0120-FM-PY0004 Rev. 3/2003

COMMONWEALTH OF PENNSYLVANIA
ENVIRONMENTAL QUALITY BOARD

PETITION FORM

I. PETITIONER INFORMATION

Name: Sierra Club, Clean Air Council, Earthworks, PennFuture, Protect Penn-Trafford, Mountain Watershed Association

Mailing Address: 50 F Street NW, Eighth Floor
Washington, DC 20001

Telephone Number: (202) 495-3023

Date: 9/14/2021

II. PETITION INFORMATION

A. The petitioner requests the Environmental Quality Board to (check one of the following):

☒ Adopt a regulation

☐ Amend a regulation (Citation _____)

☐ Repeal a regulation (Citation _____)

Please attach suggested regulatory language if request is to adopt or amend a regulation.

B. Why is the petitioner requesting this action from the Board? (Describe problems encountered under current regulations and the changes being recommended to address the problems. State factual and legal contentions and include supporting documentation that establishes a clear justification for the requested action.)

This petition requests the Environmental Quality Board to raise bond amounts for unconventional wells. Please see Attachment A for full details of the request.

C. Describe the types of persons, businesses and organizations likely to be impacted by this proposal.

Please see Attachment A.

D. Does the action requested in the petition concern a matter currently in litigation? If yes, please explain.

There are no matters in litigation that concern the action requested in this petition.

E. For stream redesignation petitions, the following information must be included for the petition to be considered complete. Attach supporting material as necessary.

1. A clear delineation of the watershed or stream segment to be redesignated, both in narrative form and on a map.
2. The current designated use(s) of the watershed or segment.
3. The requested designated use(s) of the watershed or segment.
4. Available technical data on instream conditions for the following: water chemistry, the aquatic community (benthic macroinvertebrates and/or fishes), or instream habitat. If such data are not included, provide a description of the data sources investigated.
5. A description of existing and proposed point and nonpoint source discharges and their impact on water quality and/or the aquatic community. The names, locations, and permit numbers of point source discharges and a description of the types and locations of nonpoint source discharges should be listed.
6. Information regarding any of the qualifiers for designation as high quality waters (HQ) or exceptional value waters (EV) in §93.4b (relating to qualifying as High Quality or Exceptional Value waters) used as a basis for the requested designation.
7. A general description of land use and development patterns in the watershed. Examples include the amount or percentage of public lands (including ownership) and the amount or percentage of various land use types (such as residential, commercial, industrial, agricultural and the like).
8. The names of all municipalities through which the watershed or segment flows, including an official contact name and address.
9. Locational information relevant to items 4-8 (except for contact names and addresses) displayed on a map or maps, if possible.

All petitions should be submitted to the
Secretary of the Department of Environmental Protection
P.O. Box 2063
Harrisburg, PA 17105-2063

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Attachment A

Unconventional Well Bonding Petition

BEFORE THE PENNSYLVANIA ENVIRONMENTAL QUALITY BOARD

PETITION PURSUANT TO 25 PA. CODE §§ 23.1-23.5, 58 CONS. STAT. § 3225(a)(1), AND ARTICLE I, § 27 OF THE PENNSYLVANIA CONSTITUTION TO ADOPT FULL-COST BONDING FOR UNCONVENTIONAL OIL AND GAS WELLS TO CONSERVE AND MAINTAIN PUBLIC RESOURCES FOR WHICH THE COMMONWEALTH IS A TRUSTEE

Submitted on behalf of the Sierra Club, Clean Air Council, Earthworks, Mountain Watershed Association, PennFuture, and Protect Penn-Trafford

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Dated: September 14, 2021

SUMMARY

Abandoned oil and gas wells are a menace to Pennsylvanians across the Commonwealth. They pollute the air and water, exacerbate climate change, mar the neighborhoods they are in, reduce property values, and eventually have to be plugged using taxpayer money. They have caused, and will continue to cause, acute health consequences for Pennsylvanians, including members of the organizations filing this petition ("Petitioners"), and have increased their risk for serious long-term consequences, like cancer. Requiring full-cost bonding would address the risk of well abandonment by providing operators with a financial reason to plug their wells, and providing the Commonwealth with the money to do so itself if an operator will not or cannot plug its wells. The current bond amount of $10,000 per unconventional well, with a complicated blanket bonding system that greatly lowers the actual per-well amount, does not come close to full-cost bonding.

This petition asks the Environmental Quality Board ("EQB") to adopt full-cost bonding for unconventional oil and gas wells. Specifically, the EQB should issue a rule that:

1. Increases bond amounts to $83,000 per unconventional well;
2. Makes blanket bonds equal to the sum of the individual bond amounts an operator would otherwise have to post;
3. Applies these new bond amounts to existing wells; and
4. Requires the Department of Environmental Protection ("DEP") to issue a report to the EQB every two years that recommends whether the EQB should further adjust bond amounts.

