

Blackout

in the Gas Patch

How Pennsylvania Residents are Left in
the Dark on Health and Enforcement

AUGUST 2014



EARTHWORKS™

OIL & GAS ACCOUNTABILITY PROJECT

Blackout

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

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A word of thanks

This report examines the kinds of questions that people living in the midst of gas and oil development are forced to confront every day. We are grateful to the Pennsylvania residents who shared their time, ideas, and experiences, provided key information, and trusted us to tell their stories.

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Introduction

Government accountability means that public officials, elected and un-elected, have an obligation to explain their decisions and actions to the citizens. Government accountability is achieved through the use of a variety of mechanisms...[to] ensure that public officials remain answerable and accessible to the people they serve.

- U.S. Department of State, *Principles of Democracy*, 2008

Across the United States, gas and oil field communities seek help from public agencies when they are negatively impacted by development. Industry regulators hold primary responsibility for supporting citizens, preventing harm, and ensuring accountability by companies for the damage they cause.

Upholding these responsibilities requires frequent inspections and investigations, issuing violations, acting to prevent and mitigate damage, direct assistance to citizens, and overall transparency. To be able to do all these things, regulatory agencies need sufficient funds, staff, and coordination. Most importantly, they need political leaders who are committed to protecting public health and the environment—even in the face of calls for rapid energy production and protection of industry interests.

In recent years, the Marcellus Shale drilling boom has pushed Pennsylvania into the number three spot among natural gas producing states in terms of volume, and all the way to number one for rate of growth in production.¹ From 2008 to the present (June 2014), the state issued permits for nearly 16,000 unconventional gas and oil wells, about 7,600 of which have been drilled; the pace of development has been rapid, with almost 40 percent of this drilling occurring in just the last two years.²

Yet the level of resources available to implement the state's oil and gas regulatory program and oversee extraction and production has been moving in the opposite direction. Budget cuts to Pennsylvania's regulatory agency, the Department of Environmental Protection (DEP), have been steady and steep; by 2011, the agency had nearly 40 percent less money to work with than in 2009 and 60 percent less than in 2001.³ Over the last decade, DEP has lost 20 percent of its permanent positions.⁴

In 2012, Governor Corbett issued an Executive Order requiring DEP to establish timeframes within which permit applications must be reviewed. Known as the Permit Decision Guarantee, the order aims to ensure that permits are processed "as expeditiously as possible" and makes "compliance with the review deadlines a factor in any job performance evaluations."⁵ Under the policy, a basic drill and operate well permit must be issued in no more than 32 days and a general stormwater control permit can be expedited in as little 14 days.⁶ DEP emphasizes that since late 2012, 94% of permit decisions were made within the target timeframes, and that the agency had reduced the number of most types of "permits in the queue" by 99%.⁷

A focus on speedy reviews of permit applications clearly supports expansion of the industry. But it also reflects the governor's willingness to allow potential environmental considerations to be overlooked during permitting. In addition, decreased resources have meant that DEP must "do more with less,"



possibly compromising oversight activities such as inspections and investigations—a schedule of which has not been mandated by the Governor or DEP. This brings into question the agency’s ability to implement its oil and gas regulatory program, protect the public, and provide information and assistance—particularly at a time when more and more people need it.

As shown in the following pages, Pennsylvania’s oversight of the gas and oil industry is falling far short of the demands posed by surging development. The table below summarizes the 25 key findings from our research; the information and analysis behind each one is discussed throughout the report.

Reasons for this report

We began this investigation with a central question in mind: what do residents living with gas and oil development need to know to make sense of what’s happening around them? As a watchdog of extractive industries, Earthworks is often contacted by people in the midst of the shale boom who want information and support—and for companies to be held accountable for damage they cause.

For several months in 2013-2014, we conducted both field and secondary research based on this quest for information and answers. We reviewed public documents, analyzed data, and developed case studies based on the experiences of residents in particular locations. In the process, we investigated how DEP permits and oversees gas and oil operations, what has occurred around certain operations and locations, and the circumstances facing several households and communities.

At the outset of our investigation, we presumed it would be possible to piece together how direct impacts may be related to events at certain gas well sites or facilities, and in turn how DEP and operators handled the situation. In the process, we discovered that the public faces a complicated puzzle of information—one that requires significant research and documentation to complete, often lacks transparency and accessibility, and for which some pieces may always be missing.

This report builds on two reports that Earthworks issued in 2012. In *Breaking All the Rules: The Crisis in Oil & Gas Regulatory Enforcement*, data from six states showed that more than half of active oil and gas wells go completely uninspected each year and companies are seldom held accountable for regulatory violations.⁸ We also found that when inspectors do go looking, they find problems—a clear indication that more violations and other environmentally damaging incidents are occurring than is ever documented.

Residents in gas and oil fields nationwide often report that they become sick after drilling and production begin nearby, with a troubling similarity in symptoms across geographic locations. Based on community health surveys and environmental testing, *Gas Patch Roulette: How Shale Gas Development Risks Public Health in Pennsylvania* showed a clear association between health problems and chemicals at many locations where gas wells and other facilities are widespread.⁹



TOP: 2012 rally in Harrisburg against a bill to end municipal zoning rights over oil and gas development.

BOTTOM: 2013 rally outside DEP headquarters demanding information about the state's water testing policies.

Photos by Nadia Steinzor/Earthworks

In the time since Earthworks published these two reports, awareness of the need to address both regulatory enforcement gaps and health impacts of gas and oil development have grown. News stories and scientific studies on these topics have become more frequent. What remains unclear are the specific connections between the two aspects—how regulators address, ignore, or miss the actual, day-to-day impacts of operations on people and the environment. Our hope is that this report provides a context for understanding the industry and enforcement issues, as well as the direct and often difficult realities of what it means to live with gas and oil development in Pennsylvania and beyond.

For details on the steps taken and methods used in this report, see Appendix A. For a list of the gas well files and locations researched, see Appendix B. Detailed cases studies are available on Earthworks' website at <http://blackout.earthworksaction.org>

Pieces of the Puzzle: Key Findings

Summary of Findings		
	<i>Key Finding</i>	<i>Current Status</i>
Health Considerations: Air and Water Quality		
1	Health risks from emissions not considered	Neither DEP nor any other state agency has conducted long-term analyses of the health impacts of oil and gas emissions. Continuous air monitoring near wells and facilities is rarely done.
2	Emissions information is incomplete	Information gaps make it impossible to assess the extent of pollution to which residents are exposed, in particular a lack of analysis of emissions that are local, episodic, and from conventional wells.
3	Scope and density of gas development ignored	DEP permits wells and compressor stations one at a time, with no consideration of the cumulative impacts—even though residents may be surrounded by dozens of operations that together emit significant amounts of pollution.
4	Setbacks insufficient to address air impacts	Pennsylvania oil and gas regulations presume that air emissions only have an impact over shorter distances—lagging behind emerging evidence to the contrary.
5	Residents bear a heavy burden of proof of water contamination	DEP's testing is limited and omits contaminants linked to oil and gas activities. Inconsistent pre- and post-drill testing prevents the “apples to apples” results that residents need to get replacement water supplies.
6	Water contamination from gas and oil likely understated	DEP doesn't appear to count or track the letters it issues to residents following water contamination investigations.
7	Only limited causes of water contamination are considered	DEP investigations tend to focus on methane migration—lagging behind emerging science on other causes. DEP routinely limits quality control data and information on heavy metals in reports given to residents.

Permitting and Special Requirements		
8	Faster permitting likely limits scrutiny	The Permit Decision Guarantee, mandated by Governor Corbett and adopted in 2012, requires DEP to issue permits within set timeframes. Staff (whose job performance is tied to the deadlines) may cut corners when reviewing information with environmental and health implications.
9	Long-term activities at well sites not considered	Erosion and sedimentation (E&S) control permits exempt operators from having to take protective measures as long as a site isn't restored, potentially leaving areas unprotected for long periods of time.
10	Expansion of sites ignored	New E&S permits aren't needed for activities disturbing less than 5 acres of land—even if they're part of a project that becomes much larger over time.
11	Special protection for watersheds not guaranteed	DEP doesn't require operators to take particular measures to prevent degradation of "special protection" watersheds—even though the designation requires it.
12	No evidence that waste management practices meet regulations	DEP issues waivers for "alternative" methods of waste management, but doesn't appear to follow PA law by requiring evidence that the practices will protect the environment as well as existing regulations.
13	Waste pit waivers allow circumvention of regulations	Waste management waivers allow operators to avoid regulations by putting pits even closer to groundwater and using thinner pit liners.
14	Distance from streams, springs, and wetlands requirements practically ignored	Information on DEP's issuance of stream distance waivers is limited; gas well permit reviews do not appear to consider proximity of operations to water bodies.
15	Information on well site restoration is limited	Well site restoration reports were missing from more than 80% of the reviewed well files that should have had them. DEP doesn't include these reports in the public database eFACTS, even though they are key sources of information on the status of well sites and waste disposal.
16	Information on drilling and stimulation completion missing	25% of required drilling reports and 35% of completion reports were missing from reviewed files that should have had them. These reports signal when sites should have been restored and the chemicals and substances that operators used.

Inspections, violations, and citizen complaints		
17	The majority of wells are left uninspected	DEP has been inspecting more wells every year, but given industry expansion, most are still neglected. DEP didn't inspect 83% of active wells in 2013 and 89% in 2012.
18	DEP can't meet its own inspection goals	DEP's goals include well inspections up to seven times before production even begins and once a year thereafter. Among the 485 wells we analyzed, 24% of the conventional wells had never been inspected and 38% of the producing unconventional wells had three or fewer inspections.
19	Inspection information missing	17% of the inspection reports listed in eFACTS for the wells we reviewed were missing from the hard copy files. DEP denied our Right-to-Know request for missing reports related to incidents and citizen complaints.
20	Inspections can lag for years	A long time can pass between inspections. We found gaps of up to 7 years at some active wells.
21	DEP neglecting conventional wells	As DEP shifts scarce resources to focus on unconventional wells, violations at conventional wells have increased.
22	DEP prioritizes fixes over fines, reducing deterrence of potential violators	The rate at which fines are issued for violations at both unconventional and conventional wells has declined in recent years; DEP encourages operators to "self-correct."
23	Complaints information limited and hard to get	Complaints information available to the public omits information on how DEP responded, why a problem is considered "resolved," or whether complaints are tied to particular incidents or sites. Among the nearly 120 well files we reviewed, 30% of complaint inspection reports listed in eFACTS were missing. DEP denied our Right-to-Know request for the missing reports.
24	DEP allows limited response	DEP's complaints policy allows staff to wait several days to more than a month before responding to most complaints. Complaints about odors can be ignored, even though they can signal pollution and health risks.
25	Complaints can be disregarded	DEP's complaints guidelines allow staff to dismiss complaints that are repetitive or related to situations that DEP has already investigated.

1. Health Considerations

Regulators, elected officials, and industry representatives often state that emissions and contaminants from gas and oil operations are too low to have a detrimental impact on air and water quality and, in turn, health. Yet gas and oil field residents in Pennsylvania (and many other states) have long reported changes in their water and air after drilling begins. Our research reveals that the “no harm” presumption is based on a consideration of impacts from individual wells or facilities at single points in time, as well as on limited testing. Yet the realities faced by communities—realities that are increasingly supported by emerging science—show that impacts often result from multiple pathways of pollution that can aggregate in one area and worsen over time.



TOP: Well site flaring. Photo by Frank Finan

BOTTOM: A water “buffalo” for clean water storage next to a methane vent on a contaminated water well. Photo by Nadia Steinzor/Earthworks

Air Quality

FINDING #1: Health risks not considered

Neither DEP nor any other state agency (such as the Department of Health) has ever conducted long-term, in-depth health risk analyses in Pennsylvania with regard to oil and gas emissions.¹⁰ Continuous monitoring close to the wells and facilities themselves—which would capture both episodic and ongoing pollution—is rarely used, a critical missing piece of regulating air quality to protect public health. Ongoing pollution from gas and oil wells, combined with the increasing number of wells over time, means that even “regular” operations have a detrimental impact on air quality and health.

In 2011, DEP included some health risk analyses in three short-term air studies in gas producing regions of the state.¹¹ DEP did not find levels definitively linked to immediate and adverse health impacts, but acknowledged its findings only represented conditions at the time of sampling and that the short duration of the studies made it impossible to assess the potential for chronic health impacts. In addition, DEP stated that it had not determined if the potential cumulative emissions from the many natural gas activities would result in violations of federal health standards.¹²

FINDING #2: Emissions information is incomplete

DEP asserts that natural gas operations are a relatively small contributor to overall emissions in Pennsylvania.¹³ In 2011, operators began submitting air emissions data to the DEP for unconventional well sites and facilities, collected in annual emissions inventories.¹⁴ However, **significant information gaps make it impossible to fully assess the extent of pollution to which residents are exposed.** In addition to being based on self-reported data from operators, the inventories:

- Only consider unconventional wells. However, conventional wells continue to be drilled and to produce gas statewide. While they may not emit as much air pollution on a per well basis as

unconventional wells, cumulative emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) contribute to the degradation of air quality.¹⁵

- Do not include other facilities that may contribute to pollution. For example, a 2010 DEP study found 17 VOCs near a centralized waste impoundment and concluded that several of the contaminants were likely related to Marcellus shale gas activities.¹⁶ In addition, recent research indicates that the hundreds of thousands of abandoned oil and gas wells statewide may be leaking methane.¹⁷ The United States Environmental Protection Agency (EPA) has recognized that a lack of measurement of emissions from several oil and gas processes hampers a full assessment of impacts.¹⁸
- Do not require reporting on the duration and timing of emissions, which limits the information available to determine potential links between short-term emission events and unhealthy exposures.¹⁹ Physical impacts from airborne chemicals and other pollutants can be most acute in the first few minutes or hours of exposure, and sensitivity can build up so that a later event can trigger symptoms.²⁰

DEP’s assessment of emissions from all sources statewide doesn’t address localized impacts on air quality and health experienced by many residents—particularly in rural areas where few other sources of pollution exist. A recent study by the RAND Corporation showed that in Pennsylvania counties where gas and oil operations are concentrated, nitrogen oxide (NOx) emissions were 20-40 times higher than levels than would be allowed for certain single sources of emissions (even though the classification as a “major” emission sources is generally applied only to facilities and equipment, not well sites).²¹

Most air testing is conducted for relatively short periods, which means that episodic spikes in pollution levels can be missed and results can understate pollutant concentrations.²² This is a critical factor in understanding actual health impacts. Recent scientific research indicates that a chemical’s toxicity is determined by its concentration, which itself is determined by the intensity and duration of the exposure; however, once a person’s receptor to the chemical is activated, a health event could occur immediately or in as little as 1 to 2 hours, and future exposures can compound the health impact.²³

Moreover, EPA regulates just six “criteria pollutants” (carbon monoxide, or CO; lead; nitrogen dioxide, or NO₂; ozone; particulate matter, or PM; and sulfur dioxide, or SO₂).²⁴ Standards do not exist for most of the 187 toxic or hazardous air pollutants that are known or suspected to cause cancer and other serious health effects.²⁵

Taken together, these gaps makes it much easier for operators to claim there is “no known health impact” from chemicals detected at oil and gas sites.²⁶

DEP’s air quality planning requirement contains loopholes for key pollutants. In August 2013, DEP announced new rules requiring operators of unconventional gas wells to develop air quality plans for any source of air emissions and setting annual limits on emissions of NOx, VOCs, and HAPs.²⁷ Although



Tanks venting at a well site.
Photo by Frank Finan

welcome news, DEP simultaneously exempted certain activities that emit pollutants below certain thresholds, including those “sources and classes of sources determined to be of minor significance by the Department.”²⁸

Our analysis showed that **emissions from exempted activities (e.g., well drilling and completion) can be many times higher than the threshold limits set by DEP.** For example, using DEP data we found numerous well sites that had NOx emissions during the well drilling and completion phases that were 5-10 times as high as the 6.6 tons per year limit recently set by DEP.²⁹ Similarly, emissions of VOCs and HAPs during drilling and completion at some wells can be many times higher than the 2.7 tons per year limit set for non-exempt unconventional well operations.³⁰

These loopholes are very concerning from a health impacts standpoint. In particular, NOx and VOCs combine with sunlight to create ozone pollution, which is well documented to cause respiratory and lung function problems, such as coughing, shortness of breath, and asthma.³¹ For people exposed to high levels of emissions during the relatively short time that it takes to drill and/or complete a well, the pollution may not be “minor” at all.

FINDING #3: Scope and density of gas development ignored

DEP permits wells and compressor stations one at a time, with no consideration of the cumulative impacts of having many emissions sources in one area. There was no evidence in the well files or any other departmental documents we reviewed that ongoing emissions from previously permitted wells and facilities at the same or nearby sites were considered when new permitting decisions were made.

Our analysis of available emissions information shows that groups of wells can emit more pollution on a yearly basis than individual industrial facilities, such as large compressor stations. For example, if grouped as one facility, the emissions from the 12 wells within one mile of the Woodlands community would be among the top five emitters of VOCs and several HAPs (included benzene and toluene) in Butler County in 2012; in addition, a single compressor at one well site (Voll) was in the top five for formaldehyde and toluene.

At the same time, even a single well can emit significant levels of pollution. For example, according to DEP emissions data, the Cowden 47H in Washington County emitted more than 10 tons of VOCs in 2011; 9.6 tons of this came from a single tank.³² If this well site were a different type of industrial emissions source, the operator would have needed a “state-only” permit or approval.³³ But unconventional gas wells were not required to obtain air quality plan approvals from



Homes in this neighborhood are surrounded by multiple wells, a compressor station, a gas processing facility, and an impoundment. Photo by Robert M. Donnan

DEP until 2013.³⁴ In addition, operators can seek separate permits for different facilities across an area and potentially avoid ever having them considered as a single source of emissions.³⁵

Surrounded by Development: The Judy family in Greene County, PA

Pam Judy and her family moved into their dream house in Carmichaels in 2006—and soon after began to experience fatigue, headaches, runny noses, sore throats, and muscle aches. Pam has had bouts of dizziness and vomiting, and both children often got nosebleeds before they moved away. The family would feel better when away from home, and stopped spending long periods of time in their yard or on the porch.

The Judy home is surrounded by gas operations, with a compressor station and 37 wells within one mile. An additional 150 wells and other oil and gas facilities (including compressor stations) are located between 1-2 miles of the Judy's house. Although oil and gas development has been underway since 1982, 20 of the wells within 1 mile were drilled and the compressor station was built after the Judy family moved to the area. The closest well is just 1100 feet away and the Cumberland/Henderson compressor station is about 800 feet away.

In 2011, the emissions released from gas wells close to the Judy home were the equivalent of adding a second compressor facility within a mile of their house. Specifically, the five wells in the DEP emissions database located within 1 mile of the Judy home cumulatively emitted more CO, NO_x, PM₁₀, and SO_x than the Cumberland/Henderson compressor station.³⁶

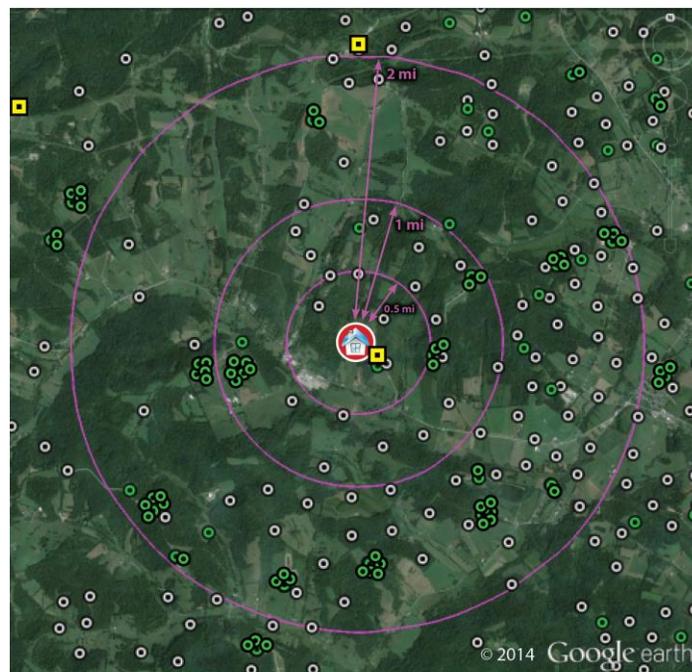
That same year, the top two facilities that emitted particulate matter (as PM₁₀) in the state were not large compressor stations, but gas wells—both of which were located within about a mile of the Judy home.³⁷

Earthworks' air sampling confirmed that a variety of air contaminants are being released into the atmosphere from the compressor station and nearby wells. Of particular concern are the large volumes of particulate matter and VOCs, as well as HAPs (such as benzene, formaldehyde, and toluene). A recent study underscores that when people are exposed to multiple chemicals such as inhalable particles and air toxics, the dose increases synergistically, with a

greater health effect felt than if these contaminants were inhaled separately.³⁸



Pam Judy in front of the compressor station near her home. Photo by Mark Schmerling



KEY
● Unconventional gas well
○ Conventional gas well
■ Compressor station
🏠 House

Hard Facts: EMISSIONS AT EVERY TURN

Wells typically emit the largest volume of emissions during drilling and stimulation (e.g., hydraulic fracturing or acidization).³⁹ Drill rigs and completion equipment burn fossil fuels for days or weeks at a time, all the while releasing contaminants into the air. A recent study by researchers at Cornell and Purdue Universities found that methane emissions at wells sites in Pennsylvania are many times higher during the drilling phase than had been previously estimated by the U.S. Environmental Protection Agency (EPA).⁴⁰

Unless operators use special “green completion” equipment, methane gas and VOCs are vented to the atmosphere or flared during well completion. Recognizing the importance of reducing emissions during this stage, EPA enacted regulations in 2012 that require green completions for most unconventional gas wells starting in January 2015. However, the requirement does not apply to conventional wells.⁴¹

Ongoing emissions generally decrease once wells are in production. During production, most emissions come from pumps, tanks, heaters, leaks, and venting of gas to the atmosphere during well maintenance/workovers (i.e., blowdowns) or liquids unloading.⁴² Engines used in compressor stations emit pollution whenever they are in operation. Certain events, however, such as venting of gases during maintenance, start-up, and shutdown (MSS) of equipment and venting to release pressure in the pipeline system (another type of blowdown), can release large volumes of emissions in a short time.⁴³

FINDING #4: Setbacks are insufficient to address air impacts

Pennsylvania oil and gas regulations presume that air emissions only have an impact over shorter distances. Currently, conventional wells are required to be a minimum of 200 feet from buildings where people live or work, and unconventional wells to be 500 feet away; compressor stations have to be 750 feet away from the nearest building or 200 feet from the nearest property line, whichever is greater.⁴⁴

In general, the closer to the source of pollution (e.g., a well or compressor station), the greater the potential for exposure to contaminants and the likelihood of impacts to health. But there is no scientifically definitive distance at which air contaminants cause health impacts, nor an established distance beyond which they would never occur. Nevertheless, recent studies suggest the potential for contamination at distances of a half-mile or more.

