conducted the modeling in this location with the understanding that similar air quality impacts are likely in other parts of the Permian where there are large releases of SO<sub>2</sub>.

Table 4 shows the largest sources of unauthorized sulfur dioxide emissions in Ector County in 2017. The two top facilities are large gas plants located in Goldsmith, Texas, that together reported 142 events and released over 2 million pounds of unauthorized sulfur dioxide pollution.

**Table 4: Largest Sources of Unauthorized SO<sub>2</sub> Emissions in Ector County, 2017**

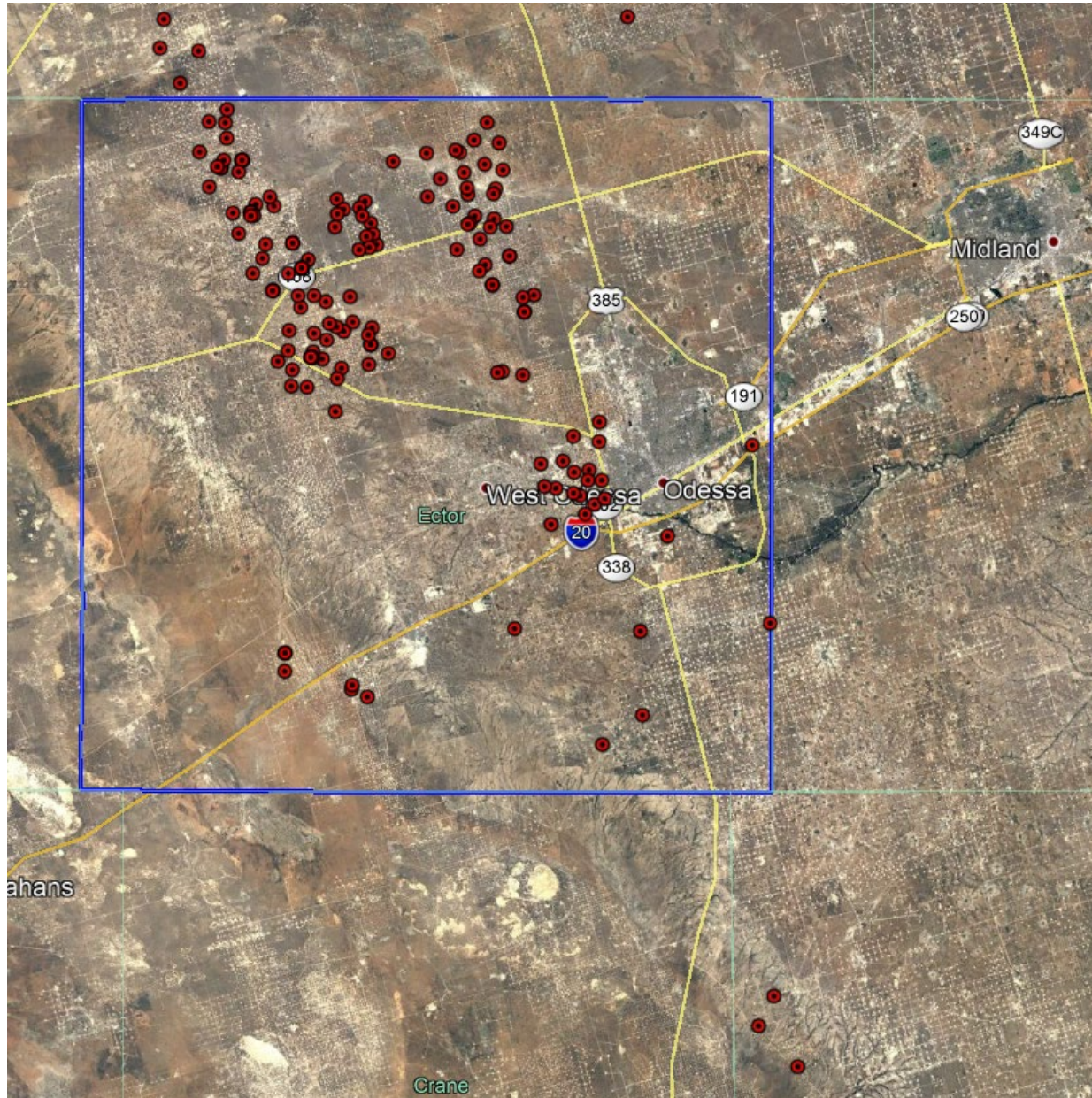
Company	Site	County	# Events	Unauthorized SO <sub>2</sub> (lbs)
Canyon Midstream/James Lake Midstream LLC	James Lake Gas Plant	Ector	106	1,214,775
DCP Operating Co., LP	Goldsmith Gas Plant	Ector	36	792,238
XTO Energy Inc.	Goldsmith CO <sub>2</sub> Pilot Phase II Facility	Ector	8	468,752
ConocoPhillips Co.	Embar 2 - WCAB	Ector	11	222,249
XTO Energy Inc.	CAG Central Battery No 448	Ector	5	197,143
XTO Energy Inc.	GSAU 2 2 Battery	Ector	9	188,773
Occidental Permian Ltd.	North Cowden Unit South Central Tank Battery	Ector	12	149,916
Occidental Permian Ltd.	OB Holt R Lease TB I	Ector	2	92,977
ConocoPhillips Co.	Gandu Battery 34	Ector	21	92,117
Occidental Permian Ltd.	Rhodes Cowden Unit Central Battery	Ector	4	84,895