The bond amounts requested in this petition are based on an expert report the Sierra Club commissioned from Dr. Jeremy Weber, a professor at the University of Pittsburgh, the Chief Energy Economist for President Trump's Council of Economic Advisers, and an established expert in the economics of oil and gas production. Dr. Weber's report uses historical plugging data within Pennsylvania to estimate the cost of plugging the average unconventional well in 2021. The report finds that under the assumption that the average well will be plugged in a fourteen-well plugging contract, as has been the case over the past decade, the cost of plugging the average unconventional well will be $83,000.

This petition requests that the EQB set blanket bond amounts equal to the sum of these per-well bond amounts, rather than a set amount as exists under the current system. The current

system does not work. It is based on an assumption that large operators have minimal risk of defaulting, which evidence indicates is not the case. It also ignores the fact that large operators—to the extent they actually are more financially secure—already get a discount on bonding fees if they use a surety to make their bond payments.

The petition further requests that the updated bond amounts apply to both existing wells and new wells. If the increased bond amounts were only applied to new wells, there would be no reduction in the massive financial and environmental risk the Commonwealth already faces from existing wells that are severely under-bonded. One estimate finds that for existing wells, the deficit between the amount that operators have paid in bonds and the amount it will actually cost to plug these wells is $12.15 billion.

Finally, this petition asks that DEP be required to examine every two years whether bond amounts should be updated because, as the Weber Report explains, plugging costs have risen every year, even adjusting for inflation, and DEP and the EQB have an obligation under the law to make sure bond amounts reflect these changes. If the agencies determine rulemaking will take longer than two years, this petition suggests that DEP undertake this analysis every four years as a secondary option.

Data from the impact of the unconventional well impact fee indicates that adopting the proposed regulations in this petition will have a minimal impact on unconventional well operators. Other studies indicate that the proposed regulations will create thousands of jobs in well plugging for Pennsylvania workers.

The EQB has the statutory authority to adopt these proposed rules. Indeed, failing to act on this petition would constitute a capricious disregard of material evidence indicating that bond amounts must be increased. The EQB also must act on this petition to meet its obligations under the Environmental Rights Amendment ("Section 27" or "the ERA"), which requires the Commonwealth to act as a trustee and manage the state's environment for the benefit of all Pennsylvanians. Failing to set bond amounts equal to the cost of plugging wells results in the state allowing the environment to be degraded without ensuring that wells are plugged and land is remediated after drilling ceases. This the Commonwealth cannot do under the ERA.

The Environmental Rights Amendment was passed to prevent future fossil fuel booms from ending in the same way the coal boom did—with thousands of acres scarred by acid mine

drainage and abandoned mines pockmarking the state. The EQB was given authority to adjust bond amounts to ensure the same. The EQB must use its delegated power to prevent this looming environmental and financial catastrophe.

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DISCUSSION

Pennsylvania's current bond amounts for unconventional oil and gas wells are much too low to cover "the projected costs to the Commonwealth of plugging the well." 58 Cons. Stat. § 3225(a)(1). This encourages the abandonment and orphaning of wells. The Pennsylvania Department of Environmental Protection lists 5,415 wells in the state as "active" that have not produced any oil or gas for more than four years, and 8,848 wells as abandoned or orphaned but unplugged. *See infra* Section II.A.2. These abandoned wells pollute surrounding communities and put the state on the hook to cover hundreds of millions to billions of dollars in cleanup costs.[1] To avert this catastrophe, and to fulfill the Commonwealth's obligations under the Environmental Rights Amendment, this petition asks the EQB to increase well bond amounts to $83,000 for unconventional wells, to make blanket bonds equal to the sum of individual bond amounts, to apply these changes to existing wells, and to revisit bond amounts every two years.

I. Failure to Plug Abandoned Wells Has Serious Public Health, Environmental, and Financial Consequences

Failing to require full-cost bonding results in the abandonment and orphaning of large numbers of oil and gas wells, which pose significant public health, safety, and environmental risks. Orphaned wells leak methane and other pollutants into the air and water, harming public health and exacerbating climate change. They mar communities, reducing property values and depressing the local tax base. Under the current system, orphaned wells ultimately must be plugged and remediated by the state, costing taxpayers hundreds of millions of dollars.