A study by the City of Ft. Worth on air quality in gas fields found concentrations of formaldehyde above state regulatory standards 750 feet beyond the site’s fence line.⁴⁵ Air modeling conducted in Pennsylvania showed nitrogen oxide above state regulatory standards up to one mile of the Barto Compressor Station in Lycoming County.⁴⁶ Further, a Colorado School of Public Health study of air



Gas development very close to home.
Photo by Nadia Steinzor/Earthworks

emissions around gas well operations found that residents living less than a half mile away are at higher risk of respiratory, neurological, and other health impacts and have a higher lifetime risk for cancer, based on exposure to pollutants, than those who live at farther distances.⁴⁷

Similarly, Earthworks' survey of health impacts in Pennsylvania found that as the distance from gas wells and facilities decreased, the percentage of respondents reporting specific health symptoms (such as throat irritation and headaches) increased.⁴⁸ That pattern was more variable at longer distances, underscoring **the possibility that chemicals linked to certain symptoms travel further than others and that landscape, wind and weather conditions, the type of production, and the use of emission control technologies can influence exposure.** Many households across Pennsylvania—including those featured in the case studies developed along with this report—have multiple wells and facilities within a half-mile, and even more within 1-2 miles.

Living with a Compressor

For years, Phyllis Carr and her family have been dealing with gas wells in their rural community in Lake Lynn, Fayette County, with 28 wells now drilled within a mile. Then Laurel Mountain Midstream constructed the Springhill Compressor Station about one-third of a mile from their home. Since that time, the entire family has often felt fatigued and had congestion, sore throats, coughs, headaches, and skin rashes. Phyllis' daughter Jeaney has periods of muscle weakness and forgetfulness, and her three grandsons have frequent nosebleeds and tremors.

The Carrs and their neighbors have filed numerous complaints with DEP about odors that they believe are from the Springhill compressor.⁴⁹ The facility is the largest single source of emissions close to the Carrs. In 2012, it released more CO, benzene, and formaldehyde than any non-natural-gas facility in Fayette County, and was among the top five emitters of NO_x and VOCs.⁵⁰ Air tests that Earthworks conducted at the Carr home detected eight VOCs, seven of which are considered to be HAPs. A 2013 air test by DEP detected many of the same

chemicals, as well as two additional HAPs (acrolein and n-hexane). HAPs can cause cancer or other serious health effects, such as reproductive problems or birth defects, or adverse environmental and ecological effects, and are regulated by EPA.⁵¹



TOP: Carr family outside their home. Photo by Mark Schmerling

BOTTOM: Infrared image of emissions from the Springhill Compressor Station, Fayette County. Video by Frank Finan

Formaldehyde has been classified as a known human carcinogen by the International Agency for Research on Cancer, and as a probable human carcinogen by EPA.⁵² When present in air, formaldehyde can cause burning or watery eyes, nose and throat irritation, coughing or wheezing, nausea, and skin irritation.⁵³

When reviewing the Springhill compressor for an air quality permit, DEP wrote, "Formaldehyde is...the primary HAP expected to be emitted from air contamination sources at Springhill."⁵⁴ But DEP didn't analyze the potential impact of formaldehyde on the health of nearby residents. Instead, DEP compared Springhill to two landfills with estimated formaldehyde emissions below the agency's benchmarks for human health risks—despite acknowledging that such a

comparison wasn't fully accurate "due to possible differences in local terrain and meteorological data."⁵⁵ DEP then issued the permit.

Water Quality

FINDING #5: Residents bear a heavy burden of proof

Because private water wells aren't regulated in Pennsylvania, even if DEP detects contamination, the agency isn't required to take action if the cause is unrelated to programs it oversees, such as oil and gas.⁵⁶ DEP has told many residents (including several included in our case studies) that even if they have experienced changes in the quality (or quantity) of their household water supplies, there's no definitive link to nearby gas operations, versus other causes. Especially at a time of constrained resources, this issue could be creating a "perverse incentive" for DEP to not fully investigate or follow up on cases—as well as making a lack of water well standards problematic for the agency and the public. Yet without proof of a definitive link, residents won't be provided with a replacement drinking water supply.⁵⁷

When DEP responds to water complaints and conducts investigations, the **water tests that DEP conducts often do not include contaminants known to be associated with oil and gas activities**, in particular methane, ethane, VOCs, and light hydrocarbons. DEP's limited testing is particularly problematic because both federal and state government regulatory agencies have established standards, or legal limits, for just a fraction of the hundreds or thousands of substances found in drinking water supplies—making it even more important to test for those known to result from gas and oil development.⁵⁸

In addition, **the parameters for pre-drilling water tests that DEP recommends to homeowners don't always match what DEP later tests for** in response to contamination complaints.⁵⁹ Nor does DEP require operators to follow a set of pre-drilling testing parameters.⁶⁰ This inconsistency prevents an "apples to apples" comparison of results from tests conducted by DEP at different times—and makes it easier for operators and regulators to say there's no evidence of whether a detected contaminant was present or absent, or at greater or lesser concentrations, before drilling began than after.



Photo by Frank Finan

Hard Facts: THE FLOW OF CONTAMINATION

Direct contamination of water supplies during gas development may occur following spills or leaks of toxic products from storage areas and equipment. The discharge of flowback and produced water into rivers and streams can also degrade water quality if contaminants aren't fully removed. Between 2008-2011, more than 50 percent of waste generated from Marcellus Shale wells in the state was discharged to surface waters after treatment at industrial waste or municipal sewage plants.⁶¹

In 2012, a DEP investigation found chloride, bromide, lithium, strontium, radium-226, and radium-228 just downstream of the discharge point of a treatment plant known to accept wastewater from gas operations, and that pollutants were building up in the Allegheny River.⁶² In 2013, a study by Duke University found high levels of radium, salts, bromide, and metals in a stream below the discharge point of a different plant that also accepted wastewater from gas operations in western Pennsylvania.⁶³

Problems can also arise over time as methane, fluids, and other substances migrate through fractured rock or faulty gas wells. Duke University researchers have found methane levels 6 times higher and ethane levels 23 times higher in drinking water wells that are less than one kilometer (0.6 miles) from shale gas wells than in water wells that are further away.⁶⁴ A 2012 study based on a review of DEP's inspection and violation databases indicates that 6-7 percent of gas wells in Pennsylvania have compromised structural integrity within three years of being drilled.⁶⁵ A recent study indicates that rates of well structural integrity problems have increased over time.⁶⁶

FINDING #6: Water contamination from gas and oil is likely understated

In 2013, a reporter for the Scranton Times-Tribune found (based on records obtained in a court case) that DEP had concluded that gas drilling operations contaminated at least 161 private water supplies between 2008-2012.⁶⁷ This was the first time a specific number for water contamination cases had been made available to the public. In July 2014, DEP told the same reporter that the updated number is 209.⁶⁸

However, the Times-Tribune investigation indicated that **DEP does not count how many letters it issues to residents following investigations of potential water contamination** from oil and gas operations, track where they are kept in files, or maintain its records to allow a comprehensive search. As a result, it's likely that the number of investigations and contamination cases is higher than the 209 confirmed cases.



Jugs with dirty water collected from a Pennsylvania home. Photo by Frank Finan

Our file reviews show the possibility of more widespread contamination of water supplies. For example, data provided by DEP shows that in Greene County's Cumberland Township alone, 15 complaints were filed for water supply impacts from gas development between 2008 and 2010—but DEP provided information on just three of those complaints to the Times-Tribune.⁶⁹ While some of the complaints may have been from the same resident, or never investigated by DEP, this is a large discrepancy. In addition, some of the cases we researched in which water investigations were conducted were not included in the information DEP provided to the newspaper. Finally, since no actual data related to these complaints is publicly available, it is difficult to examine the rationale for DEP's decisions, particularly with regard to inconclusive or negative determinations.

Water Woes Ignored

Pat Klotz rescues dogs, does her own home renovations, works as a home health aide, and loves walking in the woods and meadow behind her house in Warren Center, Bradford County. Which is why it came as a shock in 2011 to start feeling exhausted and have intense headaches, nose and throat irritation, muscle cramps, and dizzy spells. Her dogs seemed lethargic and unsteady on their feet. Then her water turned fizzy and black.

Pat kept a log—and realized that her symptoms often came on at the same time as activities on the Young well pad that was less than 1000 feet away. Changes in Pat's water over time point to a link to gas development. Water test results from 2011 and 2012 show that concentrations of ten constituents (arsenic, barium, calcium, iron, magnesium, manganese, potassium, sodium, chloride, and methane) were higher after drilling and fracking were completed at the Young gas wells than before drilling began.

Earthworks tested Pat's water in September 2013, finding that some of the parameters had returned to pre-drilling levels (e.g., barium, iron, potassium, and sodium). But even though none of the chemicals that have federal primary drinking water

standards exceeded them, iron and manganese greatly exceeded federal secondary drinking water standards (i.e., for aesthetics, taste, and odor). Concentrations of both those contaminants and sodium were much higher than the median concentrations typically found in Pennsylvania groundwater.⁷⁰

DEP tested Pat's water in February 2012 after she filed a complaint with the agency. The results showed higher levels of methane, total dissolved solids, sodium, chloride, iron, and manganese than in a water test conducted by a private lab in January 2011, before drilling began. In March 2012, she received a letter from DEP with no conclusion about the test results but stating, "the Department is continuing to investigate."

However, DEP has never followed up, provided additional information, or re-tested Pat's water—even after a significant release of "tophole" water from the Young 3H well in December 2012. According to a DEP inspection report on the incident, the operator took "no action to control/capture this water and no action was taken to control the cuttings;" subsequent soil testing revealed the presence of a petroleum product.

FINDING #7: Only limited causes of water contamination are considered

DEP's testing and reporting practices may not identify certain causes of pollution, and therefore may fail to identify risks to drinking water and health. In 2012, the technical director of the DEP's Bureau of Laboratories revealed in a court deposition that the agency routinely limits quality control and data on several heavy metals from water testing reports provided to homeowners, ostensibly because DEP only considers certain contaminants to be linked to oil and



gas activities.⁷¹ For residents and environmental advocates, this revelation sparked concern that residents may never be informed about contaminants to which they are exposed, and raised broader questions about whether the scope of DEP's investigations into links between gas and oil activities and water contamination are too limited.⁷²

DEP staff have stated to Earthworks and its partners that most of the in-depth water contamination investigations the agency conducts are related to the presence of methane in water samples taken following complaints. The DEP's Oil and Gas Annual Report for 2013 emphasizes gas migration as the key water contamination risk of gas development, attributing the problem to inadequate gas well engineering and construction.⁷³ In addition, more than half of the contamination cases for which DEP provided information to the Times-Tribune for its investigation (see above) were attributed to methane migration.⁷⁴

While EPA and state agencies such as DEP do not consider methane in water to be a health risk and there are no associated federal or state health standards, the problem has not been fully studied.⁷⁵ At the same time, agencies do consider methane in water to be a safety risk. The EPA has previously underscored the risk of explosion from methane released into the air from faucets.⁷⁶ Pennsylvania regulations requires gas operators to take measures "necessary to protect health and safety" if methane concentrations are above certain limits, including 7 milligrams per liter (mg/L) in water.⁷⁷ Penn State Extension advises that, "Wells with methane concentrations below 10 mg/l are generally considered safe for use. However, any water well with a detectable concentration of methane should be routinely tested to ensure that the methane concentration is not increasing to a dangerous level."⁷⁸

Emerging science indicates that spikes in several contaminants can signal oil and gas impacts.

According to the Center for Rural Pennsylvania, drilling can increase concentrations of iron and manganese in groundwater by disturbing aquifers.⁷⁹ Another focus of current scientific study is the chemical changes that can occur when methane levels in water increase. Methane can trigger sulfate reduction, a common anaerobic process that in turn increases pH levels and the production of both iron and manganese.⁸⁰

Iron and manganese can change the taste and color of water to the point of making it unusable without extensive treatment.⁸¹ EPA has created secondary drinking water standards to protect users from these "nuisance" effects.⁸² EPA has also established a lifetime health advisory for manganese of 0.3 mg/L, to "protect against concerns of potential neurological effects," and a one-day and 10-day health advisory of 1 mg/L for acute exposure.⁸³

Drilling may also cause increases or spikes of other "naturally occurring" contaminants. In 2013, University of Texas researchers confirmed that private water wells closest to Barnett Shale gas drilling sites had elevated levels of heavy metals such as arsenic, barium, strontium, and selenium, possibly due to faulty casings, vibrations from drilling, or the lowering of water tables.⁸⁴ Both federal and state safety limits exist for heavy metals in drinking water, due to their toxicity and links to a range of health problems and diseases.⁸⁵



Bubbling at well head, possibly due to a casing leak. Photo by Nadia Steinzor/Earthworks

Hard Facts: COMPLEX CAUSES OF CONTAMINATION

In 2007 in **Clearville, Bedford County**, Steckman Ridge proposed the conversion of a gas production field into a gas storage facility, a complicated project comprising nearly 100 acres of land for 5 existing and 18 new storage wells, 7 miles of pipeline, 23 well laterals, and a compressor station.⁸⁶ Discharges of industrial wastewater to a warm water fishery (Shaffer Creek) and an Exceptional Value waterbody (Sideling Hill Creek) would also occur.⁸⁷

In April 2008, the US Centers for Disease Control and Prevention wrote to the Federal Energy Regulatory Commission (FERC) expressing concerns about the “proximity of area residents to the pipeline alignment,” that “excessive noise levels [from the compressor station] can harm human health and well-being,” and supporting a “comprehensive assessment and mitigation of issues that might negatively affect human health, or the human environment.”⁸⁸ But just two months later, FERC approved the project, in part because “Steckman Ridge states...that its proposed facilities strike an appropriate balance between landowner and environmental concerns and system requirements. For these reasons, we find that any adverse impacts on landowners and communities will be minimal.”⁸⁹

This wasn't the case for Angel and Wayne Smith. First their well water turned brown, water started bubbling through their barn floor, and an oil sheen and foam appeared on their pond. Then headaches, fatigue, sinus problems, throat and eye irritation, and shortness of breath set in. A horse and three cows died and twelve calves were either miscarried or stillborn. Despite ongoing water, air, and health concerns, the detection of contaminants in tests, foaming in creeks, and pollution incidents at the Quarles compressor station, DEP hasn't made any connection to gas development—and the Smiths are still waiting for answers.



Angel and Wayne Smith at their farm in Clearville. Photo by Nadia Steinzor/Earthworks

Since 2010, 16 unconventional gas wells have been drilled within a mile of Janet and Fred McIntyre's home in the Woodlands neighborhood of **Connoquenessing Township, Butler County**. In early 2011, the whole family got sick after drinking tap water. Then the water in the kitchen and bathroom turned soapy and foamy. Over time, they have experienced health symptoms such as frequent nausea, eye and throat irritation, skin rashes, fatigue, and joint pain—and found out that many neighbors have had the same problems.⁹⁰

DEP water testing in response to several complaints that the McIntyres filed in 2011-2012 indicated elevated iron and manganese above pre-drilling levels. In April 2011, DEP closed its

investigation of the McIntyre's water because iron and manganese had returned to pre-drilling levels, and took no action when testing in August 2011 revealed the presence of several VOCs. By early 2012, Rex Energy had removed temporary water supplies provided to the McIntyres and other families, based on a report concluding that water changes weren't related to drilling activities. However, the consultant Rex hired to write the report noted that the analysis was limited to data Rex provided and that they "inferred" groundwater flow rather than using actual topographical data.⁹¹

In a study of water quality in the Woodlands, Dr. John Stolz and his colleagues at Duquesne University have identified a complex set of reasons for elevated levels of manganese, iron, barium, strontium, methane, ethane, and propane found in many water wells. These include faulty casing, spills, and leaks at nearby gas wells and the large volumes of fluids injected underground for fracking—which may in turn have shifted the water table and facilitated the flow of contaminants into water wells from both active and abandoned gas and oil sites and old coal mines.⁹² Dr. Stolz, Earthworks, and partner organizations have asked DEP to consider conducting a new investigation into ongoing water quality problems in the Woodlands.



Janet and Fred McIntyre at home in the Woodlands with their "buffalo" for clean water storage. Photo by Nadia Steinzor/Earthworks

2. Permits and Special Requirements

When reviewing permit applications to determine if they meet regulations, Pennsylvania (just as many other states) does not consider the various stages of gas development and their cumulative impacts. Gas and oil permits are issued primarily for individual wells but can encompass other extraction and production activities that take place at the same site, such as burial or storage of waste and the use of water and chemicals.

In addition, each well receives its own permit, even if the operator is likely to develop multiple wells on a pad. While this approach may make well application reviews more targeted, it also means that projects are not presented in their entirety to regulators. Nor does DEP ever have to consider the potential cumulative environmental impacts of permitting many wells, sites, and facilities in one location or in a broader area over time (see health considerations section above).

In addition to drilling permits, DEP requires operators to obtain separate permits for certain activities, such as air permits for compressor stations, dam permits for impoundments, and erosion and sedimentation permits for large well sites. However, our research found cases in which such facilities ended up being “rolled into” existing well site permits.



Gas processing equipment. Photo by Nadia Steinzor/Earthworks

Expansive Permitting for Expanding Operations

As gas development increases, operators may seek to expand existing facilities—but such expansion does not necessarily mean new permits or review of increased environmental impacts.

When drilling began in **McDonald in Washington County**, residents started experiencing intense odors, noise, and changes in air and water quality, which they came to associate with frequent headaches, nose and throat irritation, and fatigue. Their problems worsened with the changing use of the Carter Impoundment, which over time became a centralized impoundment that was the destination for contaminated waste (and truck traffic) from over 190 wells in a dozen townships.⁹³

Range Resources began construction on the impoundment in December 2009, after describing it as storage for freshwater to be used in hydraulic fracturing in the application for an erosion and sedimentation control permit for the Cowden and Drugmand well sites. Later, Range submitted an

application to DEP for a dam permit, indicating in the application that the impoundment would be used to store both freshwater and fracturing fluids.

DEP approved Range’s dam permit more than two months after the impoundment was completely constructed. However, DEP did nothing to hold the operator accountable for this “after the fact” permit application. In addition, DEP didn’t require new technical information when the intended and actual use of the



The Carter Impoundment and Cowden well site, Washington County. Photo by Nadia Steinzor/Earthworks

impoundment changed—even though dam permit standards for the storage of freshwater are less stringent than those for wastewater.⁹⁴

Nor was Range required to obtain a Waste Management General Recycling 123 (WMGR123) permit, which covers “Processing, transfer and beneficial use of oil and gas liquid waste to develop or hydraulically fracture an oil or gas well.”⁹⁵ DEP clearly acknowledged this practice would occur, since it issued an OG71 waste management waiver for the chemical treatment of waste onsite. DEP has confirmed that the agency requires WMGR123 permits for the processing of wastewater at centralized impoundments—but that in the past, the agency didn’t always do so.

Despite ongoing citizen complaints and several inspections related to problems at the impoundment, DEP has issued only one violation to date, for a spill of fracturing fluid in 2011.⁹⁶ Residents’ concerns continue even though the impoundment has been drained due to a zoning dispute with the township.⁹⁷ In May 2014, steel

containers used to hold radioactive material appeared at the site.⁹⁸ A few weeks later, a West Virginia landfill rejected waste from the impoundment because of high radioactivity levels.⁹⁹

In 2008 in **Washington in Washington County**, Range Resources received drilling permits for five Best wells, 1H-5H, stating on the application forms that no erosion and sedimentation (E&S) control permit would be needed. But on application addenda, the company checked that a freshwater impoundment would be constructed and the total acreage of earth disturbance would be 5.45 or 6 acres.

A few months later, Range applied for an E&S permit requesting coverage for a freshwater impoundment and access roads related to 11 wells at three sites. This included the Best 1H-7H, the LBROS 1H-2H, and Ward 1H-2H wells—even though all but one of these wells already had been permitted and all but two drilled.¹⁰⁰ Range indicated on the permit application that the total area of the project would be 172 acres.

In January 2009, Range filed with DEP an “adjusted” application for the initial Best wells (1H-5H) stating that the site wouldn’t include an impoundment or cause any earth disturbance—effectively erasing the failure to obtain an E&S permit for the Best site by rolling it into a new, vastly larger project.

The Best Impoundment was constructed in a residential neighborhood just a few hundred feet from the home of June Chappel, who soon started to report intense odors, frequent headaches, respiratory and nasal problems, and nosebleeds.¹⁰¹ In fall 2009, the impoundment liner caught fire. In March 2010, a DEP inspector confirmed that the impoundment liner was leaking and there was coal seam discharge at the site. By the summer, ongoing problems and June’s continuing complaints about odors, noise, and her health resulted in Range closing the impoundment.



The Best well site waste impoundment, with June Chappel’s house to the upper left.

Photo by Robert M. Donnan

Erosion and Sedimentation Control Permits

DEP requires oil and gas operators to obtain an “Erosion and Sediment Control General Permit for Earth Disturbance Associated with Oil and Gas Exploration, Production, Processing, or Treatment Operations or Transmission Facilities” (ESCGP-2 and the ESCGP-1 before it), for any well or sites that are five acres or larger.¹⁰²

Careful review of erosion and sedimentation (E&S) permit applications is important because when flows over bare soil or pavement, it can carry pollutants and loose soil or silt into streams, rivers, and wetlands. Such run-off can degrade water quality, harm aquatic life and wildlife, and change the flow and depth of waterways. E&S problems at well sites pose risks due to the water, chemicals, and contaminated waste that can run off large well pads, especially as pad construction requires the clearing of trees and vegetation.

FINDING #8: Faster permitting likely limits scrutiny

The Permit Decision Guarantee, mandated by the Governor and adopted in 2012, requires DEP to issue permits within set timeframes.¹⁰³ **Short reviews of applications may be efficient and benefit operators, but can mean that staff have no choice but to cut corners on the review of technical issues** (e.g., slope measurements, types of soil and vegetation at the site, weather patterns, and existing water quality). **Time constraints may also make it difficult for DEP reviewers to verify the information provided by operators on application forms** for accuracy in relation to actual site conditions.

DEP offers expedited E&S permits (designated as ESX) that can be issued within 14 business days as long as an application is administratively complete and certified by a credentialed professional, such as a state-licensed engineer.¹⁰⁴ According to DEP’s Environment Facility Application Compliance Tracking System (eFACTS), DEP has issued 631 standard and 5,497 expedited E&S permits since 2009. Projects in special protection watersheds and floodplains or on contaminated land aren’t eligible for an expedited permit, but DEP sets the review period at 43 business days.¹⁰⁵

FINDING #9: Long-term activities at well sites not considered

When applying for an E&S permit, operators have to submit information on the Best Management Practices (BMPs) they will have in place to prevent E&S during construction of new sites and submit Post Construction Stormwater Management (PCSM) plans.¹⁰⁷ But an exemption in the regulations means that as long as a site still requires restoration, gas and oil operators don’t have to conduct related stormwater control analyses. **This means that BMPs may be ineffective in preventing E&S for long periods of time, because restoration at well sites may not occur for many months or even years.**¹⁰⁸



Gas development on the farm. Photo by Frank Finan

For example, a file review on the Young site in Bradford County indicates that six wells have been permitted, but only one drilled in 2011 and

another in 2013. Talisman Energy has renewed the well permits at least once, but since some wells at the site have not yet been drilled, full restoration (such as revegetation and soil stabilization) and stormwater prevention measures would not be required—raising the possibility that activity at the site may be occurring with insufficient E&S protections in place.