Using the above data, we conducted air dispersion modeling using the regulatory model that EPA and the State of Texas require, called AERMOD, to estimate the air quality impacts of unauthorized SO<sub>2</sub> emissions in Ector County. We ran the air dispersion model, using the industry self-reported emission events for calendar years 2014 – 2017, and National Weather Service meteorological data for the days and times that the emissions events occurred. We obtained source parameters (i.e., the location, height, and other specifications) for the flares and other emission points from publicly available databases.<sup>24</sup> (For more on methodology, see Appendix A).



In Ector County, over the four-year study period, a total of 155 sources reported 2,564 separate emission incidents (mainly flaring events), including 495 in 2014; 669 in 2015; 568 in 2016; and 832 in 2017.

**Figure 3: Locations of the Pollution Sources Included in the Modeling Study**



*The red dots indicate the locations of the 155 sources of oil and gas industry emissions included in the EIP analysis, with the blue square depicting Ector County. The sources cluster north and west of the city of Odessa, exposing residents to potentially harmful air pollution.*

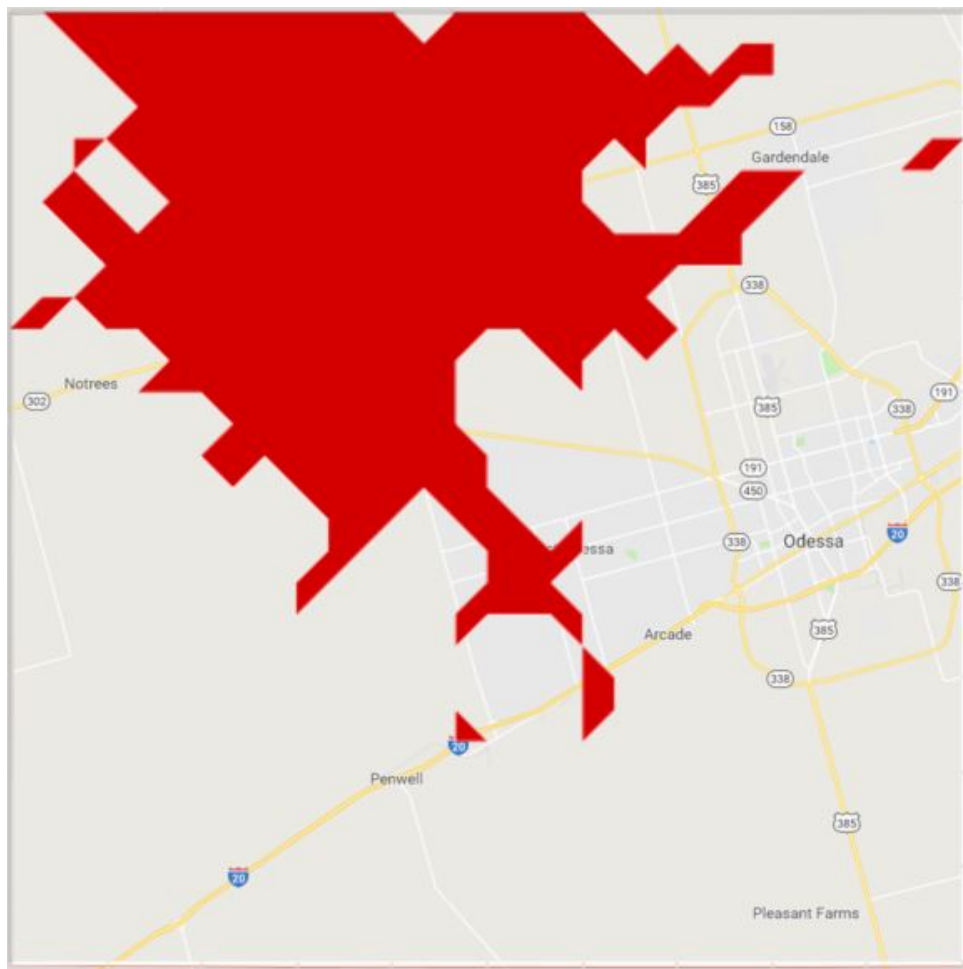


The total amount of sulfur dioxide emitted from all 155 sources for all four years was 15,270 tons, or an average of 3,818 tons of unauthorized sulfur dioxide pollution per year. Overall, the average incident lasted 70.3 hours and released 11,911 lbs of sulfur dioxide. The overall average emission rate for all incidents was 169.5 lb/hr (with a wide variation).<sup>25</sup>

## Results

Over a four-year period, from 2014 through 2017, roughly 35 percent of Ector County experienced sulfur dioxide air pollution levels in excess of the federal health-based standard, as shown in the map below. The model results indicate that in each year, oil and gas flaring resulted in hundreds of exceedences of the U.S. health-based air quality standard for sulfur dioxide.<sup>26</sup> In 2015, pollution levels over the national standard covered an approximate area of 579 km<sup>2</sup>, about 25 percent of Ector County.

**Figure 4: 4-Year Maximum Modeled 1-Hour Average Sulfur Dioxide Levels Exceeding Health Standards**



*Over a four year period, roughly 35 percent of Ector County experienced sulfur dioxide air pollution levels in excess of the federal health standards (196 micrograms per cubic meter). Occuring mostly Northwest of Odessa, this elevated pollution corresponded with an area of intense oil and gas industry emissions.*

## Recommendations

EPA and the Texas Commission on Environmental Quality share the responsibility to protect air quality and to stop illegal pollution. While the state agency is on the frontline in terms of issuing air pollution permits and enforcing emissions limits, EPA has oversight and enforcement authority. At the state level, the Railroad Commission of Texas also bears responsibility for issuing most drilling permits. When these regulators fail to protect public health and the environment, the law allows members of the affected public to hold violators accountable and to enforce pollution limits.