Numerous studies have shown that abandoned wells leak methane and other pollutants into groundwater and surface water. The Sierra Club commissioned an expert report from Dr. Jeremy Weber, a professor at the University of Pittsburgh's Graduate School of Public and International Affairs and the Chief Energy Economist for the Trump Administration's Council of Economic Advisors, and an established expert in the economics of oil and gas production to examine the negative consequences of abandoned wells and determine an appropriate bond amount to ensure abandoned wells are plugged.[2] The expert report ("Weber Report")

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[1] *See* Off. of Oil and Gas Mgmt., Pa. Dep't of Envtl. Protection, *Legacy Well Issues* 13 (2019) (DEP presentation stating that the Commonwealth has a potential cleanup liability of $6.6 billion), included as Attachment G.

[2] The Weber Report is included as Attachment C.

summarized several of the studies on methane leakage. *See* Weber Report 5-6. Potential pollutants from abandoned wells that can infiltrate water supplies include barium, chloride, arsenic, and methane. As the report explains, "[a]rsenic is a carcinogen and even short-term exposure can harm health. Further, methane leaking into groundwater can create foul-smelling and toxic hydrogen sulfide when it oxidizes." *Id.* at 5. Abandoned wells also leak methane and other chemicals into the atmosphere, further harming the health of nearby communities. Specifically, the methane leaked into the atmosphere can turn into ozone, which is extremely harmful to human health. Inhaling ozone can cause "damage to the heart and lungs and worsen[] chronic conditions such as asthma." *Id.* Methane can also explode if leaked in enclosed spaces. *Id.* All of these studies examine the impacts of abandoned conventional wells. Unconventional wells have large amounts of dangerous chemicals pumped through them. Therefore, the negative health impacts of abandoned unconventional wells may be even greater than those of abandoned conventional wells.

This pollution has real consequences for the people of Pennsylvania. Gillian Graber lives or works within two miles of at least six abandoned conventional wells and within five miles of at least 51 abandoned conventional wells. *See* Gillian Graber Aff. ¶¶ 6-7.[3] There are likely scores of additional abandoned wells near her that were never permitted and thus have not been identified by DEP. *Id*. Ms. Graber also lives near several active conventional wells. When she participated in a medical study on the effects of oil and gas development, she and her family were found to have levels of mandelic acid in their body that exceeded the 95th percentile for the general U.S. population. *Id.* ¶ 10. Mandelic acid is a metabolite of ethylbenzene and styrene, which can cause liver, kidney, and circulatory system problems and increase cancer risk. Ms. Graber's family exceeded the U.S. median, and often the 95th percentile, for numerous other biomarkers of dangerous pollutants, such as 2-methylhippuric acid (a metabolite of xylene) and trans-muconic acid (a metabolite of benzene). *Id.* They also wore portable air monitors that indicated that they were exposed to levels of benzene, ethylbenzene, and naphthalene above the risk limit set by the California Office of Environmental Health Hazard Assessment, which indicates an increased cancer risk. *Id.* ¶ 11. Ms. Graber is extremely worried about the increased

[3] Included as Attachment E.

risk of cancer and other diseases from being exposed to this pollution from both abandoned and active wells:

> It is hard to overstate the fear you are forced to live with when you and your family are exposed to these kinds of chemicals every day that you know are incredibly dangerous, and that you see are already sickening your friends and neighbors . . . . No mother should have to go through this, but so many are and no one is doing anything about it.

Id. ¶ 17. While Ms. Graber and her family have been harmed by abandoned and active conventional wells, she believes many of the worst impacts came from the fracking of those conventional wells. *Id.* ¶ 13. Thus, the negative impacts Ms. Graber has experienced may be magnified for abandoned unconventional wells, which are likely to use more fracking fluid and pose greater contamination risks until they are plugged.

Ann Lecuyer lives in the same neighborhood as Ms. Graber. There are 14 abandoned wells within a three-mile radius of Ms. Lecuyer's home and 38 abandoned wells within five miles. Ann Lecuyer Aff. ¶ 7.[4] There are likely dozens to hundreds more abandoned wells near her home that have not been identified by DEP, and she lives near numerous active conventional wells as well. *Id.* Ms. Lecuyer's asthma has gotten worse since moving to the area five years ago. In November 2018, for the first time in her life she had to be taken to the emergency room via ambulance due to an asthma attack, and she has since been prescribed additional medication for her asthma. *Id*. ¶ 11. "Having to go to the emergency room because of difficulty breathing was very scary, and it is frustrating to have to deal with additional difficulties with my asthma on a regular basis," she says. *Id.*

Ms. Lecuyer believes her worsened asthma is at least partially caused by the large number of abandoned and active wells in her neighborhood: "We live in a valley between two hills, and I believe that this traps air pollution in and makes it worse. I am concerned that whatever pollutants are coming up from these wells are sitting in the air and we are breathing it in . . . ." *Id.* ¶ 12. Ms. Lecuyer and her family participated in the same medical study as Ms. Graber, and the study showed that she and her family also had much higher levels of dangerous, cancer-causing pollutants in their bodies than the vast majority of Americans. *Id.* ¶ 8.