FINDING #10: Expansion of sites ignored

Over time, a well site may be expanded beyond what was initially included in the initial E&S permit application. For example, additional wells might be added to a single pad or gas processing equipment may be built close by. However, **if each new facility or construction activity is under the five-acre threshold that triggers an E&S permit, DEP may not always require a new permit, even if the project as a whole becomes larger**—allowing operators to avoid environmental review and making it difficult for regulators to assess whether proposed protections are sufficient.

A file review of the Vargson well in Bradford County indicated that less than six months after a drilling permit was issued in 2008, a DEP inspector noted problems with the stabilization of soil embankments and a drainage ditch. Eight months later, Chesapeake Energy applied for a permit to add a wellhead compressor engine to the site, stating that earth disturbance would be 4 acres. While this alone was below the 5-acre threshold to trigger the E&S permit requirement, total earth disturbance at the site would be greater than that; however, it does not appear that an E&S permit was ever required for the Vargson site.

Special Protection Watersheds

FINDING #11: Special protection not guaranteed

Gas and oil permit applications require operators to indicate whether the proposed project will take place in a watershed designated as “special protection.”¹⁰⁹ Pennsylvania’s special protection categories are Exceptional Value (EV), High Quality Coldwater Fishery (HQ-CWF), High Quality Trout Stocking Fishery (HQ-TSF), and High Quality Warm Water Fishery (HQ-WWF).¹¹⁰

However, our **file reviews did not find any evidence of how—or even whether—the designation of a waterway as “special protection” influences gas and oil permit decisions or triggers special permit conditions.** We did find several copies of a letter that DEP sent to operators whose permits have been approved, which simply states, “This is to inform you that the location of the well on the enclosed well permit is in a special protection watershed...to remind you of the necessity to adequately control and dispose of waste fluids generated by your activities at this location. It is expected that you will conduct your activities with these concerns in mind.”

Nor did we find information from operators about measures it planned to take to prevent impacts in watersheds designated as special protection. Such designation means that new or expanded development activities in these areas cannot degrade existing water quality, which in effect requires those proposing activities to perform anti-degradation analyses, take special measures (such as E&S controls and stream buffers), and provide plans for avoiding degradation.¹¹¹

When Special Protection Doesn't Protect

Cross Creek County Park in Washington County covers 2,800 acres in the Cross Creek and Buffalo Creek watersheds, both of which are designated as High Quality (HQ).

In May 2009, a pipe carrying wastewater from Range Resource's Cross Creek 14H and 15H wells



Polluting foam near a gas well in the special protection Sideling Hill Creek watershed, Bedford County. Photo by Seri Kern

to an impoundment broke, spilling an estimated 70 barrels of wastewater that reached a stream and Cross Creek Lake. A DEP inspector reported there was "evidence of a fish kill as invertebrates and fish were observed lying dead in the creek" and issued eight violations. In October 2009, Range had a similar but bigger spill of flowback from a pipe in the nearby Brush Run Creek HQ watershed, causing

a DEP biologist to note, "dead fish, salamanders, oligochetes, and frogs that showed signs of being affected by the spill."

In summer 2011, a contractor working for Range clearcut nearly 130 mature hardwood trees for a well site in an area of the park that was supposed to be off-limits to drilling; the company cited a "surveyor error."¹² In addition, eFACTS and our file reviews indicate that DEP issued waivers for the onsite land application and burial of waste for numerous wells in and around Cross Creek Park (such as Cowden 17H, 46, 50, 51, 53, and Cross Creek 6, 7, 8, 9, and 25)—waste that can pose risks to forested areas, groundwater, and surface waters.

Finally, Range's water management plan for shale gas development in southwestern Pennsylvania includes direct withdrawals of up to 800,000 gallons of water per day from Cross Creek Lake.

In September 2008, Range Resources received a permit for the **Best 1H well in Washington County**, noting the HQ status of the Buffalo Creek watershed on the application. In December, the DEP inspector wrote in a report that, "streamflow enters the site disturbance, and then soaks into the ground at the lowpoint below the fill slope. It appears that the construction of the site has eliminated a section of the streambed...Further investigation will be done once the snow melts to determine if the site is in violation of Chapter 105 rules and regulations."

There's no indication that further investigation ever occurred. DEP's next inspection was four months later, when drilling was already underway; the stream issue was never addressed in subsequent inspection reports, nor were violations issued for this or a 2011 wastewater spill at the site.

Hard Facts: The eFACTS maze

Developed in 2012, the Environment Facility Application Compliance Tracking System (eFACTS) is DEP's most publicly accessible database for information on gas wells and facilities. But it can be confusing and yield incomplete and contradictory information. Key problems encountered during our research include:

Well restoration reports (OG75 forms) are not included in eFACTS. This omission makes it nearly impossible for the public to determine whether the regulatory requirements related to restoration are being followed at any particular site. The only way to see any details about site stabilization, re-vegetation, onsite waste management, and other aspects is to review the paper copies of OG75s and inspection reports kept in files at DEP regional offices.

The list of authorizations for each well site does not include erosion and sedimentation permits. To find a specific E&S permit, a citizen has to search by county to see all of the E&S permits that have been issued (such as E&S Stormwater General Permit 1, Erosion and Sediment Control GP-2, and Expedited E&S Stormwater General Permit 1), and then click on all the options to try to find the one for a particular site. This is very time-consuming; for example, there are over 1,000 permit records for Bradford County and over 500 for Washington County. This type of search gets even more difficult because E&S permit applications for many projects can cover numerous wells and facilities. For example, eFACTS lists several E&S permits for projects in Butler County with broad titles, such as "SW Butler County Project Phase IVC" or "Yellow Creek Project," which don't indicate the specific wells and sites that are included.

Waste management waivers are included in eFACTS under three different names: Alternative Waste Management Practice, Alternative Waste Management Practice Land Application on Well Site, and Alternative Waste Management Practice Dusting. Even when eFACTS shows that a waste waiver was authorized, it does not provide information on which "alternative" was authorized; the only way to determine that is by reviewing paper files at DEP regional offices.

eFACTS does not provide records of stream distance waivers (OG57 forms) for any year prior to 2013—even though DEP has had a stream distance waiver in effect at least since 1997. We found 12 issued before 2013 in paper well files but couldn't find listings for them in eFACTS.¹¹³ Only two OG57 forms had authorization numbers (for the Cowden 3H and 5H wells in Washington County), but when checked in eFACTS they corresponded to drilling permits instead.

eFACTS contains different emissions data for some facilities than what is included in the DEP's Natural Gas emissions inventories.¹¹⁴ In addition, many natural gas facilities are missing entirely from the eFACTS facility emission system, which means that the most publicly accessible database underestimates statewide air emissions.

3. Waivers

With the surge in drilling in Pennsylvania, pressure on regulators to issue permits has also increased. This pressure may be behind the DEP's frequent issuance of waivers, which allow drillers not to follow certain established gas and oil regulations, or to be able to use alternative methods that DEP judges sufficient to meet regulatory requirements. There are two types of waivers we found to be most common—and which are related to practices that can have significant environmental impacts.

Alternative Waste Management Practices

Gas and oil field waste can harm environmental quality and health because it is often contaminated with chemicals, oil, heavy metals, naturally occurring radioactive material (NORM), technologically-enhanced NORM (TENORM), and a range of other toxic and polluting substances. More drilling means more waste to store, transport, process, and dispose. Marcellus Shale operators reported a 70 percent increase in wastewater generated just between 2010 and 2011, rising to a total of 613 million gallons.¹¹⁵ In 2013, the volume of produced water, fracking, and drilling fluid waste from oil and gas operations exceeded 1.35 billion gallons.¹¹⁶

FINDING #12: No evidence that waste management practices meet regulations

Operators may request on Form OG0071 (hereafter OG71) to use different waste management practices than what is required by regulation.¹¹⁷ These may include differences in methods used to bury or spread waste on land and how waste is stored, treated, and re-used onsite. The OG71 waiver form requires operators to describe the alternative practice, the type of waste, any additives to be used, and how the method provides “equivalent or superior protection” to established regulations.

In nearly all of the 44 OG71 waivers that we reviewed, there was no evidence to support the assertion of protective measures. Instead, operators answered the question with short, general descriptions. For example, the OG71s issued for waste burial at the Zinn 2 well in Fayette County and the Cowden 10, 14, 40, 50, 51, and 53 wells in Washington County simply described the proposed process as, “After removal of all fluids cement will be mixed with the cuttings in pit while trying to protect liner. Once solid, fold over pit liner then back fill. 50 tons of Portland cement will be used for solidification.” The OG71s for the Carson 1H-3H wells in Butler County stated only, “In situ treatment of flowback for the ability for future down hole re-use. Treatment will include a biocide to eliminate bacteria and a sediment filtration system using sediment bags.”



TOP: Linda and David Headley look at pipeline construction on their farm, Fayette County.

Photo by Roberto M Esquivel / Herald-Standard

BOTTOM: Contaminated spring near gas sites in Moshannon State Forest. Photo by Nadia

Steinzor/Earthworks

In addition, **no information is available on how operators demonstrate to DEP** that methods described in an OG71 application will provide “equivalent or superior protection” to established regulation, as required by Pa. Code § 78.63. In response to a Right-to-Know Law request for any guidelines or policies to determine whether methods of drill cuttings disposal approved under the OG71 are “equivalent or superior,” DEP wrote that, “the Department does not have the records that you request in its possession, custody, or control.”¹¹⁸

FINDING #13: Waste pit waivers allow circumvention of regulations

It appears that **waste management waivers may allow operators to directly avoid regulations**. For example, the OG71 specifically contains an option for operators to construct waste pits so that they can be located even closer to groundwater than the 20 inches minimum required in the Pa. Code.¹¹⁹

Our file reviews show that **operators have used liners that are 20 mils thick for temporary waste pits that are buried on-site**, rather than the more robust 30 mil liner required in Pa. Code §78.62. In 2009, DEP approved the practice of using thinner high-density polyethylene (HDPE) liners to contain drilling, exploration, and production wastes, rather than the more protective 30 mil liner required in §78.62 of the Pennsylvania Code.¹²⁰

In 2010, Scott Perry, Deputy Secretary for Oil and Gas Management at DEP, stated in a form letter presumably sent to oil and gas operators that, “pits used by operators that produce gas from unconventional shale formations to dispose of residual waste must be lined with an impervious liner that is at least 30 millimeters [sic] thick...DEP will be rescinding its approval to use 20 millimeter [sic] liners...The volume of material, the length of time the pits are in use, and the potential impacts to the environment from leaking pits necessitate this action.”¹²¹ However, this change does not appear to have been officially rescinded through DEP requirements and did not apply to conventional operators, leaving in place the option to use a practice that DEP considers risky.

Also in 2010, DEP developed a specific waiver, the OG73, for alternative pit liners.¹²² It isn’t possible to know the number of OG73s that have been issued or the type of liners and purposes they covered, since the form isn’t included as a search option in the eFACTS authorization search list, and DEP did not provide that information upon request.



Well site waste pit. Photo by Frank Finan

Hard Facts: OUT OF SIGHT IS NOT OUT OF MIND

DEP inspection reports shows that between January 2010 and August 2013, DEP issued notices of violations for the improper management and disposal of drill cuttings in pits for at least 48 well sites statewide.¹²³ The violations were issued for problems such as structural instability; improper encapsulation; liner holes and tears; leakage of fluid into springs, ponds, and streams; seepage of contaminated fluids to the surface; and erosion and runoff at pit sites.

It is nearly impossible for the public to find out if pits have been buried nearby, and therefore if they pose environmental risks or caused pollution. DEP doesn't track where waste pits are used and buried, maintain publicly available records of buried pits, or have protocols in place to monitor whether or not buried pits remain stable and impermeable over time. Nor does DEP require operators to map or list the location and volume of pits in permit applications or well reports. The only DEP form confirming pit burial at a well site is the well restoration report (OG75), which is not a search option in eFACTS.

Distance Requirements for Streams, Springs, and Wetlands

FINDING #14: Distance requirements practically ignored

Distance to a stream, wetland, or spring is a key factor in determining whether well development poses environmental risks to waterways, and therefore whether a permit should be issued. Operators can request a waiver from established distance requirements on form OGM0057, "Request for Waiver of Distance Requirements From Springs, Stream, Body of Water, or Wetland" (hereafter OG57).¹²⁴

Our research did not find any evidence that stream distance influences gas and oil permit decisions. It is impossible to know how widespread the practice is because DEP does not maintain records in eFACTS of OG57s issued prior to 2013; in that year 82 such waivers were issued. According to a recent media report, DEP has never denied a stream distance waiver request from a Marcellus driller.¹²⁵

Among the 12 OG57 waivers found in our file reviews, four were granted after the permit was issued and site construction had already begun. In three of these instances, the operator was not issued a violation for breaking the rules.

We found OG57s that were for distances far less than 100 feet. For example, Steckman Ridge's 2008 waiver application for the conversion of the Quarles 1709 well in Bedford County into a gas storage well indicated this would "disturb ground within approximately 20 feet of the stream" [Sideling Hill Creek]. In 2009, DEP gave Steckman Ridge a waiver for the nearby SR9 well, placing temporary construction only 5 feet away from wetlands.

Inspection reports reveal evidence of the risks of placing wells close to water bodies. For example, Chief Oil & Gas was allowed to build the Yoder Unit 1H well in Bradford County 40 feet from a stream and wetlands; in 2012, a spill of hydrochloric acid breached containment and flowed off the well pad, reaching a small tributary to Towanda Creek and causing a fish kill. Chief also received an OG57 waiver for the Postell Unit in Bradford County, where earth disturbance would occur 22 feet from a wetland and 35 feet from a tributary to Towanda Creek. In early 2013, an equipment failure led to a release of more than 600 gallons of flowback; fortunately, most of the contaminated fluid was captured in a containment system.

Act First, Permit Later

In October 2008, a year after Atlas Resources received a permit for the **Cowden 51 well in Washington County**, a DEP inspector realized that Atlas didn't have an OG57 waiver or an E&S permit, and issued a violation for failing to obtain the proper permits prior to construction and failing to control sediment runoff. Then in December 2008, Atlas sought an OG57, stating that the well site would be

constructed "less than 100 feet from the south fork of Cross Creek. Cross Creek is classified as HQ WWF [High Quality Warm Water Fishery]." DEP quickly approved it, for a well that was already in operation, located just 76 feet from the creek.

In August 2009, DEP issued OG57s to Range Resources for the Cowden 3H and 5H wells in Washington County. Transmittal forms

are both clearly marked "After the Fact," and the well permits had been issued months before. The OG57 application states that, "The request is for the construction of a well pad with temporary erosion controls which are less than 100 feet from an

Unnamed Tributary to Raccoon Creek which is classified as a Warm Water Fishery."

In March 2010, DEP approved an expedited E&S permit to Chesapeake Energy for the **Rexford well site in Bradford County**. Just a few weeks later, a DEP inspector noted that earth disturbance had occurred too close to a wetland and a tributary to Wysox Creek—and DEP quickly issued an OG57

waiver. About a year later, Chesapeake was cited with a violation of the Clean Streams Law for stray gas pollution that, according to inspection notes, resulted from "Significant bubbling in cellar/uncontrolled release of gas" in the Rexford 2H well. DEP emails indicated concern about the potential contamination of nearby drinking water wells. In June 2013, Chesapeake informed DEP in a letter that

methane bubbling was still occurring. According to nearby residents, Chesapeake vents the well three times a day on a regular schedule—raising concerns about ongoing risks to both water and air quality.



Photo by Nadia Steinzor/Earthworks

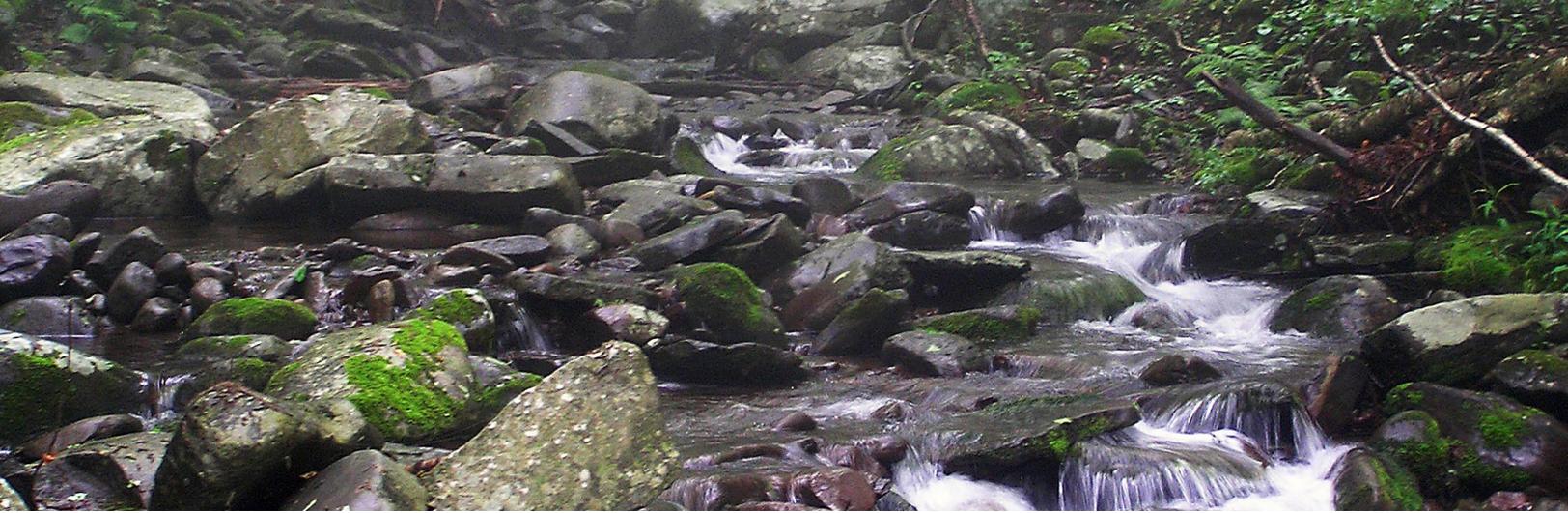


Photo by Nadia Steinzor/Earthworks

Hard Facts: THE BUFFER CONTROVERSY

Buffer zones around surface waters are essential to protecting water quality and aquatic life—particularly in a water-rich state like Pennsylvania, with an estimated 83,000 miles of rivers and streams.¹²⁶ The various stages of gas and oil development pose risks such as soil erosion (which can destabilize stream banks and clog water bodies with sediment), as well as direct pollution from spills or runoff of chemicals, drilling fluids, flowback, and wastewater. Such risks can be made worse by drilling directly under streams,¹²⁷ or by weather events such as heavy rain and floods.¹²⁸

Prior to 2012, operators in Pennsylvania were prohibited from drilling a well within 100 feet of streams, springs, and wetlands over one acre in size. The Oil and Gas Act of 2012, known as Act 13, extended the required distance between a gas well and a water body from 100 to 300 feet and required that any well pad disturbance be more than 100 feet away.¹²⁹

However, in 2013 the Pennsylvania Supreme Court decided a case focusing on Act 13's constitutionality with regard to municipal zoning.¹³⁰ But the decision, based on the importance of ensuring strong protections for environment and health, also struck down DEP's allowance of water body distance waivers.¹³¹ For now, the original setbacks required in Chapter 78 of the Pa. Code remain in force and the DEP remains mandated under the state's Clean Streams Law to protect all bodies of water. According to DEP staff, the agency no longer issues OG57s following the court ruling.

4. Operator Filings

Well Restoration Reports

FINDING #15: Information on well site restoration missing

According to Pennsylvania law, oil and gas operators have nine months from the date that drilling is completed or a well has been plugged to restore the well site.¹³² Operators are required to then file well restoration reports with DEP on form OOGM0075 (hereafter OG75) within 60 days after a well site has been restored.¹³³ This is done to confirm that earth disturbance activities have ceased and that site restoration, including installation of any post construction stormwater BMPs and permanent stabilization, has occurred.¹³⁴

We determined that **operators of 99 wells in the files reviewed should have filed a restoration report; however, they were missing from files for 81 of those wells (or 82%).**¹³⁵ According to the 2013 report on

Pennsylvania by the State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER), well restoration reports are sent to the regional oil and gas district office where they are reviewed by an inspector and recorded in an online database.¹³⁶ DEP confirmed that this database refers to eFACTS. But because OG75s are not included as a search option in the eFACTS authorization list, we could not confirm the number of restoration reports that DEP has received or registered, and DEP did not provide this information upon request.

Missing and delayed OG75s means that there is no way for the public to confirm the status of a well site or activities, and in turn the potential for environmental risks, such as a site's structural stability, whether waste has been removed, or whether a waste pit has been buried onsite.

Because site restoration requirements apply to well sites, operators are not required to undertake restoration or file OG75s until after the last well on a site is completed.¹³⁷ In effect, as long as any well is being drilled at a site, the entire site can be considered to be under construction and use. In addition, there are various conditions under which operators can request restoration extensions for individual wells for up to two years, including for the more efficient use of land and production of oil and gas and for "adverse weather conditions or a lack of essential fuel, equipment or labor."¹³⁸



Well site development.

Photos by Frank Finan (top), Helen Slottje (bottom)

Drilling and Stimulation Completion Reports

FINDING #16: Information on drilling and stimulation missing

The drilling completion date sets the clock ticking for the operator to complete restoration of the well site. Operators have 30 days from the date of drilling completion to file the drilling completion report on Form 8000-FM-OOGM0004a (titled Well Record Form).¹³⁹ Operators file information about well stimulation on Form 8000-FM-OOGM0004b, which includes a date when initial flowback began or the last frac plug was drilled out and formation flow began (whichever comes first). Operators have 30 days from the completion date to file the stimulation completion report with DEP.¹⁴⁰



Photo by Frank Finan

We determined that 25% of the drilling completion reports and 35% of the stimulation completion reports that should have been in the files we reviewed were missing.¹⁴¹ It's not clear if operators never filed these reports or if DEP received but didn't file them. Regardless, without these reports, it is more difficult for DEP staff to hold operators accountable for following regulations on stabilizing and restoring sites, and thereby prevent permanent damage to the land. It is also difficult for the public to hold DEP accountable for making sure that operators don't ignore regulations.