The state and federal regulators should take the following steps to reduce air pollution in the Permian Basin:

- Both EPA and TCEQ should expand their air quality monitoring programs for the Permian Basin, including establishing stationary air monitors in and around Odessa.
- Because EPA's air quality determinations using information gathered from the new air quality monitors will take years to complete (according to the usual EPA regulatory process), EPA should immediately conduct its own modeling to determine whether areas in the Permian Basin meet the national ambient air quality standards. EPA should also initiate the formal, public, information-gathering request and rulemaking process to gather information from the industry and the public, and to ensure all stakeholders participate in this determination.
- EPA and TCEQ should strengthen air pollution control permits in the Permian Basin, including by reviewing Texas' reliance on the less-stringent standard permits and "permits-by-rule" in oil and gas production, processing, storage, and transportation. Texas should also ensure that all major sources of air pollution obtain appropriate major source permits. The goal is to ensure that all sources of potentially dangerous air pollution have enforceable permits that protect public health.
- TCEQ should revise its rules and policies on unpermitted air pollution incidents, such that all unauthorized emissions over a threshold level determined by the state should be subject to automatic penalties.
- EPA and the State of Texas (both the TCEQ and Railroad Commission) should exercise their enforcement authority by investigating and prosecuting those operators in the Permian Basin who routinely violate anti-pollution rules and their permit limits.
- TCEQ should review its policy allowing industrial emitters to avoid compliance simply by filing timely reports about unpermitted emissions. TCEQ should adopt a rule specifying the factors that the agency will use in exercising enforcement discretion for emission events. The rule should specify that penalties will apply for any emission event over a certain threshold and for which the root cause has occurred more than once before. For all other emission events, the TCEQ should exercise its enforcement discretion as long as the operator provides proof that the

source employs the best available control technology to control emissions, and that the incident did not contribute to an exceedance of any national ambient air standard.

With common-sense steps like these, there is no reason that oil and gas producers in the Permian Basin cannot comply with air pollution rules that ensure and safeguard the health of the people of West Texas.

## ENDNOTES:

<sup>1</sup>NGI's Shale Daily, "Information on the Permian Basin". <https://www.naturalgasintel.com/permianinfo>

<sup>2</sup> RBN Energy LLC, PowerPoint Presentation (The Big Picture, Module 1), Permicon Conference, Houston, Texas, October 18, 2018.