[4] Included as Attachment F.

While the pollution affecting Ms. Lecuyer comes from conventional wells, there is no reason to believe that abandoned unconventional wells would have a less serious impact.

There are numerous Pennsylvanians who are dealing with similar negative consequences as Ms. Graber and Ms. Lecuyer because they live near abandoned wells. If these wells were plugged, much of the pollution these communities are exposed to would dissipate. As Ms. Lecuyer says, "It is known that unplugged abandoned wells leak, and plugging them would stop this leakage. This should lower the health risks my family and I face living next to these abandoned wells." *Id.* ¶ 15.

In addition to causing serious health impacts, the large amounts of methane emitted by abandoned wells also exacerbate climate change. Methane leaks from abandoned wells "account for as much as seven percent of the annual anthropogenic methane emissions in the Commonwealth." Weber Report 5. This is "equivalent to the annual greenhouse gas emissions from 200,000 to 250,000 passenger cars." *Id.* Thus, simply by ensuring that abandoned wells are plugged, as is already required under the law, the Commonwealth could eliminate a substantial portion of its greenhouse gas ("GHG") emissions.[5] There are few other policies that could have such a significant impact on reducing GHG emissions simply by ensuring existing law is followed.

Abandoned wells also have significant quality-of-life consequences for the communities they are scattered throughout. Abandoned wells are an eyesore, "appearing as uncultivated or unmowed islands in fields or backyards. Wellheads, which are made up of pipes and valves, often extend about six feet into the air and can be accompanied by metal tanks, pipes, and pumps, all of which are removed as part of plugging." Weber Report 5. These wells take away the peace of mind that comes from spending time in the beautiful environments in which they are often located. Ms. Graber explains: "I cannot walk in the woods near my home without seeing a

[5] *See* Pa. Dep't of Envtl. Prot., *Pennsylvania Climate Action Plan 2018* 80 (2019) (listing the plugging of abandoned wells as a cost-effective mitigation strategy that the state could take to meet its climate goals), available at http://www.depgreenport.state.pa.us/elibrary/PDFProvider.ashx?action=PDFStream&docID=1454161&chksum=&revision=0&docName=2018+PA+CLIMATE+ACTION+PLAN&nativeExt=pdf&PromptToSave=False&Size=4617270&ViewerMode=2&overlay=0.

gas well. I often wonder, 'Am I being exposed just by walking along this path?' I get out in nature to avoid pollution, but that's where many of these wells are." Graber Aff. ¶ 18.

These quality-of-life concerns have real economic consequences. Abandoned wells depress nearby property values. A recent study concluded that from 1970 to 2017, the two acres surrounding plugged wells had an approximately 50 percent increase in building activity as compared to the two acres surrounding unplugged wells, resulting in an average reduction in the market value of property surrounding an unplugged well of 12 percent, or $22,000.[6] This harms the local economy and suppresses the local tax base. The Weber Report examined the impact of depressed property values on the region of Pennsylvania with the most unplugged wells—McGuffey School District in Washington County—and found that abandoned wells caused the district to lose $112 per student every year, and cost Washington County as a whole over $500,000 annually. Weber Report 5-6.

Further, wells that are abandoned by an operator that goes bankrupt or refuses to plug the wells must eventually be plugged by the Commonwealth. Because current bond amounts are much too low and do not cover the actual cost of plugging, the Commonwealth must use significant taxpayer funding to close these wells. Indeed, taxpayers could be forced to pay as much as $12.15 billion just to plug the existing wells that have been drilled to date. *See infra* Section II.A.1. If bond amounts are increased, operators will be properly incentivized to close abandoned wells themselves. Even if an operator goes bankrupt, the state will have enough money via bonds to plug the wells without having to use taxpayer money. Thus, taxpayers will not be forced to pay for plugging costs that should be borne by the private operators that drilled and profited from the wells. In sum, the harmful consequences of abandoned wells are numerous and severe, while plugging those wells would yield significant environmental, public health and safety, and financial benefits.

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[6] Max Harleman, Jeremy Weber, & Daniel Berkowitz, *Environmental Hazards and Local Investment: A Half-Century of Evidence from Abandoned Oil and Gas Wells* 3, 21 (2020), available at https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID3692098_code920036.pdf?abstractid=3692098&mirid=1.