Completion reports also include the names of chemicals and substances used—critical information for emergency responders, health professionals, workers, and the public. This is particularly important given the loophole in the US Safe Drinking Water Act that allows the oil and gas industry to skirt chemical disclosure requirements, and because voluntary reporting systems are not providing information in a timely or complete manner.¹⁴²

Missing Reports = Unanswered Questions

The **Carr family in Fayette County** wants to know whether a waste pit associated with the Zinn 2 well was buried upslope from their property, and wonder if the surface seepage of an oily fluid behind their house might be from the pit leaking. But because there is no restoration report (OG75) in the Zinn 2 well file, there is no way to confirm that the waste pit was buried or what it may have contained.

The **McIntyres and their neighbors in Butler County** have raised questions about activities and

conditions at nearby sites. In 2010, Rex Energy received permits for seven Grosick wells (1H-7H). Records show that five of the wells were completed by mid-2011; the other two (6H and 7H) have produced gas, and so were clearly completed. However, none of the Grosick well files contain OG75 reports or any other documentation (e.g., inspection reports) indicating restoration of the site. Drilling has also been completed at the Carson 1H-3H wells, but none of the related well files included OG75s or any other information on restoration activities at the site.

5. Inspections

Inspections offer a means for DEP to detect pollution and equipment failures, and provide the foundation for investigations. In other words, it's when inspectors go looking that they may find ways to prevent problems—or find problems that have already occurred and need to be addressed. (The role of citizen reporting is discussed in the complaints section below.)

In its 2013 Oil and Gas Annual Report, DEP states that it is responsible for “conducting regular inspections to ensure that well sites are operated in a manner that is safe for Pennsylvania’s citizens and protective of the environment.”¹⁴³ Inspections may occur for a variety of reasons, including as part of a routine schedule, in response to a complaint, to evaluate compliance following a violation, or to check on site restoration. The recommended frequency and type of inspections are outlined in DEP’s “Inspection Policy Regarding Oil and Gas Well Activities,” which was incorporated into the Pennsylvania State Code in 1989, prior to the unconventional shale gas boom.¹⁴⁴



TOP: Impoundment under construction.
Photo by Frank Finan

BOTTOM: Gas production equipment in the front yard. Photo by Nadia Steinzor/Earthworks

FINDING #17: The majority of wells are left uninspected

In early 2014, DEP reported that both the total number of well inspections and the number of inspectors on the ground (currently 80) have been steadily increasing.¹⁴⁵ However, even though the total number of inspections conducted statewide has increased, **figures reported by DEP indicate that the average number of inspections conducted per unconventional well has gone down**, from 3.3 in 2008 to 2.2 in 2013 (the average at conventional wells appears to have remained steady).¹⁴⁶

In addition, the vast majority of wells continue to operate with no oversight. In 2008, DEP inspected 7,520 wells, which left approximately 58,000 active wells (89%) uninspected; in 2013, DEP inspected 13,367 wells, a notable increase—but because of the growth in drilling and production, DEP did not inspect more than 66,000 active wells (83%).¹⁴⁷

DEP appears to be shifting its focus of inspections and enforcement to unconventional wells and initial stages of development. DEP’s 2013 Oil and Gas Annual Report focuses its analysis of industry oversight on wells drilled as part of the Marcellus Shale gas boom.¹⁴⁸ This is borne out by our analysis (using eFACTS, DEP’s Oil and Gas Compliance Database, inspection reports, and other documents found in well files) of inspection and violations data for all drilled and producing wells within two miles of the 11 households examined for this report (as of May 2014)—a total of 485 wells.¹⁴⁹

Inspection statistics for drilled and producing wells included in our analyses		
	Unconventional wells	Conventional wells
Number of drilled and producing wells	272	213
Number of inspections	1,399	331
Average inspections per well	5.1	1.6
Number of wells with zero inspections	5	52
% of wells with zero inspections	1.8	24.4
Number of complaint inspections	117	8
% of inspections that were due to complaints	8.4	2.4
Number of complaint inspections finding violations	5	2

FINDING #18: DEP can't meet its own inspection goals

As seen in the table above, almost every producing unconventional well in our sample had been inspected at least once, but **24% of producing conventional wells had never been inspected. Our analysis also indicated that 11% of producing unconventional wells had been inspected only once, and 38% had three or fewer inspections.** This is far below the recommended number of inspections for wells outlined in DEP's own inspection policy.¹⁵⁰ The policy suggests that a well be inspected up to seven times before it begins to produce oil or gas; at least once a year thereafter during production to determine compliance with oil and gas statutes; and at various other times, such as during plugging, repairs, as part of the waiver process, and after site restoration.



Gas storage well with compressor station in background. Photo by Nadia Steinzor/Earthworks

It appears likely that the frequency of inspections does not depend on consistent guidelines, but on such factors as the choices of individual inspectors and their supervisors, whether operators and residents report problems, and resources and staff available in different DEP regions. In an internal review of inspection and enforcement practices, DEP concluded that variability exists among oil and gas regional offices, including in the forms used, how information is entered into databases, and the number and frequency of violations that are tracked by staff.¹⁵¹

FINDING #19: Inspection information missing

Because eFACTS only lists the date and type of inspections that have occurred, hard copy inspection reports are the only way for the public to know why they occurred and what transpired. Notes in inspection reports can provide vital information on problems or questions that arose at sites, how DEP responded, and the views and actions of both operators and inspectors. Unfortunately, **17% (126) of the inspection reports listed in eFACTS for the wells we reviewed were missing from**

the hard copy files. Our Right-to-Know Law (RTKL) request to DEP to obtain copies of those associated with citizen complaints and incidents at well sites was largely denied (see box on using the RTKL).

FINDING #20: Inspections can lag for years

Our file reviews indicate that time gaps between inspections can be significant—including at sites in existence prior to the Marcellus shale boom and DEP’s apparent shift of resources to unconventional wells. For example, permits were issued for the Zinn 3, 4, and 5 wells in Fayette County in August 2005 and DEP conducted drilling/alteration inspections in June 2006—but the next inspection didn’t occur until four years later. Also in Fayette County, the Wolf 22 well was completed in December 2005 but wasn’t inspected at all until October 2011. In Greene County, the Martinez 2 and Phillipi 9 were cited for water pollution incidents on In April 2007; while both wells received follow-up inspections later that month, neither has had a single inspection in the last seven years.

Hard Facts: CONTAMINATION CAN TAKE TIME

In a July 2013 letter to Earthworks and partner organizations regarding DEP’s water quality program, Scott Perry, Deputy Secretary for Oil and Gas Management at DEP, indicated how the agency prioritizes inspections and oversight: “Pa. DEP focuses its inspection efforts on wells during the site development and drilling phases, which is when environmental issues are expected to arise. Once a well is in production...it is essentially a static operation. Wells typically operate without issue for decades.” Mr. Perry added that, “Unconventional wells are clearly the focus of development in Pennsylvania...and Pa. DEP is correctly focusing its efforts on that segment of the industry.”

DEP’s assertion that wells don’t require oversight after drilling contradicts the recommended inspection policy in the Pa. Code, which includes an inspection at least once a year during production.¹⁵² As discussed in the health considerations section of this report, some environmental impacts can take months or years to become evident. Inspections during and after the production phase are when problems such as deteriorating equipment, waste pit liner tears, site erosion, and excessive emission releases may be discovered.

DEP emphasizes agency concern with gas migration due to structural problems in wells,¹⁵³ which research indicates tend to increase over time.¹⁵⁴ A recent study based on DEP inspection and drilling reports found that nearly 2% of wells drilled between 2000-2012 had a loss of casing and/or cementing integrity, posing a risk to groundwater and releasing methane emissions.¹⁵⁵

In addition, even a non-producing well can warrant inspection until it is permanently, properly, and officially plugged and abandoned—which many statewide are not, giving rise to pollution risks and incidents.¹⁵⁶ In a 2009 report, DEP attributed 27 cases of water contamination to stray gas from old wells (including three due to new wells intersecting old ones), and cited resource limitations as one of the reasons for falling behind in the oversight necessary to ensure proper well plugging and abandonment.¹⁵⁷

6. Violations

When violations of oil and gas regulations occur, the DEP can take a variety of enforcement actions, such as issuing notices of violation, assessing penalties, negotiating consent agreements with operators, and suspending or revoking permits.¹⁵⁸

Documentation of the types of violations issued (as well as when, where, and why they were issued) provides information critical to understanding the scope of industry impacts on health and the environment.

FINDING #21: DEP neglecting conventional wells

Violation statistics released by DEP may not provide an accurate picture of operator compliance with regulations. **DEP reports that violations have decreased and enforcement actions increased at unconventional wells from 2010 to 2013.**¹⁵⁹

According to DEP, violations dropped from 1,281 to 512, which “suggests that although overall compliance by unconventional oil and gas operators has been improving, DEP has continued to vigorously pursue enforcement actions as warranted.”¹⁶⁰

But DEP failed to report that the opposite is true for conventional wells. Violations at these wells increased from 1,586 in 2010 to 2,123 in 2013; meanwhile, enforcement action at conventional wells was less vigorously pursued by DEP (in 2010, DEP was taking one enforcement action per 3.0 violations at conventional well sites; in 2013 the agency was only acting on 1 out of every 3.6 violations at those sites).¹⁶¹

FINDING #22: DEP prioritizes fixes over fines, reducing deterrence of potential violators

The issuance of fines for violations at both unconventional and conventional wells has decreased.

DEP statistics contain several types of “enforcement actions,” not all of which result in a financial penalty to an operator.¹⁶² DEP data show that in 2013, fewer violations led to fines when compared to previous years. In 2009, 34% of violations at unconventional well sites were linked to enforcement actions in which fines were issued, but only 13% in 2013; conventional wells show a similar trend, declining from 12% to 8% during the same period.¹⁶³

Our review of inspection reports indicates that **inspectors often work with operators to fix a problem, rather than issuing a violation.** DEP officials have confirmed that this is done to reduce the administrative burden for offenses that inspectors consider to be minor, and to encourage operators to report problems without fear of being penalized.

While this approach may save time and streamline administrative processes, it also lets operators off the hook for impacts and irresponsible actions; weakens the deterrent effect of there being consequences for committing a violation; and increases the risk that seemingly small problems become worse over time. A gas migration response regulation adopted in 2011 supports an approach of self-



TOP: Infrared image of emissions from the Cumberland/Henderson Compressor station, Greene County. Video by Frank Finan

BOTTOM: Well site waste storage pits. Photo by Frank Finan

reporting and correction, as it allows operators to conduct their own investigations of suspected contamination and later report findings to DEP.¹⁶⁴

Using eFACTS and DEP’s Oil and Gas Compliance Database, inspection reports, and other documents found in DEP well files, we compiled inspection and violations data for all drilled and producing wells within two miles of the 11 households examined for this report (as of May 2014)—a total of 485 wells.¹⁶⁵ Because **DEP does not issue citations for all events that are violations of state oil and gas regulations, the number of problems** that occur at well sites is likely much larger.¹⁶⁶

This conclusion is supported by a recent court deposition of a DEP oil and gas program manager, which revealed that if a homeowner and operator reach a private settlement (for example following water contamination from a spill), DEP is likely to not record the event as a violation, nor to maintain a record of complaint or issue a formal determination of wrongdoing.¹⁶⁷ Pennsylvania’s Auditor General has also concluded that DEP does not consistently issue orders requiring oil and gas operators to restore or replace impacted water supplies, as required by state law.¹⁶⁸

Violations of environmental, health, and safety (EHS) rules occur at both unconventional and conventional well sites. It is clear that when DEP inspectors visit either type of well, they find violations; however, **it appears that DEP is more likely to issue monetary penalties for EHS violations at unconventional than at conventional wells.**

Violation statistics for drilled and producing wells included in our analyses		
	Unconventional wells	Conventional wells
Number of drilled and producing wells	272	213
Number of inspections	1,399	331
Number of violations	114	25
Ratio of violations to inspections	1 per 12 inspections	1 per 13 inspections
Average number of violations per well	0.42	0.12
Number of Environmental, Health and Safety (EHS) violations	66	8
% of violations that were EHS-related	46	32
Number of EHS violations resulting in a penalty	37	0

No-Cost Violations

A variety of factors seem to influence DEP's decisions about when violations should result fines, as well as the level of penalty assessed. According to DEP staff, enforcement decisions are made on a case-by-case basis. Specifically, a history of non-compliance would only influence a permitting decision if those violations are active and currently unresolved; and in assessing penalties, an operator's "cooperativeness" to address a violation or "willfulness" in having committed it is considered.

In 2011, Chief Oil & Gas obtained an OG57 waiver that allowed the **Yoder Unit 1H well in Bradford County** to be built 40 feet from a stream and associated wetlands. The waiver conditions included, among other things, that "adequate secondary containment measures must be utilized for any area on site that may contain a polluttional substance(s)." This and Chief's E&S Control permit for the entire well pad meant that a sedimentation pond was put in place to control runoff. In April 2012, an estimated 100 gallons of diesel fuel spilled into the secondary containment area around the pad.

Just three months later, 4,700 gallons of hydrochloric acid breached the containment area and flowed off the well pad. According to DEP, some of the acid flowed through a field and reached a tributary to

Towanda Creek, causing a fish kill. Then, three months after that, there was a release of 2,100 gallons of hydraulic fracturing flowback. DEP issued notices of violation for all three spill incidents—but Chief was not issued a fine for any of them.

At the **Voll 3H well in Butler County** in November 2010, Rex Energy spilled bentonite drilling gel while boring under Little Connoquenessing creek. Because the inspection report was missing from the well file we reviewed, details on the incident aren't available—but according to an entry in the DEP's Oil and Gas Compliance database, the violation was classified as "immediately corrected," based on a DEP inspector's assessment that the operator cleaned up the spill and there were no visible impacts on aquatic life.

In November 2010, a DEP inspector arriving at the **Gilliland 4H site in Butler County** discovered oil leaking from an air compressor and that (according to an inspection report), "the oil was spraying into the air and being carried downwind. The rig crew shut down the compressor. Personnel then undertook repair of the leaking fitting and cleanup of the spilled oil." DEP issued an EHS violation, but did not issue a fine.

7. Citizen Complaints

Citizen complaints are essential to the documentation of gas and oil impacts and subsequent accountability. In the words of the Texas Railroad Commission (which oversees oil and gas operations in that state), “Citizens are viewed as extra eyes to help...identify problems.”¹⁶⁹ In Pennsylvania, complaints are often the reason that DEP inspectors visit sites and find problems, and can therefore be the catalyst for investigations of irresponsible practices that cause environmental damage. Between 2007 and 2011 approximately 2,890 oil and gas inspections took place because of complaints, and violations were found as a result of more than 700 of these complaint-driven DEP inspections.¹⁷⁰

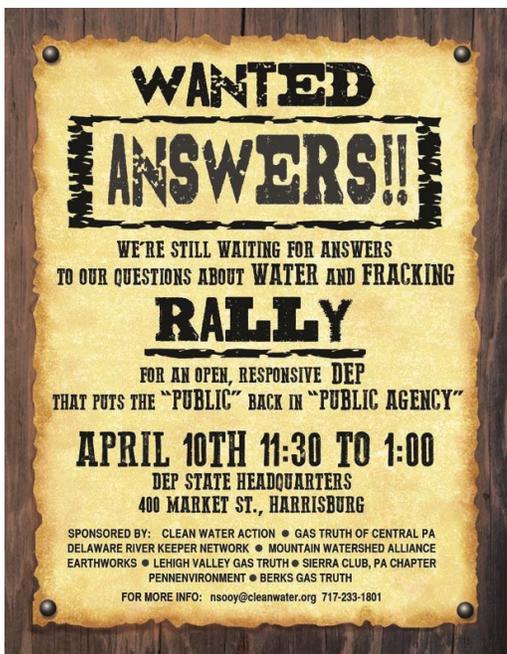
FINDING #23: Information limited and hard to get

According to DEP records, the agency registered more than 2,000 complaints related to oil and gas operations between 2011 and March 2014.¹⁷¹ DEP’s central office and regional offices have the ability to provide spreadsheets with entries from the agency’s Complaints Tracking System (CTS).¹⁷² These include fields with complaint ID; county; municipality; date received; date resolved; a short descriptor (e.g., malodor, well water problem, property damage); responsible party if the complainant identified one (e.g., Atlas Resources, Springhill compressor station); and the complaint type (e.g., general, spill, water).

But complaint records do not include any information to verify whether a complaint is related to a particular site or incident (such as facility ID or well permit number). Nor is it possible to know how DEP responded or why DEP considered the complaint to be resolved. While such information is maintained in the CTS for use by DEP, it is not available to the public—which in turn cannot track DEP’s actions or assess the agency’s accountability to citizens or its work to solve problems that spur them. In addition, hard copy complaint records are not kept in DEP well and facility files, but must be requested for review separately.

Among the nearly 120 well files we reviewed, 30% of complaint inspection reports listed in eFACTS were missing. This is a significant gap in information, since inspection reports contain information about what occurred, what operators did and didn’t do, and how DEP handled the situation. The critical role that residents can play in enforcement is reflected by the fact that failure of an operator to report a pollution incident to DEP is one of the most common violations to occur.¹⁷³

Using Pennsylvania’s Right To Know Law (RTKL), we submitted requests to DEP regional offices to obtain both the missing complaint inspection reports and records of public complaints related to oil and gas operations in all the townships in which we researched cases—but DEP largely denied them.



Photos by Frank Finan (top), Karen Feridun (bottom)

This made it difficult to fully assess the types and frequency of problems that occurred at the locations we reviewed, as well as DEP’s response to residents’ concerns and communication with operators.

Hard Facts: TRYING TO USE THE RIGHT-TO-KNOW LAW

Under Pennsylvania’s Right to Know Law (RTKL), we submitted requests to DEP regional offices for records of public complaints related to oil and gas operations in all the townships in which we were researching cases.¹⁷⁴ DEP denied these requests for three key reasons:

Protection of a complainant’s personal identity, such as name, address, and telephone number. However, confidentiality and privacy—which Earthworks fully agrees must be maintained—would not be violated by DEP providing information on the substance of complaints. One DEP employee we spoke with indicated that any agency office processing RTKL and file review requests can determine what constitutes a “privacy concern” or “identifier” that would result in redaction of information on a record, and it could include descriptions of landscape features or well site names. Other DEP employees indicated that the agency simply doesn’t have the resources available to redact identifying information. Oddly, a resident who made a RTKL request for all complaints she had made with regard to her own water supply told Earthworks she was also denied DEP records in part on the basis of protecting an informant—which in that case would have been herself.

The RTKL excludes records that are part of current investigations. The law contains several types of information that are exempt from access by a requestor, including complaints in both criminal (§708(b)(16)(i)) and non-criminal investigations (§708 (b)(17)(i)), as well as records that reveal the “institution, progress, or result of an agency investigation” (§708 (b)(17)(vi)).¹⁷⁵ In other words, if DEP is actively investigating a case, the agency doesn’t have to provide related complaints information contained in records or inspection reports. As a result, the public may be able to obtain details about complaints only after problems have been resolved—a process that can take years.

Internal and deliberative process privilege. RTKL §708(b)(10)(i)(A) allows public agencies to withhold records that reflect how officials and employees have “contemplated or proposed policy or course of action” or any written documents “used in the pre-decisional deliberations.” This essentially means that DEP does not have to provide to the public any information on how it responds to residents or investigates and resolves complaints—in other words, documents that can demonstrate how DEP serves the public and holds industry accountable.

FINDING #24: DEP allows limited response

Depending on the priority level assigned to a complaint, **DEP has from several days to more than a month to respond to most complaints.** DEP Service Representatives and employees taking calls and receiving emails and letters classify the complaint (e.g., emergency, moderate, or low risk), enter key information into the CTS database, and assign management of the complaint to the appropriate program or regional office.¹⁷⁶

A time lag between complaints and inspections is problematic when it comes to events that can dissipate with time. Odors, visible air emissions or substances in water, and noise may be the result of equipment malfunction, safety problems, and serious pollution issues. DEP clearly recognizes this; for example, under General Permit 5 (GP-5) or Minor Source Plan air permit approvals, gas and oil facilities are required to prevent malodors from leaving their property lines.¹⁷⁷

While both odors and visible emissions can dissipate quickly, they reflect the episodic nature of gas and oil field pollution events that impact health.¹⁷⁸ In addition, odors can serve as a warning sign of the presence of a pollutant in the air and associated health risks.¹⁷⁹ In Earthworks' research on health impacts among Pennsylvania residents living near gas facilities, odors were among the most common complaints. Over 80 percent of health survey participants experienced them sometimes or constantly; most attributed the source of the odors as coming from nearby gas wells and facilities, and they associated odor events with the onset of health symptoms (such as headache, dizziness, and sore throat).¹⁸⁰

Yet despite these risks, **DEP's complaints manual instructs employees that, "The odors must be occurring at the time of the call...** If the odors are not present at time of call, then instruct the caller to contact the Department the next time they detect the odors...**DO NOT REGISTER THE COMPLAINT.**"¹⁸¹ With this in mind, while DEP registered 110 complaints statewide specifically for odor issues in 2011 to early 2014,¹⁸² it is likely that this number represents only a fraction of the actual odor incidents experienced by gas field residents.

For example, a November 2009 inspection report for the Cowden 1H well in Washington County notes, "Responded to a call...about a neighbor reporting a loud noise and odor that made them nauseous. I found no odors or noise when I visited the site...Range Resources personnel [sic] on site said they were not the cause of the problem." A follow up inspection on



Photo by Frank Finan

December 1 simply concluded, "There is no odor or noise." In October 2009 at the Henderson/King 1 MH well in Greene County, an inspector responding to an odor complaint noted, "The Department did not observe any odors at the time of this inspection. The Department did not observe possible pollution concerns at the site."

FINDING #25: Complaints can be dismissed

In the course of this research project and previous health survey work in Pennsylvania, **residents often reported that they do not always receive a response from DEP**, even though the agency website instructs them to report problems.¹⁸³ Others report that DEP inspectors and other employees who call back say that there's no reason to come out and investigate, since the resident has made the same complaint before.

Such situations can mean that the complaints of residents about problems that are ongoing, sporadic, or change over time (e.g., odors, noise, light, or declining water quality or quantity) may be left unaddressed. In addition, if DEP employees disregard complaints, the number of complaints entered

into CTS may be far lower than the number residents report—leaving the full scope of problems experienced by residents undocumented.

This problem reflects contradictions in DEP’s official complaints response. The agency’s guidelines state that, “the Department has the duty to investigate all complaints received and to determine if such violations have occurred.”¹⁸⁴ But the DEP complaints manual tells employees that, “Complaints that are without merit or within DEP’s purview should not be entered into CTS nor should they be investigated....Repetitive complaints from a person or group that are determined by prior investigation to be without merit may be disregarded at the discretion of the Regional Director.”¹⁸⁵

The Squeaky Wheel Gets a Response

The **VanNoy well site in Bradford County** is a stark illustration of how repeated complaints can be necessary to ensure that DEP inspections occur—even for problems that DEP has previously addressed.

In February 2009, a DEP inspector found that a drill cuttings pit at the site was overfilled. In March 2009, a follow up inspection found that Chesapeake Energy had resolved that particular problem, but also that water for hydraulic fracturing was flowing out of storage tanks and causing sedimentation and turbidity in a natural pond downslope. Less than three weeks later, a contractor at the site spilled over 400 gallons of hydrochloric acid (HCL), some of which reached the pond.