[https://rbnenergy.com/sites/default/files/static\\_pages/permicon\\_brochure\\_20180830.pdf](https://rbnenergy.com/sites/default/files/static_pages/permicon_brochure_20180830.pdf)

<sup>3</sup> New IHS Markit Outlook – "Stunning" Permian Basin Oil Production to More than Double from 2017-2023, Exceeding Expectations. BusinessWire, June 13, 2018.

[https://www.businesswire.com/news/home/20180613005357/en/New-IHS-Markit-Outlook--"Stunning"-Permian](https://www.businesswire.com/news/home/20180613005357/en/New-IHS-Markit-Outlook--).

<sup>4</sup> "As oil and gas exports surge, West Texas becomes the world's 'extraction colony,'" by Kiah Collier, The Texas Tribune and Jamie Smith Hopkins and Rachel Leven, Center for Public Integrity, published Oct. 11, 2018, available at: <https://www.texastribune.org/2018/10/11/west-texas-becomes-worlds-extraction-colony-oil-gas-exports-surge/>

<sup>5</sup> See, "Report: Unauthorized air pollution in Texas up 27 percent in 2017," Texas Tribune, by Kiah Collier, published Jan. 31, 2019, available at: <https://www.texastribune.org/2019/01/31/environment-texas-report-unauthorized-air-pollution/> (the report found that the TCEQ's Midland region, located in the heart of the Permian Basin, accounted for more than half of the statewide total of unauthorized air pollution in 2017, more than even the Houston region which suffered from pollution releases during Hurricane Harvey).

<sup>6</sup> "Understanding Excess Emissions from Industrial Facilities: Evidence from Texas," Nikolaos Ziropiannis, Alex J. Hollingsworth, and David M. Konisky, *Environmental Science and Technology* 52 (5): 2482-2490 (2018)

<sup>7</sup> Environment Texas study, using TCEQ data obtained by the Environmental Integrity Project, "Major Malfunction:

Air Pollution from Industrial Malfunctions and Maintenance in Texas in 2017," January 2019. Link:

[https://environmenttexas.org/sites/environment/files/reports/TX\\_MajorMal\\_scrn.pdf](https://environmenttexas.org/sites/environment/files/reports/TX_MajorMal_scrn.pdf)

<sup>8</sup> GeoTAM, TCEQ

<https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=ab6f85198bda483a997a6956a8486539>

<sup>9</sup> See, [https://www.tceq.texas.gov/airquality/monops/sites/monitors\\_map.html](https://www.tceq.texas.gov/airquality/monops/sites/monitors_map.html) (Map of all Texas air quality monitoring stations); See, <https://www.tceq.texas.gov/cgi-bin/compliance/monops/monitors.pl?region=07> (listing three "active" air monitoring stations in the Odessa-Midland TCEQ region)

<sup>10</sup> See, TCEQ Site Information for CAM 1072 (Big Spring Midway), March 2018, available at:

[https://www.tceq.texas.gov/cgi-bin/compliance/monops/monthly\\_summary.pl](https://www.tceq.texas.gov/cgi-bin/compliance/monops/monthly_summary.pl)

<sup>11</sup> See, [https://www3.epa.gov/ttn/naaqs/standards/so2/s\\_so2\\_history.html](https://www3.epa.gov/ttn/naaqs/standards/so2/s_so2_history.html). 75 parts per billion sulfur dioxide is equivalent to 196 micrograms per cubic meter.

<sup>12</sup> See, NGI's Shale Daily "Severe 'Takeaway Capacity Disorder' Striking Permian, Says RBN Chief," November 8, 2018. <https://www.naturalgasintel.com/articles/116414-severe-takeaway-capacity-disorder-striking-permian-says-rbn-chief>; "Cryogenic gas processing plants cropping up throughout basin," Midland Reporter-Telegram, February 3, 2018. <https://www.mrt.com/business/oil/article/Cryogenic-gas-processing-plants-cropping-up-12547366.php>

<sup>13</sup> See, Environmental Integrity Project. Breakdowns in Air Quality: Air Pollution from Industrial Malfunctions and Maintenance in Texas; Environmental Integrity Project: Washington, DC, 2016.

<https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects>

<sup>15</sup> United State Environmental Protection Agency. (2013). *Sulfur Dioxide: Health*. Available:

<http://www3.epa.gov/airquality/sulfurdioxide/health.html>

<sup>16</sup> U.S Department of Labor. (2005). Osha Fact Sheet. Available:

[https://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/hydrogen\\_sulfide\\_fact.pdf](https://www.osha.gov/OshDoc/data_Hurricane_Facts/hydrogen_sulfide_fact.pdf). Last accessed 26th Jan 2016.