II. The EQB Should Increase Bond Amounts to $83,000 for Unconventional Wells and Set Blanket Bonds to the Sum of an Operator's Individual Bond Liability

To prevent these serious public health, environmental, and fiscal consequences from orphaned wells, the EQB must set bond amounts at a level that reflects the actual cost of plugging wells (*i.e.*, full-cost bonding). Unfortunately, the current bond amounts are much too low—covering as little as 0.4 percent of the actual cost of plugging. *See infra* Section II.A.1. To determine an appropriate amount, the Sierra Club commissioned the aforementioned expert report from Dr. Weber. Based on the data in that report, Petitioners request that the EQB raise the bond amounts to $83,000 for each unconventional well and to reconsider bond amounts every two years (or every four years if the agencies determine rulemaking will take longer than two years). Petitioners also request that the EQB set blanket bonds equal to the sum of the individual bonds that an operator would otherwise have to pay. Failing to act on this petition and to raise the currently inadequate bond amounts would constitute a capricious disregard of material, competent evidence.

A. Full-cost bonding is necessary to ensure operators plug abandoned wells

Requiring full-cost bonding is necessary to ensure that abandoned wells are plugged and to prevent the serious negative consequences described in Section I. The current system, in which the state fines operators that do not plug abandoned wells in an attempt to force compliance with well closure requirements, has failed to prevent thousands of wells from being abandoned by operators. Further, this system, as well as other alternatives to full-cost bonding, puts the state at risk of seeing a massive surge of orphaned wells if, or when, oil and gas prices no longer support the operations of both large- and small-scale operators and operators are forced into bankruptcy.

1. Pennsylvania currently does not have full-cost bonding

The current bond amounts do not come close to reflecting the actual cost of well plugging. For unconventional wells with a total well bore length of more than 6,000 feet, the Commonwealth currently requires bond amounts of $10,000 per well. 58 Pa. Cons. Stat. § 3225(a)(1). Different blanket bonds then apply based on the number of wells the operator owns. Consequently, the actual bond amount is lower than $10,000 per unconventional well for

any operator that owns more than fourteen wells, with a maximum bond amount of $600,000 per company no matter how many wells the company owns. *Id.*

An analysis by Carbon Tracker shows just how woefully inadequate the state's current bond amounts are. Carbon Tracker has a portal that tracks every identified unplugged oil and gas well in the state, the bond amounts posted by the operators, and the total cost of actually plugging all of the identified unplugged wells in the state.[7] Carbon Tracker almost certainly undercounted the number of unplugged oil and gas wells in the state—it is impossible to track all of the orphaned wells since so many were drilled before a full permitting scheme was in place and thus are not on any lists.[8] The portal uses a formula for calculating the cost of plugging each well based on a dataset of wells plugged in Australia.[9] Under that formula, the plugging cost per well changes as the "true vertical depth" of a well increases. *Id.* This formula likely overestimates the cost of plugging wells in Pennsylvania because it relies on data from operators that plugged wells as they stopped producing, such that wells were plugged one at a time or in batches of just a few wells. *Id.* When the Commonwealth plugs wells, it usually plugs multiple wells at one time per contract, which reduces the cost of plugging each individual well. *Id.*; *see also infra* Section II.B.

Even with these uncertainties in mind, Carbon Tracker's estimates demonstrate the extreme financial liability that orphaned wells pose for taxpayers. The portal estimates that it would cost $12.2 billion to plug all identified wells in Pennsylvania, and that the state has $47.2 million in bonding available to plug these wells.[10] That is a bonding ratio of *0.4 percent*. In other words, 99.6 percent of the total cost of plugging these wells, or $12.15 billion, is unaccounted for. Even if the plugging costs estimated by Carbon Tracker are ten times higher than the actual costs—which is unlikely—Pennsylvania's currently available bond amounts would still cover only 3.8 percent of the total cost to plug all existing unplugged wells in the state identified by Carbon Tracker, and there would be a bonding shortfall of $1.22 billion. Further, as mentioned

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[7] *Asset Retirement Obligations (ARO) Portal*, Carbon Tracker, https://carbontracker.org/tools-and-insights/aro-portal/ (last visited Sept. 8, 2021).
[8] Off. of Oil and Gas Mgmt., *supra* note 1, at 13 (presentation by DEP stating that "between 100,000 to 560,000 legacy wells . . . have not yet been accounted for").
[9] *ARO Portal User Manual*, Carbon Tracker, https://carbontracker.org/aro-portal-user-manual/ (last visited Sept. 8, 2021).
[10] Carbon Tracker, *supra* note 7.

earlier, it is likely that Carbon Tracker's estimate does not account for a large number of unidentified wells, meaning that the actual cost to plug all unplugged wells in the state may even be higher than Carbon Tracker's estimate. This analysis makes it clear that the state does not currently have a full-cost bonding system in place.

2. Lack of full-cost bonding has resulted in the abandonment of thousands of wells

In the absence of full-cost bonding, operators are not incentivized to plug abandoned wells. DEP lacks the resources to force operators to comply with plugging requirements through enforcement actions. Further, if an operator has been allowed to drill wells that it does not have the money to plug, no enforcement action can make the operator plug the well.