A March 24, 2009 complaints record refers to an acid spill and dead fish in a pond, noting that, “Complainant is very unhappy with the condition of his property and wants Chesapeake to rectify the problem.”¹⁸⁶ A DEP inspection report from three days later notes that testing “revealed the potential for additional HCL contamination” and that the drill cuttings pit was once again overfilled and the liner had holes. In April, DEP sent a letter to Chesapeake describing violations for failure to control and manage waste and discharge of pollution to water bodies.

In a July 2009 inspection, DEP noted that while violations for the pit remained, the erosion and sedimentation (E&S) violations were resolved. Yet an October complaints record from the area refers to E&S problems and a large acid spill, noting that, “Sediment and runoff from [redacted] well pad has been entering complainant’s pond for some time. Trees on portions of cmpts property have died as a result of runoff and waste spills.”¹⁸⁷

In November, DEP inspected the site again in response to “reports” of water quality degradation. The agency later concluded that, “historical documentation and the laboratory analysis results suggest that the degradation to Burnett Pond is a result of activities associated with the VanNoy well pad.” By early 2010, Chesapeake and DEP entered into a Consent Agreement and settlement and the company was fined about \$27,000.

Unfortunately, problems at the site didn’t end there. Inspection reports indicate that the homeowner continued to report erosion and runoff problems in 2010, and as late as June 2013, a consultant submitted a work plan for ongoing assessment of the pond’s water and biological quality.¹⁸⁸ The homeowners have filed a lawsuit against Chesapeake Energy for contamination of their land and groundwater.¹⁸⁹

Conclusions

Like most other oil and gas states, Pennsylvania did not take the steps necessary to prepare for a rapid expansion of the industry. And as has been occurring nationwide, state agencies have faced steep budget cutbacks in recent years. As a result, DEP has been struggling to keep pace both administratively and in the field, and has been unable to stay abreast of both residents' concerns and emerging science on pollution and health impacts from gas development.



Fall in Loyalsock State Forest. Photo by Mark Szybist

Oversight of Pennsylvania's oil and gas industry is occurring with three inherent contradictions at play:

1. DEP is charged with protecting the environment and the public, but is under strong political pressure to advance an industry that harms water, air, and health.
2. Steep budget cuts to DEP during a shale gas boom means the agency has to do more with less—which in effect has meant insufficient oversight and enforcement.
3. As the number of people impacted by and concerned about the impacts of gas development grows, public access to information on the activities of both operators and DEP remains limited, inconsistent, and restricted.

As detailed in this report, Pennsylvania is actively expanding gas development without the ability to fully implement its regulatory program, oversee operations, prevent and resolve problems on the ground, respond to residents, and hold companies accountable for damage they cause. In the final analysis, Pennsylvania is making a choice to sacrifice the health of its communities and environment. By not addressing—and sometimes willfully ignoring—DEP's constrained resources and the growing severity of the gas and oil industry's impacts, the state is failing in a basic role of government: to serve the public interest first.

Many Pennsylvania residents now live surrounded by gas wells, processing equipment, and waste facilities. Each one seems to have sprung up on its own, with no planning or consideration of their interconnections. Neither the immediate impacts on individuals and communities nor the cumulative impacts on local and regional air and water quality have been fully considered. Yet many people already face difficult problems, while changes over time and geographic areas will determine the ultimate severity of damage to the environment and public health.

As we were completing this research project, DEP issued its annual oil and gas report, stating that, Pennsylvania is a "world class leader" for a regulatory approach that "protects its environment and citizens while also providing for optimal development of oil and gas resources."¹⁹⁰ Not long after, the Pennsylvania legislature passed bills declaring that the conventional oil and gas industry "has had a benign impact on human health and the environment" statewide and exempting many drillers from updates to regulations that would cover all types of drilling—the passage of which could now be indefinitely delayed.¹⁹¹

In both these cases, officials were in effect declaring that there is no need to change the status quo—regardless of evidence to the contrary and mounting concerns among Pennsylvanians over how the gas and oil industry is managed and related impacts on the environment and health.¹⁹²



Photo by Tracy Carluccio

At the same time, Pennsylvania’s Auditor General concluded a year-long investigation of DEP’s water quality protection policies that documented serious lapses in the agency’s enforcement protocols, recordkeeping, and handling of citizen complaints—and concluded that DEP is “underfunded, understaffed, and does not have the infrastructure in place to meet the continuing demands placed upon the agency by expanded shale gas development.”¹⁹³

Both the very real experiences of residents statewide and the findings of this report serve as a cautionary tale of just how difficult it is to oversee a complex industry that poses inherent threats to water and air quality. Rapid expansion of gas development is outpacing the ability of regulators keep up with oversight and enforcement, and with the public’s need for information and assistance. Repairing this situation in Pennsylvania to prevent irreparable harm—and avoiding it in other states and countries contemplating an expansion of gas and oil development—will require a significant investment of both resources and political will. Below is a set of recommended actions to start moving Pennsylvania in the right direction.

Recommendations

Recommendations: Public Information

In the course of this project, we found that many pieces of the puzzle of how problems reported by gas field residents are linked to the development around them—but we also found huge gaps in documentation and recordkeeping. Lack of a “paper trail” hampers DEP’s ability to carry out its enforcement responsibilities. It also severely limits the public’s right to know what is happening in their communities and to hold DEP—as a public agency—accountable. To ensure access to information, Pennsylvania should:

CONDUCT A COMPREHENSIVE AUDIT OF DEP’S OIL AND GAS REGULATORY ENFORCEMENT PROGRAM.

Aspects to be investigated include (but are not limited to) rates and types of inspections; when and why violations are issued; recordkeeping practices; water and air testing policies; citizen complaints tracking; incident response, inspection, and enforcement protocols; and fulfillment of public information requests.

DEVELOP AND IMPLEMENT CONSISTENT RECORDKEEPING POLICIES across DEP regional offices. We found variation among DEP regional offices in providing information (e.g., complaints data and planning documents), while our file reviews revealed differences in whether operator and inspection

reports were filed by staff. DEP has recognized this regional variability as a problem that needs to be solved, including with regard to how the number and frequency of violations are tracked.¹⁹⁶

MAINTAIN DOCUMENTS ONLINE. DEP has stated that efficiency in permitting and administrative compliance by operators will be achieved in large part through a new electronic system called “eWell,” which enables operators to submit paperwork online and track it in a central database.¹⁹⁷ DEP should fully implement eWell and establish full operator participation as a condition of receiving a permit. DEP should also ensure that all relevant records are entered and maintained in a single, open source, map-based system that allows for bulk-download and querying.

ENSURE FILING OF FORMS AND REPORTS. A centralized database should be developed to track well restoration and drilling and completion reports and alert DEP when they are due and past due; penalties should be issued to operators for failing to file reports on time. Information on chemicals and processes used and offsite and onsite waste management should be included in the database and made available to the public. All operator reports, permits, and waivers should be included in hard copy files and listed in eFACTS.

REDUCE RESTRICTIONS ON RIGHT-TO-KNOW-LAW REQUESTS. Our research, investigations by partner organizations, and reports from residents indicate that DEP continuously uses exceptions in Pennsylvania’s Right-to-Know Law to restrict public access to agency documents. DEP should develop a system to redact personal/private information from agency documents so they can be provided to the public and increase resources available for fulfillment of RTKL requests. Documents related to non-criminal investigations, in which no parties would be directly harmed by release of the information, should not be withheld indefinitely.

ALLOW ACCESS TO COMPLAINTS. As noted above, DEP should develop a system to redact personal/private information so that complaints records can be provided to the public. This is particularly important with regard to information on incidents, environmental and health impacts, how and when DEP employees responded to the complaint, any remedial measures taken, and why DEP considers the complaint to be resolved. To be able to connect complaints with particular sites, they should be listed in the Complaints Tracking System not only by geographic location, but by operator and well site or facility.



Recommendations: Water and Air Quality

While gas and oil development involve inherently polluting activities, measures can be taken to reduce harm and ensure that lax pollution controls are a rare exception rather than widespread. This will require changes in several areas, including to:

STRENGTHEN REGULATIONS. Among the most critical measures for Pennsylvania to consider are significant increases in setback distances for wells and facilities from buildings; requirements for operators to install and use advanced technologies to reduce emissions, odors, and noise; the replacement of open pits with closed-loop systems to store waste and drilling fluids; elimination of centralized waste impoundments; prohibition of the onsite burial of solid waste and solidified liquid waste; and required “green completions” to eliminate flaring and venting of methane gas and other pollutants.

ESTABLISH COLLABORATION BETWEEN DEP AND THE PENNSYLVANIA DEPARTMENT OF HEALTH (DOH).

The two agencies should develop an agreement to document and respond to spills of chemicals and waste, migration of methane and fracturing fluids, leaks, and other problems that could give rise to health problems. The budgets of both agencies should be increased to ensure they have the resources necessary to track reports of health problems near gas facilities and to respond to citizen complaints (e.g., through a shared database and online and telephone citizen response systems). DOH should train health and medical professionals on exposure pathways and symptoms related to gas operations, so that residents can receive informed advice and appropriate testing and care referrals.¹⁹⁸

EXPAND AND STRENGTHEN AIR AND WATER QUALITY TESTING AND REPORTING. DEP should require operators to perform and submit assessments of cumulative emissions from multiple wells and facilities in an area. DEP's emissions inventories should include reporting by operators of conventional wells and all waste impoundments, waste treatment/processing facilities, and gas processing plants. The loopholes for VOCs and HAPs during drilling and completion should be eliminated from the inventories.

DEP should develop a comprehensive and required set of pre-drilling water testing parameters that match what the agency tests for in response to water complaints. DEP should integrate emerging science into its water quality investigations (e.g., the role of gas operations in mobilizing iron, manganese, and other contaminants and shifting water tables and sub-surface topography) and consider changes in secondary water standards when making determinations. DEP should clearly explain to homeowners why a negative or undecided water contamination determination has been made, and follow up at regular intervals to see if conditions have changed.



Photo by Frank Finan

DEP should follow a recent recommendation by the Pennsylvania Auditor General to routinely and consistently issue orders to operators to restore or replace private water supplies whenever it is determined that they have been impacted by oil and gas activities, as required by state law.¹⁹⁹

Recommendations: Permits and Waivers

As discussed above, the well permitting process in Pennsylvania (as well as other oil and gas states) is piecemeal and limited. Action is needed to:

RESCIND THE PERMIT DECISION GUARANTEE. This policy places undue pressure on DEP staff to review applications and issue permits quickly, risking inadequate review and potentially facilitating the issuance of regulatory waivers after construction and operations are underway. Instated through an Executive Order, the Governor should rescind that order and give DEP the time needed to do its job.

PLAN AND PACE PERMITS. DEP should stop reviewing and approving permits on a one-by-one basis, but rather should consider the number of wells and facilities already in one area when making permitting decisions. In collaboration with other state and county agencies, DEP should develop a long-

term, comprehensive plan for the scope and pace of permits issued. As part of this process, information on air and water quality conditions and potential pollution sources should be considered and, in turn, be factored into decisions on the number and location of wells and facilities allowed—particularly in relation to places where water, air, and health would be most at risk (such as near homes, schools, parks and public lands, agricultural areas, and watersheds).

REVIEW THE MULTIPLE, SEQUENTIAL STAGES OF DEVELOPMENT. Currently, a well permit covers activities that DEP and operators consider to be part of the well site. As a result, some equipment and facilities that can impact health and the environment (e.g., site access roads and waste and chemical storage) are not reviewed. DEP should require operators to submit applications for site projects as a whole, including documentation on all stages and parts of a well site, and review them with regard to their potential impact.²⁰⁰ When operators change their plans and expand sites or facilities (e.g., with new waste management activities or the addition of compressors), DEP should review whether different standards and permitting are required to prevent cumulative impacts (e.g., erosion and sedimentation, emissions, and noise).

STRENGTHEN REGULATORY WAIVER REQUIREMENTS. DEP should not issue waste management waivers unless the applicant can clearly document how the method proposed provides “equivalent or superior” protections, as required by state law. DEP should not allow practices for which the agency does not have established guidelines, chemical composition standards, and monitoring/inspection resources.

END EXPEDITED E&S PERMITS. Erosion and sedimentation control permit applications include maps, equipment specifications, engineering plans, geological assessments, and other technical information. Consideration of environmental factors (e.g., site location, soil stability, and proximity to water resources) is likely more limited under this expedited process, which should not be allowed.

PROTECT SPECIAL PROTECTION WATERSHEDS. DEP should track and map all permitted wells and facilities in special protection watersheds, and deny new permits if additional development risks degradation of water quality in these areas and particular water bodies. DEP should develop benchmarks for permit reviews to ensure analysis of whether a proposed project would degrade water quality in special protection watersheds, as required by Pennsylvania law.²⁰¹ DEP should reject any permit applications that do not include detailed protocols for enhanced water protections.

Recommendations: Oversight and Enforcement

Inadequate oversight of gas operations means that risks and damage to air and water quality frequently go undocumented and steps aren't taken to ensure accountability, deter offenders, and prevent problems from occurring. To turn this situation around, DEP should take actions to:

CLOSE THE ENFORCEMENT GAP. Key steps include binding, effective inspection protocols and schedules and well-to-inspector ratios; significantly higher fines and penalties for violations; and more timely, thorough responses to citizen reports of problems. Operators should only be allowed to “correct on site” violations that are administrative and have no direct impact on the environment and health.

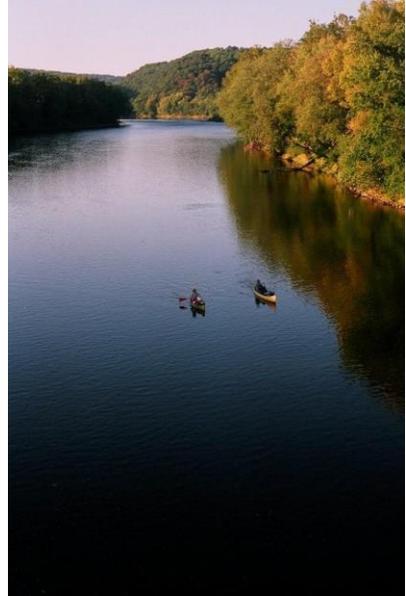


Photo by Paul Carluccio

STOP BAD ACTORS. DEP should be given the authority to use denial of future permits as an enforcement tool. Permit decisions should be based in part on compliance history, including resolved violations, other types of incidents in other locations, and operator capacity to adhere to regulations. These aspects should be integrated into permit guidelines in the Pennsylvania Code²⁰² DEP should shut down operations when spills, blowouts, and other incidents occur that cause environmental damage, and peg violation levels to the costs of DEP investigation/administration, water and air sampling, resident evacuation and relocation, and other aspects. The state legislature should enact measures to allow DEP to increase fines and enforcement actions, especially against repeat offenders and those with the most fines in order to encourage better practices and improve overall compliance.

ENSURE CONSISTENT INSPECTIONS AND VIOLATIONS. DEP should advocate for more resources for oversight and enforcement, rather than justifying a decrease in inspections and enforcement actions at conventional wells in favor of unconventional wells. Differences exist across regional DEP offices in how inspections are conducted, reported, and classified, as well as the level and frequency of violations issued for particular problems and regulatory lapses. DEP should ensure that all inspectors and office staff follow the same protocols for inspections, documentation, and follow up.

INSPECT MORE. DEP should update its 1989 inspection policy and make it (or parts thereof) requirements rather than recommendations. DEP should develop a resource requirement/work flow analysis to ensure that inspections are comprehensive, frequent, timely, and cover all stages of extraction and production—and then work with advocacy groups and legislators to secure sufficient funds for implementation of the new policy.

VALUE COMPLAINTS. DEP should give more weight to complaints filed by citizens when conducting inspections, determining violations and penalties, and making permitting decisions. The activities of operators with patterns of “being a bad neighbor” should be restricted. Complaint response protocols should be determined in part on the basis of whether problems will dissipate over time (e.g., odors and water pollution events); complaints should not be disregarded or left undocumented because an inspector doesn’t see, smell, or hear the reported problem.

Finally, an overarching recommendation to improve industry oversight and enforcement in Pennsylvania also applies to all oil and gas states nationwide:

REVERSE SPECIAL EXEMPTIONS IN KEY PROVISIONS OF SEVEN U.S. ENVIRONMENTAL LAWS.²⁰³ It is clear from the information in this and other reports that states lack the ability to oversee the oil and gas industry on their own.²⁰⁴ These loopholes weaken the ability of federal agencies to protect the environment and public health, yet they allow oil and gas operators to avoid rules that every other industry must follow. In turn, this distorts perspectives on the relative costs and benefits of gas development and slows action to prevent impacts. Closing the loopholes would increase the availability and transparency of information on contaminants and exposures and make it possible to resolve remaining questions about impacts on the environment and public health.



Appendix A: Methods

Earthworks took the following steps to investigate connections between the health and environmental impacts of gas and oil development and the oversight and enforcement of industry:

1. Case selection. Using our previous research in Pennsylvania, we identified particular households where residents living in proximity to gas wells and facilities (i.e., wells, compressor stations, and waste impoundments) reported health symptoms. We also considered whether problems with operations and pollution incidents had occurred (i.e., as documented by the Pennsylvania Department of Environmental Protection, or DEP; reported in the media; and recounted by residents)—and in turn would have been likely to spur inspections, violations, and other aspects of industry oversight and enforcement.

2. Review of information from DEP. We collected information on several aspects of how DEP manages gas and oil operations (both generally and in the selected locations), including:

- The types of drilling permits and regulatory waivers issued to gas and oil operators.
- Operations and incidents that can impact air and water quality.
- Response to accidents, spills, and other events and efforts to mitigate and prevent pollution.

A primary source of information was the DEP's online Environment Facility Application Compliance Tracking System (eFACTS), established in early 2012, which allows users to search for facilities and permits and basic information on violations that have occurred.²⁰⁵ However, because eFACTS does not provide key information related to enforcement (e.g., event details, how DEP handled violations, or penalty amounts), we also gathered data from DEP Office of Oil and Gas Management databases, including:

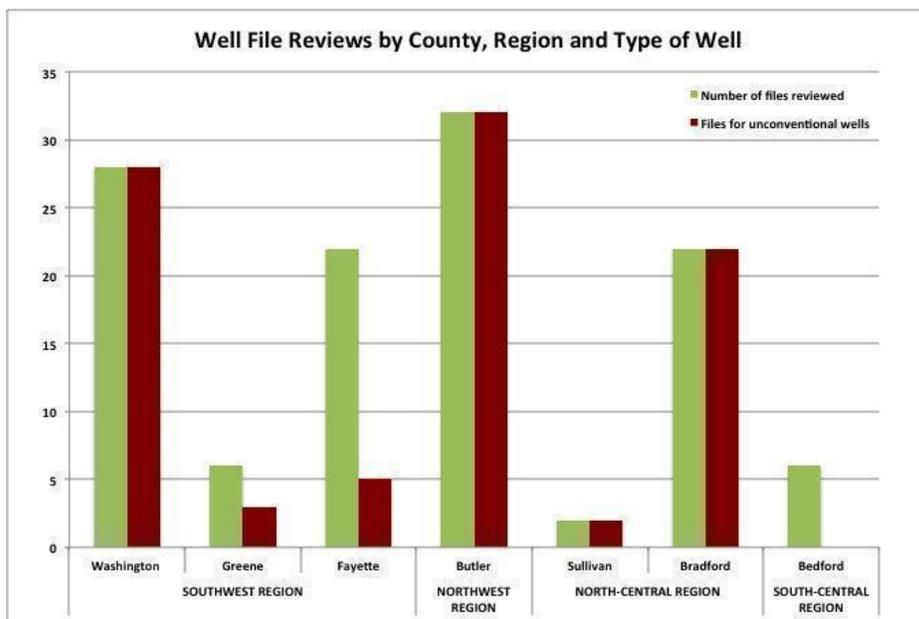
- Oil and Gas Compliance Reports, which provide information on inspections, violations, and enforcement actions.²⁰⁶
- Production Reports, which provide information on if and when a well started producing and the volume of gas produced.²⁰⁷
- DEP's 2011 and 2012 Natural Gas Drilling Emissions Inventories, which identify volumes of several air contaminants being released from wells and compressor stations.²⁰⁸

3. Well file reviews. Detailed inspection reports and copies of permits and supporting data filed by operators are not available online. DEP does not maintain a public database of spills, blowouts, and other problems, nor a system to easily track when and where potentially polluting activities have occurred. (The Oil & Gas Compliance database fills this function to a degree—but only for those events that result in the issuance of violations.)

Because so much information related to specific facilities is only available in the paper records maintained at the DEP's regional offices, we conducted in-person file reviews on 118 natural gas wells, 14 compressor stations, two production facilities, a centralized impoundment, and a gas storage project. (See Appendix B for a list of wells, facilities, and locations.) We also submitted requests under

Pennsylvania’s Right-to-Know Law (RTKL) for other key information, such as resident complaint records and inspection reports that were missing from the paper files.²⁰⁹

The chart at right shows a breakdown of well file reviews that we conducted by DEP region and county. Most of the files that we reviewed in Washington, Butler, Sullivan, and Bradford counties were for unconventional wells. In Greene, Fayette, and Bedford counties, the majority of wells most relevant to the cases selected were conventional wells.



4. Environmental testing. Water and air testing can yield data on the presence and concentrations of pollutants that may be linked to health impacts and have resulted from the operations and incidents under investigation. In collaboration with ShaleTest, in 2011-2012, Earthworks conducted 34 Summa canister tests, with single tests carried out at multiple locations. In the summer and early fall of 2013, we conducted 52 tests at fewer locations, including all of the households included in the case studies. This approach made it more likely that we would detect pollutants at different phases and times—a key concern given the episodic nature of gas and oil field emissions. The tests were analyzed at a certified laboratory using the TO-15 method, which is used and approved by the US EPA to test for VOCs (such as benzene, toluene, ethylbenzene, and xylene, or the BTEX chemicals), as well as for methane.

We also conducted water quality testing at some of the homes of residents reporting ongoing problems or health symptoms consistent with water contamination. In all, we conducted 12 water tests in 2011-2012 and 8 in 2013-2014. The water tests were samples drawn directly from household sinks or water wells by technicians employed by certified laboratories and covered the standard Tier 1, Tier 2, and Tier 3 (including VOCs/BTEX) and methane. As with all environmental testing, these samples represent a “moment in time,” meaning that conditions may have been different at other points before or during gas development. Our assessment of water quality is therefore based on patterns that we could identify, the presence of contaminants associated with oil and gas activities, and emerging science on water quality impacts.



Air testing with a Summa canister. Photo by Nadia Steinzor/Earthworks

5. Secondary research. Additional information that guided our analysis included scientific studies on air and water quality, health impacts, and related topics; oil and gas regulations; research by organizations and institutions; and media reports on both general trends in gas operations and specific incidents at facilities.