<sup>17</sup> "Denver City remembers H2S tragedy," Lubbock Avalanche-Journal, 09/15/2010.

<http://lubbockonline.com/local-news/2010-09-15/denver-city-remembers-h2s-tragedy#.VjpXTGSrRmA>

<sup>18</sup> EPA, "Sulfur Dioxide Basics." <https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects>

<sup>19</sup> "Hydrogen Sulfide Monitoring Near Oil and Gas Production Facilities in SE New Mexico and Potential Effects of Hydrogen Sulfide to Migratory Birds and Other Wildlife," by Joel D. Lusk and Erik A. Kraft, U.S. Dept. of the Interior, Fish and Wildlife Service, Project Identification Number: FFS 2F41- 200220006.1, December 2010, at p. 4 (citing Dombkowski, R.A., M.J. Russell, A.A. Schulman, M.M. Doellman, and K.R.

Olson. 2005. Vertebrate phylogeny of hydrogen sulfide vasoactivity. *American Journal of Physiology: Regulatory, Integrative and Comparative Physiology* 288:R243-R252.)

<sup>20</sup> "Understanding Excess Emissions from Industrial Facilities: Evidence from Texas," Nikolaos Ziropiannis, Alex J. Hollingsworth, and David M. Konisky, *Environmental Science and Technology* 52 (5): 2482-2490 (2018)

<sup>21</sup> The threshold of 75 parts per billion of sulfur dioxide in air can also be expressed as 196 micrograms of sulfur dioxide per cubic meter of air.

<sup>22</sup> TCEQ, "Annual Monitoring Networking Plan, 2018" pp. 10-11

[https://www.tceq.texas.gov/assets/public/compliance/monops/air/annual\\_review/historical/2018-AMNP.pdf](https://www.tceq.texas.gov/assets/public/compliance/monops/air/annual_review/historical/2018-AMNP.pdf).

<sup>23</sup> Continuous Air Monitoring Stations (CAMS), available at:

[https://www.tceq.texas.gov/airquality/monops/sites/monitors\\_map.html](https://www.tceq.texas.gov/airquality/monops/sites/monitors_map.html) (Map of all Texas air quality monitoring stations)

<sup>24</sup> The sources were either the TCEQ's Air Permits Allowables Database, or individual permit application files.

<sup>25</sup> The maximum incident duration was 2,659 hrs (or 110 days). Eight incidents had a duration that exceeded 1,000 hours each. The largest incident resulted in the release of more than a million pounds of SO<sub>2</sub> and lasted 15.5 days starting in late November 2016. Forty-six incidents had total SO<sub>2</sub> emissions exceeding 50 tons. The highest emission rate was 39,561 pounds of sulfur dioxide per hour, which occurred during a two-hour period in December 2016. Twenty six (26) incidents resulted in emission rates that exceeded 10,000 pounds per hour; and 329 incidents resulted in emission rates that exceeded 1,000 pounds per hour.

<sup>26</sup> The standard was set by U.S. EPA at 196 micrograms per cubic meter, the 1-hour sulfur dioxide national ambient air quality standard



## APPENDIX A: METHODOLOGY

The Environmental Integrity Project ran an EPA approved air dispersion model called AERMOD, which is also used by the state of Texas when it issues air quality permits. We ran the air dispersion model using the industry self-reported emission events for calendar years 2014 – 2017 and National Weather Service meteorological data for the days and times that the emissions events occurred as inputs. We obtained source parameters (i.e., the location, height, and other specifications) for the flares and other emission points from TCEQ via publicly available databases and a Public Information Act request.

In some cases, mainly for smaller sources, the specific source parameters were unavailable in TCEQ records. In these instances, we used conservative inputs as estimates, based on TCEQ guidance, i.e. tall stack/flare height.

The model results indicate that in each year from 2014 through 2017, oil and gas flaring resulted in hundreds of exceedences of the U.S. health-based air quality standard for sulfur dioxide (set by U.S. EPA at 196 micrograms per cubic meter or the equivalent of 75 ppb, the 1-hour sulfur dioxide national ambient air quality standard). In 2015, pollution levels over the national standard covered an approximate area of 579 km<sup>2</sup>, about 25 percent of the entire Ector County. In 2016, the 1-hour SO<sub>2</sub> design value (the modeling result that defines air quality relative to the national standards) exceeded 400 µg/m<sup>3</sup> at 74 receptors in 2016. The peak design value during all 4 model years was 3,644 µg/m<sup>3</sup> (in 2014, located about 1 km NW of the Goldsmith Gas Plant).