The failure of the current non-full-cost bonding system is evidenced by the enormous number of wells across Pennsylvania that have been abandoned for years, but which DEP has not ensured are plugged (under Pennsylvania law, any well that has not produced oil or gas for at least a year is legally abandoned, 58 Pa. Cons. Stat. § 3203). DEP lists 8,848 conventional wells as abandoned or orphaned but not plugged.[11] DEP has acknowledged that there are up to an additional 560,000 orphaned wells that have not been accounted for and thus are not on any list.[12] In addition, there are 5,415 conventional wells that did not produce oil or gas in any year between 2017 and 2020 (inclusive), but that were still listed as "active" by DEP, comprising more than seven percent of all "active" conventional oil and gas wells in the Commonwealth.[13] Finally, there were over 2,000 wells listed as active in every year from 2013 to 2020 that failed to produce over that eight-year period, comprising nearly three percent of all active conventional wells in the state. In other words, approximately one of every 14 conventional wells listed as

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[11] *Orphan & Abandoned Wells*, Pa. Dep't of Envtl. Protection Off. of Oil and Gas Mgmt., http://cedatareporting.pa.gov/Reportserver/Pages/ReportViewer.aspx?/Public/DEP/OG/SSRS/Abandoned_Orphan_Web (last visited Sept. 10, 2021).

[12] Off. of Oil and Gas Mgmt., *supra* note 1, at 13.

[13] *Unclosed Conventional Wells, PA*, Sierra Club, https://www.google.com/maps/d/u/0/viewer?mid=1RbWAxS5TU6IDcQpq6agoHxL31xTk7uOP (report generated July 23, 2021); *see also Oil and Gas Production Reports*, Pa. Dep't of Envtl. Protection Off. of Oil and Gas Mgmt., http://cedatareporting.pa.gov/Reportserver/Pages/ReportViewer.aspx?/Public/DEP/OG/SSRS/OG_Well_Prod_Status. Wells in the survey are restricted to conventional wells listed as active in both 2013 and 2020, and identified as oil, gas, condensate, or coalbed methane wells.

operational in Pennsylvania has been violating the state's plugging requirements for at least four years. Yet DEP appears not to have taken enforcement action against many of these "active" wells. This level of enforcement is likely why Pennsylvania's non-full-cost bonding system has led to thousands of wells abandoned over the past two decades remaining unplugged for years—not to mention the hundreds of thousands of wells that were abandoned or orphaned previously that remain unplugged.

Ann Lecuyer experienced the issues with Pennsylvania's current system for plugging abandoned wells first-hand. After receiving the results of the study showing she had elevated rates of several cancer-causing chemicals in her body, she looked up the records for all oil and gas wells within a few miles of her home. She found numerous wells that had no production reports associated with them for several years but were still listed as active, and alerted DEP to this discrepancy. Lecuyer Aff. ¶ 14. DEP did not take any enforcement action against any of the wells Ms. Lecuyer sent them. *Id.*

Currently, it is almost entirely conventional wells that have been abandoned by operators without being plugged, as unconventional well drilling began relatively recently, and in most cases the oil or gas reserves for these wells have not yet been exhausted. However, the failure of the current non-full-cost bonding system to ensure that abandoned conventional wells are plugged will only repeat itself for unconventional wells as their reserves begin to be exhausted. In sum, if Pennsylvania's current non-full-cost bonding system worked to plug wells after production ceased, and the Commonwealth could rely on the threat of fines to compel operators to plug their abandoned wells, the system would not have left the state with over 14,000 confirmed unplugged wells (and likely hundreds of thousands of unconfirmed unplugged wells) that have been abandoned for years. 5,415 of these wells have been abandoned within approximately the last decade, under the current bonding system. These wells pollute the Commonwealth and threaten the health and safety of its citizens.

3. Lack of full-cost bonding exposes taxpayers to further liability if the health of the oil and gas industry continues to decline

The gap between the level of financial assurance provided to the Commonwealth by oil and gas operators and the cost of the Commonwealth's ultimate obligation threatens to transfer

substantial liability to the Commonwealth (and thus taxpayers) if, or when, the oil and gas industry faces additional financial pressure.

The U.S. Government Accountability Office explained in a report on a self-bonding program restricted to the most financially stable coal mine operators that because of the decline of the coal industry, even the largest operators are now financially unstable.[14] That has resulted in more and more bankruptcies by self-bonded coal mine operators, which pushes remediation costs onto the states. The oil and gas industry now faces a similar decline, increasing the likelihood that operators will go bankrupt and making the failure to require full-cost bonding even more problematic.