6. Development of household case studies. We developed profiles of residents living in close proximity to gas operations across Pennsylvania that have experienced both health impacts and enforcement problems. We examined information that we anticipated would shine light on the links between these two aspects, including:

- Household members' situation and concerns.
- Number and location of wells and other facilities.
- Inspections and violations at nearby sites.
- Complaints filed with DEP about operations.
- Air emissions data from DEP on nearby facilities.
- Results of air and water testing conducted by Earthworks in 2011-2013.

In order to illustrate the extent of development near the homes of the people involved in our case studies, we mapped active wells and facilities within a two-mile radius. We reduced that radius to one mile for the analysis of air emissions and changes in water quality, which is more in keeping with emerging science on shale gas pollution and in order to make the data sets more manageable. The location of wells and other facilities is based on DEP data.²¹⁰ Using a mapping program (Batchgeo), we generated information on the distance from each well or facility to the household.

Appendix B: Gas Wells and Facilities Reviewed

File reviews were conducted on the following gas wells and facilities			
DEP Region: Southwest			
Washington County	Permit Number / Facility ID	Operator	Township
Best Unit 1H	125-23277	Range Resources Appalachia	Hopewell
Best Unit 2H	125-23283	Range Resources Appalachia	Hopewell
Best Unit 3H	125-23282	Range Resources Appalachia	Hopewell
Best Unit 4H	125-23284	Range Resources Appalachia	Hopewell
Best Unit 5H	125-23370	Range Resources Appalachia	Hopewell
Christman Unit 2	125-22264	Range Resources Appalachia	Cross Creek
Cowden Unit 1H	125-23023	Range Resources Appalachia	Mt. Pleasant
Cowden Unit 3H	125-23693	Range Resources Appalachia	Mt. Pleasant
Cowden Unit 5H	125-23781	Range Resources Appalachia	Mt. Pleasant
Cowden 10H	125-23392	Atlas Resources	Hopewell
Cowden 14	125-23385	Atlas Resources	Hopewell
Cowden 17H	125-23386	Atlas Resources	Hopewell
Cowden 40	125-23161	Atlas Resources	Cross Creek
Cowden 41	125-23537	Atlas Resources	Cross Creek
Cowden 46	125-22957	Atlas Resources	Cross Creek
Cowden 47H	125-23271	Atlas Resources	Cross Creek
Cowden 48	125-23270	Atlas Resources	Cross Creek
Cowden 48H	125-23429	Atlas Resources	Cross Creek
Cowden 50	125-23070	Atlas Resources	Cross Creek
Cowden 51	125-22960	Atlas Resources	Cross Creek



Cowden 53	125-22961	Atlas Resources	Cross Creek
Cowden 76	125-23515	Atlas Resources	Cross Creek
Drugmand Unit 3H	125-23853	Range Resources Appalachia	Mt. Pleasant
Drugmand Unit 8H	125-23894	Range Resources Appalachia	Mt. Pleasant
Lowry William Unit 3H	125-23169	Range Resources Appalachia	Hopewell
Ohio Valley LBC Unit 8H	125-24145	Range Resources Appalachia	Mt. Pleasant
Stewart Nancy Unit 6	125-22688	Range Resources Appalachia	Mt. Pleasant
Stewart Nancy Unit 8	125-22669	Range Resources Appalachia	Mt. Pleasant
Lowry Compressor	716399	MarkWest Liberty Midstream & Resources	Hopewell
Nancy Stewart Compressor	708698	Laurel Mountain Midstream	Mt. Pleasant
Stewart Compressor	711407	Laurel Mountain Midstream	Mt. Pleasant
Carter Impoundment	729332 (Site ID)	Range Resources Appalachia	Mt. Pleasant
WASHINGTON COUNTY TOTAL: 32			
Greene County	Permit Number	Operator	Township
Henderson 2	059-23599	Eastern American Energy Corporation	Cumberland
Meadows 1MH	059-25574	Energy Corporation of America	Cumberland
Phillippi 9	059-23720	Eastern American Energy Corporation	Cumberland
Martinez 2	059-23727	Eastern American Energy Corporation	Cumberland
V Virgili 1	059-24674	Eastern American Energy Corporation	Cumberland
Henderson/King 2MH	059-25125	Eastern American Energy Corporation	Cumberland
Ceylon Compressor	698705	Laurel Mountain Midstream	Cumberland
Cumberland/Henderson	670262	Energy Corporation of America	Cumberland
Davis Compressor	708028	Laurel Mountain Midstream	Jefferson
Gribble Pump House	737810	Energy Corporation of America	Cumberland
GREENE COUNTY TOTAL: 10			

Fayette County	Permit Number	Operator	Township
Baker 3	051-23616	Atlas Resources	Springhill
Baker 4	051-23617	Atlas Resources	Springhill
Baker 5	051-23618	Atlas Resources	Springhill
Chico Unit 1H	051-24490	Chevron Appalachia LLC	Springhill
Chico Unit 2H	051-24466	Chevron Appalachia LLC	Springhill
Chico Unit 3H	051-24467	Chevron Appalachia LLC	Springhill
Grimm 14	051-23515	Atlas Resources	Springhill
Grimm 15	051-23516	Atlas Resources	Springhill
Grimm 16	051-23517	Atlas Resources	Springhill
Grimm 17	051-23518	Atlas Resources	Springhill
Grimm 18	051-23519	Atlas Resources	Springhill
Wolf 20	051-22804	Atlas Resources	Springhill
Wolf 21	051-22916	Atlas Resources	Springhill
Wolf 22	051-22917	Atlas Resources	Springhill
Wolfe 24	051-23489	Atlas Resources	Springhill
Wolfe 25	051-23490	Atlas Resources	Springhill
Wolf 27	051-24247	Atlas Resources	Springhill
Zinn Unit 2	051-24052	Atlas Resources	Springhill
Zinn 3	051-22885	Atlas Resources	Springhill
Zinn 4	051-22886	Atlas Resources	Springhill
Zinn 5	051-22887	Atlas Resources	Springhill
Zinn 6	051-23495	Atlas Resources	Springhill
Springhill Compresspr	719219	Laurel Mountain Midstream	Springhill
West Summit Compressor	734851	Burnett Oil	Springhill
FAYETTE COUNTY TOTAL: 24			



DEP Region: Northwest			
Butler County	Permit Number	Operator	Township
Burgh Unit 2HD	019-21958	RE Gas Development	Lancaster
Carson Unit 1H	019-21850	Rex Energy Operating Corporation	Connoquenessing
Carson 2H	019-21851	Rex Energy Operating Corporation	Connoquenessing
Carson 3H	019-21852	Rex Energy Operating Corporation	Connoquenessing
Gilliland Unit 4H	019-21732	Rex Energy Operating Corporation	Connoquenessing
Gilliland Unit 11HB	019-21792	Rex Energy Operating Corporation	Connoquenessing
Graham Unit 3H	019-21808	Rex Energy Operating Corporation	Lancaster
Graham Unit 2H	019-21807	Rex Energy Operating Corporation	Lancaster
Graham Unit 1H	019-21806	Rex Energy Operating Corporation	Lancaster
Grosick 1H	019-21708	Rex Energy Operating Corporation	Lancaster
Grosick 2H	019-21709	Rex Energy Operating Corporation	Lancaster
Grosick 3H	019-21710	Rex Energy Operating Corporation	Lancaster
Grosick 4H	019-21711	Rex Energy Operating Corporation	Lancaster
Grosick 5H	019-21712	Rex Energy Operating Corporation	Lancaster
Grosick 6H	019-21713	Rex Energy Operating Corporation	Lancaster
Grosick 7H	019-21714	Rex Energy Operating Corporation	Lancaster
Lonchena P 1	019-21568	Rex Energy Operating Corporation	Forward
Marburger Farm Dairy B Unit 1H	019-21936	XTO Energy	Forward
Marburger Farm Dairy B Unit 2H	019-21937	XTO Energy	Forward
Marburger Farm Dairy Inc Unit	019-21866	XTO Energy	Forward
Marburger Farm Dairy Inc Unit	019-21865	XTO Energy	Forward
Magill Unit 1H	019-21661	Rex Energy Operating Corporation	Forward
McElhinny Unit 1H	019-21781	Rex Energy Operating Corporation	Forward
Merten Unit 1H	019-21876	XTO Energy	Forward
Merten Unit 2H	019-21877	XTO Energy	Forward
Shannon 1H	019-21663	Rex Energy Operating Corporation	Connoquenessing



Shannon 2H	019-21664	Rex Energy Operating Corporation	Connoquenessing
Voll Unit 1H	019-21674	Rex Energy Operating Corporation	Connoquenessing
Voll Unit 2H	019-21675	Rex Energy Operating Corporation	Connoquenessing
Voll Unit 3H	019-21747	Rex Energy Operating Corporation	Connoquenessing
Warner Unit 1H	019-21987	R.E. Gas Development, LLC	Lancaster
Warner Unit 2H	019-22005	R.E. Gas Development, LLC	Lancaster
Voll Compressor	735873	Rex Energy Operating Corporation	Connonquenessing
Sarsen Gas Plant	726031	Keystone Midstream Services	Forward
BUTLER COUNTY TOTAL: 34			
DEP Region: Northeast			
Sullivan County	Permit Number	Operator	Township
Lambert Farms 2H OG Well	113-20016	Chesapeake Appalachia	Forks
Lambert Farms 5H OG Well	113-20017	Chesapeake Appalachia	Forks
SULLIVAN COUNTY TOTAL: 2			
Bradford County	Permit Number	Operator	Township
Morse 1H OG Well	015-20940	Chesapeake Appalachia	Leroy
Morse 3H OG Well	015-20929	Chesapeake Appalachia	Leroy
Morse 5H OG Well	015-20932	Chesapeake Appalachia	Leroy
Morse Bra 4H OG Well	015-22565	Chesapeake Appalachia	Leroy
Postell Unit A 1H OG Well	015-22204	Chief Oil & Gas LLC	Franklin & Leroy
Postell Unit A 2H OG Well	015-22205	Chief Oil & Gas LLC	Franklin & Leroy
Rexford 2H	015-20871	Chesapeake Appalachia	Orwell
Rexford 4H	015-20869	Chesapeake Appalachia	Orwell
Rexford 5H	015-20865	Chesapeake Appalachia	Orwell
Rexford 6H	015-20864	Chesapeake Appalachia	Orwell
Rexford N Bra 3H	015-22413	Chesapeake Appalachia	Orwell

Van Noy 627109 1 OG Well	015-20096	Chesapeake Appalachia	Granville
Vannoy 627108 2 OG Well	015-20113	Chesapeake Appalachia	Granville
Vannoy 627109 3 OG Well	015-20114	Chesapeake Appalachia	Granville
Vargson 1H OG Well	015-20097	Chesapeake Appalachia	Granville
Yoder Unit 1H OG Well	015-22076	Chief Oil & Gas LLC	Leroy
Young 05 080 01 R	015-21514	Talisman Energy	Warren
Young 05 080 02 R	015-21515	Talisman Energy	Warren
Young 05 080 03 R	015-21516	Talisman Energy	Warren
Young 05 080 04 R	015-21517	Talisman Energy	Warren
Young 05 080 05 R	015-21518	Talisman Energy	Warren
Young 05 080 06 R	015-21519	Talisman Energy	Warren
Bradford West Compressor	646940	Chief Gathering	Ward
Vargson Compressor	722676	Chesapeake Appalachia	Granville
VanNoy Compressor	721786	Chesapeake Appalachia	Granville

BRADFORD COUNTY TOTAL: 25

DEP Region: Northcentral

Bedford County	Permit Number	Operator	Township
Beegle 1558 OG well	009-20067	Steckman Ridge, LP	Monroe
Clark 1663 OG well	009-20069	Steckman Ridge, LP	Monroe
Quarles 1709 OG well	009-20072	Steckman Ridge, LP	Monroe
SR 6 well	009-20074	Steckman Ridge, LP	Monroe
SR 7 well	009-20083	Steckman Ridge, LP	Monroe
SR 9 well	009-20084	Steckman Ridge, LP	Monroe
Quarles 1709 Compressor Station	696566	Steckman Ridge, LP	Monroe
Steckman Ridge gas storage	N/A	Steckman Ridge, LP	Monroe

BEDFORD COUNTY TOTAL: 8

TOTAL WELLS AND FACILITIES REVIEWED: 135



Endnotes

- ¹ US Energy Information Administration. "Today in Energy," December 17, 2013. www.eia.gov/todayinenergy/detail.cfm?id=14231.
- ² PADEP, "Oil and Gas Reports," all types, unconventional oil and gas wells. www.portal.state.pa.us/portal/server.pt/community/oil_and_gas_reports/20297#InteractiveReports.
- ³ Conservation Voters of Pennsylvania. "Groups, legislators call for end to years of DEP budget cuts." Press release, March 24, 2011. www.conservationpa.org/groups-legislators-call-for-end-to-years-of-dep-budget-cuts/.
- ⁴ "Growing Leaner: Shrinking Commitment to the Environment Over the Last 10 Years." PA Environment Digest, January 28, 2013. www.paenvironmentdigest.com/newsletter/default.asp?NewsletterArticleID=24446.
- ⁵ Office of the Governor, Executive Order 2012-11, "Permit Decision Guarantee for the Department of Environmental Protection." Pennsylvania Office of Administration, records and directives.
- ⁶ PADEP. Permit Review Process and Permit Decision Guarantee Quarterly Report. November 1, 2013.
- ⁷ PADEP "Permit Decision Guarantee Update," website feature frame #3. www.depweb.state.pa.us/portal/server.pt/community/dep_home/5968 (accessed July 26, 2014).
- ⁸ Earthworks 2012. *Breaking All the Rules: The Crisis in Oil and Gas Regulatory Enforcement*. See national overview and state-specific reports at <http://enforcement.earthworksaction.org>.
- ⁹ Earthworks 2012. *Gas Patch Roulette: How shale gas development risks public health in Pennsylvania*. See report and supporting data at <http://health.earthworksaction.org>.
- ¹⁰ Former Pennsylvania Secretary of Health Eli Avila recently commented on the state's failure to address public health concerns, in part because of a lack of study and investigation. See Marie Cusick, "Former Health Secretary: Pa. failed to address fracking concerns," *Statelmpact*, July 13, 2014.
- ¹¹ See PADEP, *Marcellus Shale Short-Term Ambient Air Sampling Report* for the Northeast region, 2011 (www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_NE_01-12-11.pdf); Northcentral region, 2011 (www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_NC_05-06-11.pdf); and Southwest region, 2010 (www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_SW_11-01-10.pdf). In September 2012, DEP launched a one-year air monitoring study in Washington County to "determine potential air quality impacts associated with the processing and transmission of unconventional natural gas." At the time of writing, the final report (initially due in October 2013) had not yet been released. See PADEP, Bureau of Air Quality, "Monitoring Toxic Pollutants," www.dep.state.pa.us/dep/deputate/airwaste/aq/toxics/toxics.htm.
- ¹² In 2010-2011, DEP conducted what it referred to as "limited air sampling initiatives" whose "findings only represent conditions at the time of the sampling and do not represent a comprehensive study of emissions." (e.g., see pp.ii-iii of the SW report). The reports include: Southwestern Pennsylvania Marcellus Short-Term Air Sampling Report. November 1, 2010. http://files.dep.state.pa.us/RegionalResources/SWRO/SWROPortalFiles/Marcellus_SW_11-01-10.pdf; Northcentral Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report. May 6, 2011. http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_NC_05-06-11.pdf; and Northeastern Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report. Jan. 12, 2011. http://files.dep.state.pa.us/RegionalResources/NERO/NEROPortalFiles/Marcellus_NE_01-12-11.pdf
- ¹³ Katie Colaneri, "DEP says gas drilling air pollution a small fraction of Pa. emissions." *Statelmpact*, April 4, 2014.
- ¹⁴ See PADEP, "Air Emissions Data from Natural Gas Operations." www.dep.state.pa.us/dep/deputate/airwaste/aq/emission/marcellus_inventory.html. Operators report emissions of carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM2.5 and PM10), sulfur oxide (SOx), volatile organic compounds (VOC), benzene, ethylbenzene, formaldehyde, n-Hexane, toluene, xylenes, and trimethylpentane. In 2012, operators also started reporting quantities of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).
- ¹⁵ According to the US Environmental Protection Agency, conventional gas wells emit VOCs, methane and hazardous air pollutants during well completion/hydraulic fracturing. See "Regulatory Impact Analysis: Proposed New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry." EPA, 2011 (www.epa.gov/ttn/ecas/regdata/RIAs/oilnaturalgasfinalria.pdf).
- ¹⁶ *Ibid.*
- ¹⁷ Bobby Magill, Climate Central. "Thousands of fracking wells in Pennsylvania 'may be leaking methane.'" *The Guardian Environment Network*, June 20, 2014.

¹⁸ US EPA Office of Inspector General. *EPA Needs to Improve Air Emissions Data for the Oil and Natural Gas Production Sector*. Report No. 13-P-0161, February 2013.

¹⁹ For some emissions data used in the case studies, we were able to narrow the timeframe for emissions; for example, volumes of emissions are reported for drill rigs and well completion, and using other sources of DEP data we were able to determine when these activities occurred.

²⁰ PADEP . Spreadsheet Reporting Guide for Natural/Coal Bed Methane Gas Air Emissions Reporting System: www.dep.state.pa.us/dep/deputate/airwaste/aq/emission/marcellus/2013_Mid-Stream_Air_Emissions_Guide.pdf. This guidance indicates that operators are only required to provide a start date and end date, and these dates are preloaded into the forms that the operators download (January 1 and December 31 in the inventory year).

²¹ Aviva Litovitz, Aimee Curtright, Shmuel Abramzon, et al., “Estimation of regional air-quality damages from Marcellus Shale natural gas extraction in Pennsylvania.” *Environmental Research Letters*, January 31, 2013.

²² David Brown, Beth Weinberger, Celia Lewis, and Heather Bonaparte. “Understanding exposure from natural gas drilling puts current air standards to the test.” *Reviews on Environmental Health*, March 2014.

²³ Ibid.

²⁴ US Environmental Protection Agency website: “National Ambient Air Quality Standards.” <http://www.epa.gov/air/criteria.html> Pennsylvania adopted the EPA standards, and also set air quality limits for beryllium, fluorides and hydrogen sulfide; see Pennsylvania DEP. Ambient Air Quality Standards. www.dep.state.pa.us/dep/deputate/airwaste/aq/standards/standards.htm.

²⁵ US Environmental Protection Agency website: “About Air Toxics.” www.epa.gov/air/toxicair/newtoxics.html

²⁶ David Brown, Beth Weinberger, Celia Lewis, and Heather Bonaparte. “Understanding exposure from natural gas drilling puts current air standards to the test.” *Reviews on Environmental Health*, March 2014. This study also indicates that interactions among chemicals may produce more intense effects than would be implied by the hazard posed by each one. Although gas and oil field residents may be exposed to multiple chemicals at the same time, safety standards are based on exposure to single substances, a gap discussed in Earthworks’ 2012 report *Gas Patch Roulette* (<http://health.earthworksaction.org>).

²⁷ PADEP stated that, “Emissions of volatile organic compounds [VOC] and hazardous air pollutants [HAP] must also be controlled beyond levels required by the federal rules. DEP’s guidance also requires that emissions of nitrogen oxides be less than 100 pounds per hour, half a ton per day, and 6.6 tons per year; the federal rules do not address or limit such emissions.” See DEP press release, “DEP Finalizes Air Quality Permit Criteria for Unconventional Gas Well Sites.” August 8, 2013. www.portal.state.pa.us/portal/server.pt/community/newsroom/14287?id=20104&typeid=1.

²⁸ PADEP, 2013. “Plan Approval and Operating Permit Exemptions.” See provision 38.b at www.elibrary.dep.state.pa.us/dsweb/Get/Document-96215/275-2101-003.pdf.

²⁹ Earthworks submitted a query to PADEP to obtain data for every source of emission (i.e., drill rig, completion, tank, fugitive emissions) on a well-site basis. Data were provided by M. Rudawski at PADEP. From this data, we found the following NOx emissions during the drilling and completion stages: Cree 6MH (Greene County): 64.8 tons in 2011; Aikens 5A (Westmoreland County): 38.9 tons in 2012; Meadows 1MH (Greene County): 37.6 tons in 2011; Midler/Froebe A Unit 1H (Washington County): 36 tons in 2012; COP Tract 293 Pad F 2507 (Lycoming County): 34.7 tons in 2012; Consol Mor10ash (Greene County): 31.3 in 2012; Britner 1MH-S (Greene County): 23.3 tons in 2012; and Midler/Froebe B Unit 5H (Washington County): 32 tons in 2012; and many others.

³⁰ For example, in 2012 single wells emitted VOCs during completion as high as: 18 tons (Drake W 2053 5HM well); 15.4 tons (Mono 4H); 12.7 tons (Mayberry W 2046 1HS) and 10.2 tons (Mojo 1H). Drill rigs also emitted high volumes of VOCs: 16.8 tons (Amigos 6H); 14.2 (Amigos 3H); 13.4 (X-Man G5); and 11.1 (Thunder Unit One 6H). Source: PADEP’s 2012 Natural Gas Inventory data by Emissions Source Type, obtained from M. Rudawski at PADEP.

³¹ US Environmental Protection Agency. “Health effects of ozone in the general population.” www.epa.gov/apti/ozonehealth/population.html.

³² In 2011, Chevron Appalachia LLC reported that VOC emissions from the Cowden 47H site in Washington County to be: 9.6 tons from a tank-vessel; 1.3 tons from fugitive emissions; and 0.0002 tons from well completion. Source: DEP’s 2011 Natural Gas Inventory data for VOCs by Emissions Source Type, obtained from M. Rudawski at PADEP.

³³ According to the PADEP brochure “Understanding Air Permits in PA,” a state-only permit is required if a facility has the “potential to emit” less than 50 tons of VOCs/year, but the permitting threshold isn’t reached unless more than 8 tons per year are “actually” emitted. See www.dep.state.pa.us/dep/deputate/pollprev/iso14001/Tools/Facility%20Environmental%20Issues%20Toolbox/AE%20Air%20Emissions/AE3%20Understanding%20Air%20Permits%20in%20PA.pdf.

³⁴ PADEP press release. “DEP Finalizes Air Quality Permit Criteria for Unconventional Gas Well Sites.” August 8, 2013. www.portal.state.pa.us/portal/server.pt/community/newsroom/14287?id=20104&typeid=1



³⁵ See PADEP Bureau of Air Quality “Guidance for Performing Single Stationary Source Determinations for Oil and Gas Industries,” October 2012. This relates to the emissions “aggregation” loophole for the oil and gas industry in the US Clean Air Act; see Earthworks 2011, “Loopholes for Polluters,” www.earthworksaction.org/library/detail/loopholes_for_polluters.

³⁶ The five wells are: Phillippi 1MH, V. Virgili 1, Meadows 1MH and Pechin Leasing 1MH, all operated by Energy Corp of America; and Rush 18, operated by Atlas Resources. The compressor station is the Henderson/Cumberland Compressor, operated in 2011 by Energy Corp of America. Source: PADEP’s 2011 Unconventional Natural Gas Emissions Inventory. www.dep.state.pa.us/dep/deputate/airwaste/aq/emission/marcellus/Unconventional_Natural_Gas_Emissions_Well-Station-All.xlsx.

³⁷ The Cree 6MH well (1.09 miles from the Judy home) and Phillippi 1MH (0.53 miles) emitted 8.2 and 6.8 tons of PM, respectively, in 2011. The Houston Gas Plant and Cumberland Compressor station were the next highest emitters of PM10, both emitting approximately 6 tons. Source: PADEP’s 2011 Unconventional Natural Gas Emissions Inventory.

³⁸ David Brown, Beth Weinberger, Celia Lewis, and Heather Bonaparte. “Understanding exposure from natural gas drilling puts current air standards to the test.” *Reviews on Environmental Health*, March 2014.

³⁸ Ibid.

³⁹ PADEP’s Unconventional Natural Gas Emissions Inventory by Source Type, 2011 and 2012. www.dep.state.pa.us/dep/deputate/airwaste/aq/emission/marcellus_inventory.html. The data show that wells can and do emit gases from drill rigs, completion activities, and once the site is in operation, from tanks, pumps, leaks, and other sources.

⁴⁰ Dana R. Caulton, Paul B. Shepson, Renee L. Santoro, et al. “Toward a better understanding and quantification of methane emissions from shale gas development.” *Proceedings of the National Academy of Sciences of the United States of America*, March 2014.

⁴¹ The new rules apply to wells drilled after August 23, 2011. US Environmental Protection Agency fact sheet. “Summary of Requirements for Processes and Equipment at Natural Gas Well Sites.” 2012. www.epa.gov/airquality/oilandgas/pdfs/20120417summarywellsites.pdf.

⁴² Liquids unloading is a technique to remove water and other liquids from the wellbore to improve the flow of natural gas in conventional wells and unconventional wells. After liquids are cleared from the well, gas is vented to the atmosphere for periods up to several hours. The process is sometimes referred to as a well blowdown. See Shires, T. and Lev-On, M. Sept. 2012. Characterizing Pivotal Sources of Methane Emissions from Natural Gas Production. Summary and Analysis of API and ANGA Survey Responses. Report prepared for the American Petroleum Institute/American Natural Gas Alliance.

⁴³ Texas recognizes the potential impact of MSS emissions by requiring them to be authorized, according to an agreement with the US EPA; see <https://www.tceq.texas.gov/permitting/air/mss.html>. Emissions of VOCs and hazardous air pollutants from these processes were outlined in a DEP air permit application from Laurel Mountain Midstream for the Springhill Compressor station in Fayette County (permit #GP5 26-00587B).

⁴⁴ Citizens for Pennsylvania’s Future. 2012. “Pennsylvania’s New Oil and Gas Law (Act 13): A Plain Language Guide and Analysis.” http://pennfuture.org/UserFiles/File/MineDrill/Marcellus/CitizenGuide_Act13_2012.pdf.

⁴⁵ Eastern Research Group, Inc. and Sage Environmental Consulting, L.P., 2011. *City of Fort Worth Natural Gas Air Quality Study, Final Report*. http://fortworthtexas.gov/uploadedFiles/Gas_Wells/AirQualityStudy_final.pdf.

⁴⁶ AMI Environmental for the Clean Air Council, 2013. *AERMOD Modeling of NO2 Impacts of the Barto Compressor Station*. www.pennfuture.org/UserFiles/File/MineDrill/Marcellus/CAC_EmissionsNO2_CompressorBarto_20130124.pdf.

⁴⁷ The authors also noted that results are uncertain since “the actual distance at which residents may experience greater exposures from air emissions may be less than or greater than a 1/2 mile, depending on dispersion and local topography and meteorology.” Lisa M. McKenzie, Roxana Z. Witter, Lee S. Newman and John L. Adgate, Human health risk assessment of air emissions from development of unconventional natural gas resources. *Science of the Total Environment* March 21, 2012.

⁴⁸ Earthworks 2012. *Gas Patch Roulette: How shale gas development risks public health in Pennsylvania*. <http://health.earthworksaction.org>.

⁴⁹ Although the Carrs and their neighbors have filed numerous complaints with PADEP about odors, there is no way to determine if operators reported problems to DEP or if certain events at the site led to spikes in emissions. Operators of compressor stations aren’t required to monitor concentrations of chemicals released during blowdowns, making it difficult to fully assess emissions or related health effects.

⁵⁰ PADEP’s Facility Emissions search (by county). www.ahs.dep.pa.gov/eFACTSWeb/criteria_facilityemissions.aspx.

There were other natural gas facilities in Fayette County that emitted more of some contaminants (e.g., The Prah and Dunbar compressor stations emitted more CO and formaldehyde; Adams and Prah compressors emitted more NOx; Howser compressor emitted more benzene; Dunbar compressor emitted more VOCs; and numerous natural gas facilities emitted more SOx); see: DEP’s 2012 Air Emissions Inventory Data for the Unconventional Natural Industry. www.dep.state.pa.us/dep/deputate/airwaste/aq/emission/marcellus_inventory.html.

⁵¹ US Environmental Protection Agency Air Toxics web site: “Pollutants and Sources.” www.epa.gov/ttn/atw/pollsour.html.

⁵² National Cancer Institute. “Formaldehyde and Cancer Risk.” www.cancer.gov/cancertopics/factsheet/Risk/formaldehyde.



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- ⁵³ World Health Organization. 2000.WHO Air Quality Guidelines for Europe. 2nd Ed. Chapter 5.8. Formaldehyde. www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/pre2009/who-air-quality-guidelines-for-europe,-2nd-edition,-2000-cd-rom-version.
- ⁵⁴ Parihar, J. Air Quality Engineering Trainee, to Air Quality Permit File GP6-26-00587B. Jan. 9, 2012. "Review of General Permit Application Laurel Mountain Midstream Operating, LLC Springhill Compressor Station, Springhill Township, Fayette County. Auth# 894174, APS#7 59362, PF#7 19219."
- ⁵⁵ Ibid.
- ⁵⁶ PADEP, "Private Water Wells" information pages. www.depweb.state.pa.us/portal/server.pt/community/private_water_wells.
- ⁵⁷ Pennsylvania law is unique in establishing a "zone of presumption," by which operators of unconventional (i.e., shale) wells are responsible for pollution of a water supply if it is up to 2,500 feet away and the pollution occurred within 12 months of completion, drilling, stimulation, or alteration of the well. Although operators can rebut the presumption under certain conditions, they often conduct pre-drill tests, which they are required to share with homeowners. See DEP's "Act 13 Frequently Asked Questions," www.portal.state.pa.us/portal/server.pt/community/act_13/20789/act_13_faq/1127392. In addition, DEP has pre-drill recommendations, but not requirements, for what operators should include in this testing. See PADEP fact sheet. "Recommended Basic Oil & Gas Pre-Drill Parameters." November 2012. www.elibrary.dep.state.pa.us/dsweb/Get/Document-91717/8000-FS-DEP4300.pdf.
- ⁵⁸ See lists of Maximum Contaminant Levels (MCLs) for drinking water regulated by the US Environmental Protection Agency at <http://water.epa.gov/drink/contaminants/> and DEP at http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/lib/watersupply/pa-mcls_06.pdf.
- ⁵⁹ PADEP, "Recommended Basic Oil & Gas Pre-Drill Parameters" fact sheet. Revised 2012. www.elibrary.dep.state.pa.us/dsweb/Get/Document-91717/8000-FS-DEP4300.pdf.
- ⁶⁰ In 2012, the Marcellus Shale Coalition issued guidance for its member operators on pre-drill water testing, but was careful to clarify that the list of parameters included in related materials, (which mirrored DEP's list for homeowners) is "offered as a reference aid...It is not intended to establish or impose binding requirements." See http://marcelluscoalition.org/wp-content/uploads/2013/03/RP_Pre_Drill_Water.pdf.
- ⁶¹ E. Hansen, D. Mulvaney, and M. Betcher. Water Resource Reporting and Water Footprint from Marcellus Shale Development in West Virginia and Pennsylvania. Downstream Strategies and San Jose University, 2013.
- ⁶² Consent Decree, PA Department of Environmental Protection v. Waste Treatment Corporation. Filed in the Commonwealth Court of Pennsylvania, November 25, 2013.
- ⁶³ N.R. Warner, C.A. Christie, R.B. Jackson, and A. Vengosh "Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania." *Environmental Science & Technology*, 2013.
- ⁶⁴ Robert B. Jackson, Avner Vengosh, Thomas H. Darrah, et al. *Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction*. Proceedings of the National Academy of Sciences of the United States of America, June 2013.
- ⁶⁵ Anthony R. Ingraffea. "Fluid Migration Mechanisms Due to Faulty Well Design and/or Construction: An Overview and Recent Experiences in the Pennsylvania Marcellus Play." Physicians, Scientists, and Engineers for Healthy Energy, 2012.
- ⁶⁶ Anthony R. Ingraffea, Martin T. Wells, Renee L. Santoro, and Seth B.C. Shonkoff. "Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012." *Proceedings of the National Academy of Sciences of the United States*. June 30, 2014.
- ⁶⁷ Laura Legere. "Sunday Times Review of DEP drilling records reveals water damage, murky testing methods." Scranton Times-Tribune, May 19, 2013. The Times-Tribune published the data on both alleged and confirmed contamination cases and the FracTracker Alliance mapped it; we included this location information in the maps generated for this report. See <http://thetimes-tribune.com/news/gas-drilling-complaints-map-1.1490926>
- ⁶⁸ Laura Legere, "DEP: Oil and gas operations damaged water supplies 209 times since the end of '07." Pittsburgh Post-Gazette, Power Source feature, July 22, 2014.
- ⁶⁹ The Times Tribune site contains information on three complaints in Cumberland Township (Greene County): Letters [398](#), letter [399](#) and letter [400](#).
- ⁷⁰ According to Boyer et al. (2012), the approximate median concentrations of iron, manganese and sodium in PA groundwater are 0.20 mg/L, 0.01 mg/L and 6.87 mg/L, respectively. Concentrations in Pat Klotz's water in 2013 were: iron (2.9 mg/L), manganese (2.02 mg/L) and sodium (41 mg/L). See Boyer, E., Swistock, B., Clark, J., Madden, M. and Rizzo, D. *The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies*. Center for Rural Pennsylvania. 2012.
- ⁷¹ Scott Detrow. "Kraner Responds to Claims State Withheld Water Contamination Data." StateImpact, November 6, 2012.
- ⁷² Earthworks et al. press release, February 4, 2013. "PADEP Keeps Homeowners in the Dark on Water Testing Policy, Abruptly Cancels Meeting with Environmental Groups." www.earthworksaction.org/media/detail/pa_dep_keeps_homeowners_in_the_dark_on_water_testing_policy_abruptly_cancel#.

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- ⁷³ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, "2013 Oil and Gas Annual Report."
- ⁷⁴ Laura Legere. "Sunday Times Review of DEP drilling records reveals water damage, murky testing methods." *Scranton Times Tribune*, May 19, 2013.
- ⁷⁵ Dusty Horwitt, Environmental Working Group. "Is Natural Gas Toxic in Water?" *Enviroblog*, March 19, 2013. www.ewg.org/enviroblog/2013/03/natural-gas-toxic-water.
- ⁷⁶ "Feds to Pavillion Residents: Don't Drink the Water and Be Careful Not to Blow Yourselves Up." Press release, Earthworks, Pavillion Area Concerned Citizens, and Powder River Basin Resource Council. September 1, 2010. www.earthworksaction.org/media/detail/feds_to_pavillion_residents_don_t_drink_the_water_and_be_careful_not_to_blo#.U530D41dWM4.
- ⁷⁷ Pennsylvania Code §78.89, Gas Migration Response. www.pacode.com/secure/data/025/chapter78/s78.89.html.
- ⁷⁸ Brian A. Swistock and Dana Rizzo, Penn State Extension. "Methane Gas and Its Removal from Wells in Pennsylvania." <http://extension.psu.edu/natural-resources/water/drinking-water/water-testing/pollutants/methane-gas-and-its-removal-from-wells-in-pennsylvania>.
- ⁷⁹ E. Boyer, B. Swistock, J. Clark, M. Madden and D. Rizzo. 2012. *The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies*. Center for Rural Pennsylvania. 2012.
- ⁸⁰ Glenn Miller and Ann Maest. Considerations for Determining the Source of Groundwater Contamination Associated with Hydraulic Fracturing. Paper prepared for the US EPA, 2013.
- ⁸¹ Penn State Extension. "Iron and Manganese in Private Water Systems." <http://extension.psu.edu/natural-resources/water/drinking-water/water-testing/pollutants/iron-and-manganese-in-private-water-systems>.
- ⁸² US Environmental Protection Agency website: "Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals." <http://water.epa.gov/drink/contaminants/secondarystandards.cfm>
- ⁸³ US Environmental Protection Agency website "Drinking Water Health Advisory for Manganese." January 2004. http://water.epa.gov/action/advisories/drinking/upload/2004_02_03_support_cc1_magnese_dwreport.pdf.
- ⁸⁴ Brian E. Fontenot, Laura R. Hunt, Zacariah L. Hildenbrand, et al. "An Evaluation of Water Quality in Private Drinking Water Wells Near Natural Gas Extraction Sites in the Barnett Shale Formation." *Environmental Science and Technology*, July 2013.
- ⁸⁵ Center for Hazardous Substance Research, Kansas State University. "Human Health Effects of Heavy Metals" briefing paper. 2009. www.engg.ksu.edu/CHSR/outreach/resources/docs/15HumanHealthEffectsofHeavyMetals.pdf.
- ⁸⁶ Federal Energy Regulatory Commission Order Issuing Certificates. Docket No. CP08-15-000, June 5, 2008. <https://www.ferc.gov/EventCalendar/Files/20080605185040-CP08-15-000.pdf>.
- ⁸⁷ "Steckman Ridge Storage Project, Monroe Township, Bedford County, Pennsylvania." Project proposal submitted by Steckman Ridge to PADEP, December 17, 2007.
- ⁸⁸ Letter from Sarah Heaton, MPH, Public Health Analyst, National Center for Environmental Health, Centers for Disease Control and Prevention, to Kimberly D. Bose, Secretary, FERC. April 1, 2008.
- ⁸⁹ Federal Energy Regulatory Commission Order Issuing Certificates. Docket No. CP08-15-000, June 5, 2008. <https://www.ferc.gov/EventCalendar/Files/20080605185040-CP08-15-000.pdf>.
- ⁹⁰ Erich Schwartzel, "Fouled Waters: Woodlands residents search for ways to survive without clean water." *Pittsburgh Post-Gazette*, August 19, 2012.
- ⁹¹ AMEC. Evaluation of Alleged Groundwater Impacts in Four Domestic Wells. Western Connoquenessing Twp, Butler County, Pennsylvania. Prepared for Rex Energy Corporation, October 10, 2011.
- ⁹² S.K. Alawattagama, T. Kondratyuk, R. Krynock, M. Bricker, J.K. Rutter, D.J. Bain, and J.F. Stolz. Well Water Contamination in a Rural Community in Southwestern PA with Unconventional Shale Gas Extraction. *Environmental Science and Health*, Part A (in press). 2014.
- ⁹³ Joint Stipulation, Range Resources Appalachia, LLC, Appellant, v. Mt. Pleasant Township, Washington County, PA, Appellee, before the Mt. Pleasant Township Zoning Hearing Board, August 13, 2013. Sections D28-29 on Carter Impoundment.
- ⁹⁴ PADEP's permitting of centralized impoundments is less than clear. Standards in Chapter 105 of the Pa. Code were developed for freshwater impoundments, but DEP has been applying them to wastewater impoundments by virtue of requiring the same type of dam permit. At the same time, DEP has applied regulations in the state's Solid Waste Management Act to wastewater impoundments, but recently proposed that new requirements for them be included in oil and gas regulations (Chapter 78 of the Pa. Code). However, this proposal may be illegal because it applies certain well site regulations to centralized impoundments; see comments of PennFuture on proposed rulemaking, 25 Pa. Code Chapter 78, March 14, 2014, www.pennfuture.org/content.aspx?SectionID=381.

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- ⁹⁵ PADEP, "General Permit WMGR123: Processing and Beneficial Use of Oil and Gas Liquid Waste." http://files.dep.state.pa.us/Waste/Bureau%20of%20Waste%20Management/WasteMgtPortalFiles/SolidWaste/Residual_Waste/GP/WMGR123.pdf. The Pennsylvania Bulletin description of Range's dam permit application for the Carter Impoundment (found in a file review) states that it will be used "to collect and store flowback water for the use and re-use of hydraulic fracturing water."
- ⁹⁶ The violation was for failure to properly store, transport, process or dispose of a residual waste and to properly control or dispose of industrial or residual waste to prevent pollution of the waters of the Commonwealth. Range paid a penalty of \$59,000 as part of a consent agreement reached with DEP that included these violations and 17 others unrelated to the Carter Impoundment. See http://www.ahs.dep.pa.gov/eFACTSWeb/searchResults_singleViol.aspx?InspectionID=1975495.
- ⁹⁷ Emily Petsko, "Mt. Pleasant Supervisors reject Range proposal." *Washington Observer-Reporter*, September 28, 2013. www.observer-reporter.com/article/20130928/NEWS01/130929340#.U35V91hdU98.
- ⁹⁸ Don Hopey, "Radioactive water near fracking pond has Mount Pleasant residents worried." *Pittsburgh Post-Gazette*, May 2, 2014.
- ⁹⁹ Don Hopey, "West Virginia won't accept additional drilling waste tainted with radioactivity." *Pittsburgh Post-Gazette*, May 29, 2014.
- ¹⁰⁰ Permitting and spud dates for the Best, LBROS, and Ward wells are in eFACTS facility search and the DEP oil and gas well pad database at www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/Well_Pads.
- ¹⁰¹ See profile of June Chappel's concerns and accompanying documentation and photos of the impoundment at www.marcellus-shale.us/June-Chappel.htm.
- ¹⁰² Since 2005, the U.S. Clean Water Act has exempted most stormwater discharges associated with oil and gas construction activities from certain permitting requirements under the National Pollutant Discharge Elimination System (NPDES) program. The protection of water quality from E&S therefore falls primarily to the state. In Pennsylvania, erosion and sedimentation is regulated under Pennsylvania Code Chapters 93 (water quality standards) and 102 (erosion) and the Clean Streams Law. See the ESCGP form at www.elibrary.dep.state.pa.us/dsweb/Get/Document-92174/8000-PM-OOGM0005%20Permit%20doc.pdf.
- ¹⁰³ Executive Order 2012-11, "Permit Decision Guarantee for the Department of Environmental Protection." Pennsylvania Office of Administration, records and directives.
- ¹⁰⁴ See ESCGP-2 Authorization of Coverage form at www.elibrary.dep.state.pa.us/dsweb/Get/Document-92174/8000-PM-OOGM0005%20Permit%20doc.pdf.
- ¹⁰⁵ See 2012 Permit Review Process and Permit Decision Guarantee Policy at http://files.dep.state.pa.us/ProgramIntegration/PermitDecisionGuaranteePortalFiles/021-2100-001_PRP_and_PDG_Policy.pdf.
- ¹⁰⁷ See erosion & sedimentation control plan components at www.elibrary.dep.state.pa.us/dsweb/Get/Document-77632/5500-FM-OG0111.pdf.
- ¹⁰⁸ This exemption is in Pennsylvania Code §102.8(a). DEP assumes that if a site is under active restoration, stormwater management BMPs can be based on "natural measures" that do not require construction or maintenance efforts by the operator.
- ¹⁰⁹ The US Clean Water Act directs states to establish water quality standards as part of comprehensive efforts to protect water resources. Pennsylvania has met this requirement by classifying its surface water resources for their designated uses and developing associated regulations. Pennsylvania's water quality standards are set out in Chapter 93 of the Pennsylvania Code. Also relevant in this context are Chapter 95 on wastewater treatment, Chapter 102 on erosion and sedimentation control, and Chapter 105 on dam safety and water management. See PA Code Title 25, Environmental Protection, at www.pacode.com/secure/data/025/025toc.html.
- ¹¹⁰ Delaware Riverkeeper Network. *Protecting Streams in Pennsylvania: A Guide for Municipal Officials*. 2007. www.delawariverkeeper.org/pdf/Protecting%20Streams%20in%20PA.pdf
- ¹¹¹ Pennsylvania Campaign for Clean Water, *The Effects of Special Protection Designation: A Guide for Communities*. 2007.
- ¹¹² Barbara Miller, "DEP investigating spill at Cross Creek County Park." *Washington Observer-Reporter*, March 15, 2013.
- ¹¹³ In addition to searching eFACTS search for all OG57s issued between 1/1/2005 and 12/31/2013, we conducted facility searches for all of the wells we had files for in eFACTS, and OG57 never came up as one of the authorizations.
- ¹¹⁴ For example, VOC emissions for the Shamrock Compressor Station (Fayette County) is 2.715 tons in eFACTS but 6.26 tons in the natural gas emissions inventory. (Sources: eFACTS report search by Facility Emissions, Fayette County, 2012, Volatile Organic Compounds; and DEP's 2012 Air Emissions Inventory Data for the Unconventional Natural Gas Industry, search for Shamrock in the spreadsheet labeled VOC; as listed on May 2014.)
- ¹¹⁵ E. Hansen, D. Mulvaney, and M. Betcher. *Water Resource Reporting and Water Footprint from Marcellus Shale Development in West Virginia and Pennsylvania*. Downstream Strategies and San Jose State University, 2013.
- ¹¹⁶ Data from: PA DEP Oil and Gas Reporting Website, state downloads. www.paoilandgasreporting.state.pa.us/publicreports/Modules/DataExports/DataExports.aspx. Downloaded data for unconventional wells for the periods January – June 2013 and July– December 2013. We filtered results by waste type = produced fluid, fracing fluid and

drilling fluid waste. Results: January–June 2013, 15,050,160 barrels; July –December 2013, 17,206,374 barrels. Total for both periods: 32,256,534 million barrels, or 1.35 billion gallons).

¹¹⁷ See Form 5500-PM-OG0071 at www.elibrary.dep.state.pa.us/dsweb/Get/Document-82269/5500-PM-OG0071.pdf.

¹¹⁸ This RTKL request was filed by PennFuture, which shared the resulting documents with Earthworks.

¹¹⁹ Per Pennsylvania Code §78.56(4)(iii). Since a seasonal high groundwater table indicates hydrologic connectivity with water bodies such as wetlands and streams, even the regulated distance is inexcusably short in a state with many shallow water resources. It is notable that other states require far greater separation, such as 25 feet in New Mexico (see www.nmcpr.state.nm.us/nmac/_title19/T19C015.htm), 5 feet in Louisiana (see http://dnr.louisiana.gov/assets/OC/43XIX_June2010.pdf#page=30), and 4 feet in Michigan (see www.michigan.gov/documents/deq/ogs-oilandgas-reg_263032_7.pdf).