This wave of bankruptcies will not spare large operators. As evidenced by the bankruptcy of Chesapeake Energy in June 2020, oil and gas financial risk is less dependent on the productivity of any given well, and far more dependent on national or global movements: a sustained downturn in oil or gas prices impacts large operators just as it does small operators. Like the subprime mortgage crisis of 2008, an assumption that the diversity of the underlying assets protects creditors, when in fact the entire underlying asset class is at risk, poses a serious risk to the last entity holding the bag (in this case, the Commonwealth and its taxpayers). When companies do go bankrupt, their closure obligations should be characterized as non-dischargeable administrative obligations, but in many cases bankruptcy proceedings either do not explicitly seek to protect that state interest or to guarantee a cashflow sufficient to meet closure obligations, or simply are not able to generate enough cash to discharge those obligations.

B. Bond amounts should be increased to $83,000 per unconventional well

The expert report by Dr. Weber analyzes what full-cost bonding would require. The report first estimates plugging costs for the average well plugged by DEP from 1989 to 2020—a dataset that consists entirely of conventional wells. Weber Report 7-8. It then adjusts this average number to reflect a growth in well plugging costs over time, and estimates an average cost for plugging a conventional well in 2021. The report uses this data to estimate the expected cost of plugging unconventional wells in 2021 and 2022. It adjusts the data on conventional

[14] Gov't Accountability Office, *Coal Mine Reclamation: Federal and State Agencies Face Challenges in Managing Billions in Financial Assurances,* 22-23 (2018), available at https://www.gao.gov/assets/gao-18-305.pdf.

wells to reflect the increased cost due to increased well depth (which the report estimates at $1.90 per foot), as well as the increased cost of plugging solely gas wells as compared to a mix of oil and gas wells. *Id.* at 13. The report finds an average cost to plug an unconventional well in 2021 of $70,000 if the Commonwealth employs larger plugging contracts (an average of 55 wells per contract). *Id.* With plugging contracts akin to those that the Commonwealth has employed since 2011 (an average of 14 wells per contract), the report estimates the cost of closing the average unconventional well would be $83,000 at the end of 2021. *Id*. at 15.

The report finds that since 2011 the average well that DEP plugged was in a contract with 14 wells, while from 2000 to 2011 the average well that DEP plugged was in a much larger contract. *Id.* at 14-15. The higher contract size for the average well from 2000 to 2011 was likely due to the Growing Greener program, which was established in 1999 and provided $650 million over five years for environmental conservation.[15] This funding allowed DEP to plug more wells, resulting in larger contract sizes. Weber Report 15. Because larger contract sizes generate economies of scale, the report provides two estimates of average plugging costs for an unconventional well depending on different assumptions regarding the contract size that the average well will be plugged in. The report first estimates an average plugging cost of $70,000 for an unconventional well, calculated using the contract size in which the average well was plugged from 1989 through 2020 (i.e., 55 wells per contract). *Id.* at 13. The report then estimates a more recent average plugging cost of $83,000 for an unconventional well, calculated using the average contract size for wells plugged from 2011 through 2020 (i.e., 14 wells per contract). *Id.* at 15.

Petitioners request that the EQB adopt bond amounts of $83,000 for unconventional wells. While the size of future plugging contracts is unknown, setting the bond rate at a lower value on the assumption that future plugging contracts will be large carries a far higher risk to the Commonwealth than the imposition of marginally higher bonding rates based on recent plugging contracts. As the Weber Report explains, the economies of scale effect is diminished for contracts with more than 15 wells; while plugging costs decline dramatically as contract size increases from one to 15 wells, the rate of decline slows greatly after that. *Id*. at 15-16.

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[15] *Revenue & Legislative History*, Envtl. Stewardship Fund, https://esfund.info/how-growing-greener-works/enabling-legislation/ (last visited Aug. 12, 2021).

Therefore, if the state sets bonding costs at the higher value (i.e., $83,000) and future plugging contracts are large, the state will have required bonds marginally in excess of plugging costs. But if the state sets bonding costs at the lower value (i.e., $70,000) and future plugging contracts are smaller than 14 wells, the state will have set bond amounts at a level much lower than the actual cost of plugging, a condition which prevails today. In other words, it is much more likely that a bond amount of $70,000 will greatly underestimate the actual cost of plugging than it is that a bond amount of $83,000 will greatly overestimate the cost of plugging.