¹²⁰ See “Approved Alternate Liners for Pits at Oil and Gas Well Sites,” *Pennsylvania Bulletin*, Saturday, January 17, 2009. www.pabulletin.com/secure/data/vol39/39-3/78.html. Commonly used to measure the thickness of plastic, a “mil” equals one-thousandth of an inch, or 0.001 inch. (In contrast, a millimeter is 0.4 inch). HDPE liners overall have only been given a rating of “fair” for puncture performance, installation damage resistance, and stress cracking by Geosynthtica.net, as well as lower ratings for these aspects than the Linear Low-Density Polyethylene (LDPE) liners required in some other states (such as New Mexico); see Geosynthtica.net, based on research by M. Sadlier and R. Frobel; www.geosynthtica.net/resources/a-flexible-membrane-liner-comparison-1/.

¹²¹ August 20, 2010 letter from Scott Perry to well operators (obtained through a Right-to-Know request filed by PennFuture, which shared the resulting documents with Earthworks).

¹²² See OG73 form at www.elibrary.dep.state.pa.us/dsweb/Get/Document-82274/5500-PM-OG0073.pdf.

¹²³ This RTKL request was filed by PennFuture, which shared the resulting documents with Earthworks.

¹²⁴ See “Request for Waiver of Distance Requirements From Springs, Stream, Body of Water, or Wetland.” Form 8000-PM-OOGM0057 – Instructions. www.elibrary.dep.state.pa.us/dsweb/Get/Document-90104/8000-PM-OOGM0057%20-%20Instructions.pdf.

¹²⁵ Marie Cusick, “DEP always granted drillers’ requests to avoid Act 13’s stream buffers.” *State Impact*, January 16, 2014.

¹²⁶ Delaware Riverkeeper Network. *Protecting Streams in Pennsylvania: A Guide for Municipal Officials*. 2007.

¹²⁷ Marie Cusick, “PA leases more than 1,400 acres under rivers and streams to drillers.” *State Impact*, March 31, 2014.

¹²⁸ Nathan Atkinson and Katie King, “Flooding and Fracking: A Review of Extreme Weather Impacts on Drilling Activities.” *Natural Resources and Environment*, American Bar Association, Fall 2012.

¹²⁹ PA DEP, Act 13 Frequently Asked Questions, “Are there new setback provisions?” www.portal.state.pa.us/portal/server.pt/community/act_13/20789/act_13_faq/1127392.

¹³⁰ See Marie Cusick, “Pennsylvania Supreme Court strikes down controversial portions of Act 13.” *State Impact*, December 19, 2013.

¹³¹ Mark Szybist, Esq. “The Act 13 decision: A setback for setbacks?” *Penn Future Environmental Law Blog*, January 10, 2014.

¹³² See Title 58, §3216 of the Pa. Consolidated Statutes, Well Site Restoration, www.legis.state.pa.us/WU01/LI/LI/US/HTM/2012/0/0013..HTM.

¹³³ See Well Restoration Report form OG75 at www.elibrary.dep.state.pa.us/dsweb/Get/Document-90385/8000-PM-OOGM0075%20Application.pdf and instructions for its completion at www.elibrary.dep.state.pa.us/dsweb/View/Collection-9842.

¹³⁴ Section IV of the Policy for Erosion and Sediment Control and Stormwater Management for Earth Disturbance Associated with Oil and Gas Exploration, Production, Processing or Treatment Operations or Transmission Facilities addresses site restoration and reclamation standards for oil and gas wells. See www.elibrary.dep.state.pa.us/dsweb/Get/Document-92195/800-2100-008.pdf.

¹³⁵ Based on the regulation that restoration must be finished within nine months of completion of drilling a well, we found the drilling completion date for each of the wells in our review on forms in the files. When the necessary forms weren’t in the files, we presumed that the date of well stimulation completion would provide a rough approximation, since stimulation only occurs once drilling has been completed. We also factored in whether DEP had granted a restoration extension, and for how long.

¹³⁶ State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER), *Pennsylvania Follow-up State Review*, 2013 (p. 23).

¹³⁷ See Title 58, §3216 of the Pa. Consolidated Statutes, Well Site Restoration, www.legis.state.pa.us/WU01/LI/LI/US/HTM/2012/0/0013..HTM.

¹³⁸ *Ibid.*

¹³⁹ Regulation at §601.212(a) of the Oil and Gas Act and Pa. Code §78.122(b). See well record form at www.elibrary.dep.state.pa.us/dsweb/Get/Document-99493/8000-FM-OOGM0004a%20-%20Form.pdf. “Drilling Complete” is the date



drilling of wellbore was finished (i.e., all laterals have been drilled or decision made to not drill further has been made), while “Date Well Completed” is when the wellbore was finished with casing and cementing.

¹⁴⁰ See §601.212(b) of the Oil and Gas Act and Pa. Code §78.122(b) and forms at www.portal.state.pa.us/portal/server.pt/directory/well_record_and_completion_report/179500?DirMode=1#.

¹⁴¹ To determine which wells should have had a drilling completion report filed with DEP by the time of our review, we assumed that if the well of concern was producing gas, or had a well completion report indicating that the well had been stimulated, that the well had obviously been drilled. For well files that were missing drilling completion reports, we were obviously unable to know the drilling completion date. So we added 30 days to the date of well completion, or if the file was missing that report, we added 30 days to the first date of production (found on the PA Oil and Gas Reporting web site, <https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Agreement.aspx>) to determine the expected date by which the operator should have filed the drilling completion report.

¹⁴² Mike Soraghan, “One-fifth of FracFocus reports in Colo., Pa. were late in 2012.” *Energywire*, June 7, 2013.

¹⁴³ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, “2013 Oil and Gas Annual Report.”

¹⁴⁴ Pennsylvania Code, Title 25, §78.901-906. www.pacode.com/secure/data/025/chapter78/subchapXtoc.html.

¹⁴⁵ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, “2013 Oil and Gas Annual Report.”

¹⁴⁶ *Ibid.* Using figures in DEP’s annual report, we divided the number of inspections for each type of well (unconventional and conventional) by the number of wells inspected to reach the average number of inspections conducted.

¹⁴⁷ *Ibid.* **Inspected wells:** According to PADEP’s 2013 Oil and Gas Annual Report (*Ibid.* p. 19), in 2008 PADEP conducted inspections of 377 unconventional and 7,143 conventional wells = 7,520 wells inspected. In 2013, PADEP conducted inspections at 5,559 unconventional and 7,808 conventional wells = 13,367 wells inspected. **Active wells:** We were unable to find PADEP-generated statistics on the number of active wells in the state. In its Permitted Well Inventory (“Inventory”) under “Well Status” there is an option to select “Active.” But because the data in the Inventory are submitted by operators, this category does not actually guarantee that the well is still in service, or in a condition where it should be inspected (e.g., temporarily plugged or abandoned). Inventory available at PADEP Oil and Gas Reporting Web site, under statewide downloads: <https://www.paoilandgasreporting.state.pa.us>.

The following numbers are our best estimate of the number of active wells in the state. We downloaded the data for unconventional and conventional wells by year, filtering the Well Status data to only include “Active” wells. Then we filtered the Comment fields to remove data that indicated that the well was not active (e.g., comments that said the well was “plugged”, “never spud or drilled – permit expired/cancelled”, “no record of well”, and duplicate records were removed).

2008 data: The Inventory contains 65,272 wells with a Well Status classification of “Active” in 2008, but after filtering out what we deemed to be wells that were not actually active, we came up with a number of 65,102. If 7,520 wells were inspected (as per DEP), then 57,582 active wells were not inspected.

2013 data: The 2013 Inventory data had 75,293 and 6,806 “Active” conventional and unconventional wells, for a total of 82,099 “Active” wells, but when we removed the wells that were not actually active we came up with 73,063 conventional and 6,630 unconventional active wells, for a total of 79,693. If 13,367 wells were inspected, then 66,326 active wells were not inspected.

Note: This approach is different than the approach we took in our 2012 report *PADEP: Inadequate Enforcement Guarantees Irresponsible Oil and Gas Development in Pennsylvania*. 2012, for which we filtered the Inventory data by “Active” Well Status, and then we only selected wells that were producing gas. We realized that this underestimates the number of wells that should be inspected regularly, because a non-producing well, until it has been officially and permanently plugged and abandoned, should still be inspected. So the numbers are slightly different, but the overall issue is the same: tens of thousands of wells are not being inspected every year in Pennsylvania.

¹⁴⁸ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, “2013 Oil and Gas Annual Report.”

¹⁴⁹ For this analysis, we used DEP locational data (lat/long) for permitted wells (data downloaded from the DEP permitted well inventory in December 2013), and mapped the facilities located around our case study homes. The mapping program that we used (Batchgeo) provided information on the distance from each well/facility to the home addresses that we mapped. Not all of the wells in the permitted well inventory have been drilled. We did not map the wells that had not yet been spud (this information is in the permitted well inventory). For every well within two miles of our case study homes that had been spud, we collected inspections and violations data, and gas production data. Inspection and violation data were obtained from eFACTS and the DEP Oil and Gas Compliance database, and production information was obtained through DEP’s Oil and Gas Production Reporting web site.

¹⁵⁰ Pennsylvania Code, Title 25, §78.901-906. www.pacode.com/secure/data/025/chapter78/subchapXtoc.html.

¹⁵¹ PADEP, “Internal Review of Inspection and Enforcement of Natural Gas Operations.” November 14, 2011.

¹⁵² Pennsylvania Code, Title 25, §78.901-906. www.pacode.com/secure/data/025/chapter78/subchapXtoc.html.

¹⁵³ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, “2013 Oil and Gas Annual Report.”



¹⁵⁴ Anthony R. Ingraffea. "Fluid Migration Mechanisms Due to Faulty Well Design and/or Construction: An Overview and Recent Experiences in the Pennsylvania Marcellus Play." Physicians, Scientists, and Engineers for Healthy Energy, 2012.

¹⁵⁵ Anthony R. Ingraffea, Martin T. Wells, Renee L. Santoro, and Seth B.C. Shonkoff. "Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012." *Proceedings of the National Academy of Sciences of the United States*. June 30, 2014.

¹⁵⁶ Scott Detrow, "Perilous Pathways: Behind the Staggering Number of Abandoned Wells in Pennsylvania" StateImpact, October 10, 2012.

¹⁵⁷ PADEP, Bureau of Oil and Gas Management. *Stray Natural Gas Migration Associated with Oil and Gas Wells*. Draft, October 28, 2009.

¹⁵⁸ For a full list of Pennsylvania enforcement options, see "Enforcement Actions by DEP's Oil and Gas Management Program." PADEP, 2005, Document number 550-4000-001. www.elibrary.dep.state.pa.us/dsweb/Get/Version-48291/01%20550-4000-001.pdf.

¹⁵⁹ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, "2013 Oil and Gas Annual Report." The agency goes on to state that, "The number of enforcement actions has proportionally increased by percentage during this same time period," but does not provide data to support this statement.

¹⁶⁰ Ibid.

¹⁶¹ These figures are based on PADEP violations data for a given year (e.g., Jan. 1, 2010 through Dec. 31, 2010) from the Oil and Gas Compliance Data Report system. This provided us with the number of violations and enforcement actions per year. By dividing the total number of violations by the total number of enforcement actions, one can determine how many violations are issued per enforcement action.

¹⁶² In DEP's compliance database, we found examples of: Administrative Order (ADORD); Compliance Orders (CMPOR); Court Order (CTORD); Field Order (FDORD); Field Notice of Violation (FLNOV); Notice of Violation (NOV); Consent Assessment of Civil Penalty (CACP); and Consent Order and Agreement (COA). ADORD, CMPOR, CTORD, FDORD, FLNOV and NOV rarely had penalties associated with them; COAs and CACP often resulted in penalties.

¹⁶³ Using the DEP Compliance database, we derived these statistics by: 1) Determining the number of violations found by DEP. We downloaded data on unconventional wells, inspections finding violations only; and we filtered the results by "unique violation ID" so that we only counted each violation once. We came up with 528 violations. 2) Finding out how many violations had an associated fine. We filtered all 2013 unconventional records to include only those with a penalty greater than 0\$. We then filtered the results by unique violation ID so that we would not double-count a penalty. We found 70 violations that resulted in penalties. 3) Determining the percent of violations resulting in penalties. We divided the number of violations with penalties (70) by the total number of violations (528), and multiplied by 100, or 13.3%. We repeated these steps using 2009 data and found 684 violations; 234 had associated penalties. For conventional wells, in 2013 we found 2,123 violations, 175 of which had associated penalties; and in 2009 there were 2,689 violations, 324 of which had associated penalties.

¹⁶⁴ Pennsylvania Code, Chapter 78, Oil & Gas Wells, §78.89, Gas migration response. www.pacode.com/secure/data/025/chapter78/s78.89.html.

¹⁶⁵ For this analysis, we used PADEP locational data (lat/long) for permitted wells (data downloaded from the PADEP permitted well inventory in December 2013), and mapped the facilities located around our case study homes. The mapping program that we used (Batchgeo) provided information on the distance from each well/facility to the home addresses that we mapped. Not all of the wells in the permitted well inventory have been drilled. We did not map the wells that had not yet been spud (this information is in the permitted well inventory). For every well within two miles of our case study homes that had been spud, we collected inspections and violations data, and gas production data. Inspection and violation data were obtained from eFACTS and the PADEP Oil and Gas Compliance database, and production information was obtained through PADEP's Oil and Gas Production Reporting website.

¹⁶⁶ We did not map the wells in the permitted inventory that have not yet been spud. Inspection and violation data were obtained from eFACTS and the PADEP Oil and Gas Compliance databases. We looked at all unconventional and conventional natural gas operations where the well sites had been constructed and wells had been spud (i.e., drilling had been started). A large percentage of these wells were also producing gas, so they had also undergone well stimulation (e.g., hydraulic fracturing), and possible site restoration. (Note: we did not include wells from our case study in Bedford county, as they are all gas storage wells that didn't fit into "conventional" and "unconventional" categories.)

¹⁶⁷ Commonwealth Court of Pennsylvania, Docket No. 284 M.D. 2012. Petitioner's brief in Robinson Township, et al. v. Commonwealth of Pennsylvania. See also Don Hopey, "Weak Records cited on Pa. shale pollution." *Pittsburgh Post-Gazette*, April 3, 2014.

¹⁶⁸ Eugene D. Pasquale, Auditor General of the Commonwealth of Pennsylvania. *DEP's Performance in monitoring potential impacts to water quality from shale gas development, 2009-2012*. July 2014. Under Pennsylvania law, an oil or gas operator that pollutes or diminishes a private water supply must restore or replace the supply "with an alternate source of water adequate in quality and quantity." See DEP's "Act 13 Frequently Asked Questions," www.portal.state.pa.us/portal/server.pt/community/act_13/20789/act_13_faq/1127392.

¹⁶⁹ RRC of Texas. Self Evaluation Report Submitted to the Sunset Advisory Commission, September 2011. <https://www.sunset.texas.gov/reviews-and-reports/agencies/railroad-commission-texas-rrc>



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- ¹⁷⁰ Earthworks, *PADEP: Inadequate Enforcement Guarantees Irresponsible Oil and Gas Development in Pennsylvania*. 2012. <http://enforcement.earthworksaction.org>.
- ¹⁷¹ Naveena Sadasivam, "In Fracking Fight, a Worry About How Best to Measure Health Threats." ProPublica, April 1, 2014.
- ¹⁷² DEP employees provided Earthworks with some spreadsheets. See also Naveena Sadasivam, "In Fracking Fight, a Worry About How Best to Measure Health Threats," ProPublica, April 1, 2014; Don Hopey, "Weak records cited on Pa. shale pollution," *Pittsburgh Post-Gazette*, April 3, 2014; and Public Herald's complaints research files at <http://publicfiles.org/complaints/water-complaints/bradford-county/>.
- ¹⁷³ Statelmpact, "Natural Gas Drilling in Pennsylvania: Violations." <http://stateimpact.npr.org/pennsylvania/drilling/violations/>.
- ¹⁷⁴ See PADEP's RTKL request procedures at www.portal.state.pa.us/portal/server.pt/community/public_records/19207/right_to_know_procedure/723458.
- ¹⁷⁵ See the RTKL (Title 65 Pennsylvania Statutes, §§67.101-67.3104) at www.pafaic.org/rtk.html.
- ¹⁷⁶ PA DEP, Director of Environmental Emergency Response, "Standard Procedure for Complaint Response Management." Document No: OPI 2012-01, revised October 2013.
- ¹⁷⁷ Clean Air Council, letter to US Environmental Protection Agency Region 3 Administrator Shawn Garvin. June 28, 2012. http://cleanair.org/program/outdoor_air_pollution/marcellus_shale/clean_air_council_seeks_federal_intervention_marcellus.
- ¹⁷⁸ David Brown, Beth Weinberger, Celia Lewis, and Heather Bonaparte, "Understanding exposure from natural gas drilling puts current air standards to the test." *Reviews on Environmental Health*, Vol. 29, 2014.
- ¹⁷⁹ S. Schiffman, "Science of Odors as a Potential Health Issue." *Journal of Environmental Quality* Vol. 34, 2005.
- ¹⁸⁰ Nadia Steinzor, Wilma Subra, and Lisa Sumi, "Investigating Links Between Shale Gas Development and Health Impacts through a Community Survey Project in Pennsylvania." *NEW SOLUTIONS*, Vol. 23(1), 2013.
- ¹⁸¹ PADEP, *Complaints Manual*. (Date unknown.) Received through a RTKL request filed by Clean Air Council, which provided the resulting documents to Earthworks.
- ¹⁸² Naveena Sadasivam, "In Fracking Fight, a Worry About How Best to Measure Health Threats." ProPublica, April 1, 2014.
- ¹⁸³ Environmental Complaints phone numbers and forms are accessible through the appropriate regional office webpage, via the DEP Regional Resources webpage: www.portal.state.pa.us/portal/server.pt/community/regional_resources/13769.
- ¹⁸⁴ PADEP, Director of Environmental Emergency Response, "Standard Procedure for Complaint Response Management." Document No: OPI 2012-01, revised October 2013.
- ¹⁸⁵ PADEP, *Complaints Manual*. (Date unknown.) Received through a RTKL request filed by Clean Air Council, which provided the resulting documents to Earthworks.
- ¹⁸⁶ March 24, 2009 complaints record (complaint ID 262087) from the DEP Northcentral regional office. Obtained by Public Herald through a file review request for general complaints records.
- ¹⁸⁷ October 22, 2009 complaints record (complaint ID 267557) from the DEP Northcentral regional office. Obtained by Public Herald through a file review request for general complaints records.
- ¹⁸⁸ See a 2010 video about the Burnett's problems with their pond at money.cnn.com/video/news/2010/10/22/n_pa_gas_fracking_truman.cnnmoney/.
- ¹⁸⁹ Court filing, Truman Burnett and Bonnie Burnett, Plaintiffs, v. Chesapeake Appalachia LLC; Chesapeake Energy Corporation; et. al. in the US District Court for the Middle District of Pennsylvania. http://law.psu.edu/file/aglaw/Marcellus_Shale/Burnett_v_Chesapeake_Appalachia.pdf.
- ¹⁹⁰ PADEP Secretary Christopher Abruzzo and Deputy Secretary Scott Perry, "2013 Oil and Gas Annual Report."
- ¹⁹¹ Neither bill was brought to the floor of the legislature for a vote, but instead integrated into the fiscal code as part of the budget process. See Laura Legere, "Power Source" feature, *Pittsburgh Post-Gazette*, June 24, 2014.
- ¹⁹² Katie Colaneri, "Pa. DEP reviews thousands of comments on overhaul of drilling regulations," Statelmpact, June 26, 2014,
- ¹⁹³ Eugene D. Pasquale, Auditor General of the Commonwealth of Pennsylvania. *DEP's Performance in monitoring potential impacts to water quality from shale gas development, 2009-2012*. July 2014.
- ¹⁹⁶ PADEP, "Internal Review of Inspection and Enforcement of Natural Gas Operations." November 14, 2011.
- ¹⁹⁷ PADEP. Permit Review Process and Permit Decision Guarantee Quarterly Report. November 1, 2013.

¹⁹⁸ The Southwest Pennsylvania Environmental Health Project has prepared useful materials and presentations in this regard. See “Health concerns in the era of gas drilling—a basic toolkit for health care providers.” www.environmentalhealthproject.org/resources/medical-resources.

¹⁹⁹ Recommendation for Finding One. Eugene D. Pasquale, Auditor General of the Commonwealth of Pennsylvania. *DEP’s Performance in monitoring potential impacts to water quality from shale gas development, 2009-2012*. July 2014.

²⁰⁰ The Maryland Departments of the Environment and Natural Resources recently recommended requiring well permit applicants to submit a Comprehensive Gas Development Plan that would “address, at a minimum, all land on or under which the applicant expects to conduct exploration or production activities over a period of at least the next five years.” See State of Maryland *Marcellus Shale Safe Drilling Initiative Study, Part II: Interim Best Practices*. July 2014. www.mde.state.md.us/programs/Land/mining/marcellus/Documents/7.10_Version_Final_BP_Report.pdf.

²⁰¹ In a case brought by Damascus Citizens for Sustainability, Delaware Riverkeeper Network, and others against DEP and Newfield Appalachia PA, court depositions and proceedings verified that DEP generally does not consider the impact of gas and oil activities on special protection watersheds unless projects are five acres in size or larger. As a result of the 2012 settlement of the case, DEP is now required to ensure that applicants will comply with anti-degradation regulations before starting earth disturbance activities in special protection watersheds, regardless of the size of the project. See Susan Phillips, “Shale gas wells with smaller footprint to get greater scrutiny.” *State Impact*, February 13, 2012.

²⁰² Pennsylvania Code, Subchapter B, General Requirements, at www.legis.state.pa.us/WU01/LI/LI/CT/HTM/58/00.032.011.000..HTM.

²⁰³ See “Loopholes for Polluters” fact sheet. Earthworks 2011. www.earthworksaction.org/library/detail/loopholes_for_polluters.

²⁰⁴ See *Breaking all the Rules: The Crisis in Oil and Gas Regulatory Enforcement* and related state-specific reports. Earthworks, 2012. <http://enforcement.earthworksaction.org>.

²⁰⁵ eFACTS database information and search options are accessible at: www.ahs.dep.pa.gov/eFACTSWeb/default.aspx.

²⁰⁶ PADEP Oil and Gas Compliance Reports are accessible at: www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/OG_Compliance

²⁰⁷ PADEP Oil and Gas Reporting Website is accessible at: <https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Welcome.aspx>.

²⁰⁸ PADEP Air Emissions Data from Natural Gas Operations are available at: www.dep.state.pa.us/dep/deputate/airwaste/aq/emission/marcellus_inventory.html

²⁰⁹ See PADEP’s RTKL request procedures at www.portal.state.pa.us/portal/server.pt/community/public_records/19207/right_to_know_procedure/723458.

²¹⁰ PADEP Permitted Well Inventory available at: www.depreportingservices.state.pa.us/ReportServer/Pages/ReportViewer.aspx?/Oil_Gas/Operator_Permitted_Well_Inventory. Data downloaded in December 2013.