Petitioners request that in addition to increasing the bond amounts this year, the EQB reconsider bond amounts every two years, as envisioned by the legislature when the current bond amounts were set. *See* 58 Pa. Cons. Stat. § 3225(a) (giving the EQB authority to adjust bond amounts "every two years to reflect the projected costs to the Commonwealth of plugging the well"). The Weber Report calculated projected costs to plug a well in 2021 but explained that "plugging costs rose over the three-decade period even after adjusting for inflation." Weber Report 10-11. The Weber Report recommends updating bond amounts every two years to account for steadily rising costs. *Id.* at 12. Dr. Weber concludes that this is "especially important in the case of unconventional wells because there is currently no publicly available data on the cost of plugging unconventional wells in Pennsylvania," and it is possible additional data will come to light that results in a different cost estimate. *Id.* at 13. This petition asks the EQB to act on that proposal by requiring DEP to prepare a report every two years (starting in 2025) that examines plugging costs and recommends to the EQB whether it should adjust bond amounts. However, if DEP and the EQB believe that the agencies cannot issue regulations updating bond amounts within a two-year time period, petitioners suggest that the agencies modify the proposed regulatory language to require DEP to prepare a report every four years. If DEP does recommend a change in bond amounts, the proposed regulatory language requires DEP to draft a proposed rule within six months of filing its report.

C. Blanket bonds should be set to the sum of total per-well bonding amounts

In addition to requesting that the EQB raise bond amounts for individual wells, Petitioners request that the EQB revise the blanket bond amount to make it equal to the sum of per-well bonding amounts that an operator would otherwise have to pay (referred to herein as "full-coverage blanket bonds"). Under a full-coverage blanket bond, an operator that owns ten

unconventional wells could choose to provide a single bond of $830,000 rather than ten individual bonds of $83,000 each. This would provide operators the ease of administrability that the legislature intended while ensuring that operators furnish resources sufficient to cover the actual cost of closing all their wells.

Full-coverage blanket bonds are much better supported by the data than blanket bonds of a set value for which the per-well bond amount shrinks as the number of wells covered by the blanket bond increases (referred to herein as "diminishing-coverage blanket bonds"). The main argument in favor of diminishing-coverage blanket bonds appears to be that large operators carry a more diverse array of wells, and thus spread their risk over a wider pool of wells and experience lower volatility. However, large operators that do appear to be financially stable already have the option of obtaining discounted bond premiums. Many operators choose to meet their bonding obligations by paying for surety bonds, where a third-party surety guarantees to the state that it will pay the required bond if it is forfeited to the state, and the operator pays the surety a small percentage of the bond amount every year. Weber Report 16-18. As the Weber Report explains, more stable operators pay less to sureties "because sureties base their rates on an operator's finances and the risk that it defaults on its plugging obligations." *Id.* at 16. Therefore, even without blanket bonds, a larger operator that actually is more financially secure can obtain lower rates. Further, as explained in Section II.A.3, large operators are not all financially secure and do in fact go bankrupt; accordingly, a blanket bond system based on the unsupported assumption that they will not is inherently unstable.

This petition and the accompanying Weber Report at attachment C lay out clearly, through a data-based analysis, the average plugging costs for unconventional wells. The current bond amounts fall well below that mark. This failure to require full-cost bonding ensures that wells will be abandoned and orphaned, in violation of the law. *See* 58 Pa. Cons. Stat. § 3220 (describing plugging requirements). 58 Pa. Cons. Stat. § 3225(a)(1) specifically informs the EQB that it should ensure that bonding levels reflect the cost of closure. If the EQB nonetheless fails to act on this petition, it would be capriciously disregarding substantial, material evidence that well bond amounts must be increased. *See Leon E. Wintermyer, Inc. v. Workers' Comp. Appeal Bd. (Marlowe)*, 812 A.2d 478, 487 (Pa. 2002).

III. The EQB Should Apply the Increased Bond Amounts to Existing Bonded Wells

The EQB should apply the increased bond amounts to both new wells and existing wells. Applying the adjusted amounts to existing wells is necessary to ensure the bonding program serves its intended purpose and is consistent with the language of the statute and Commonwealth precedent.

A. Applying the increased bond amounts to existing wells is necessary to address a major part of the abandoned well problem

As discussed above, an appropriate bonding level removes an operator's incentive to retain, rather than plug, unproductive wells. The EQB must raise bonding amounts for existing wells in addition to new wells in order to incentivize operators to plug not only newly drilled wells, but also the thousands of wells that have already been drilled. There are 12,796 unconventional wells that have been drilled in the state and 10,105 that reported gas production in 2020 according to DEP.[16] If increased bond amounts do not apply to these wells, their operators will continue to lack the incentives to close them when production ceases. Closing these existing wells when they become unproductive, as incentivized through appropriate bonding amounts, will result in avoiding the serious environmental harms described in Section I. It will also result in new well-plugging jobs (discussed *infra* Section IV) becoming available sooner, as existing wells are likely to become unproductive sooner than newly drilled wells, and the operators of these wells will need to hire workers to plug them if the operators are properly incentivized to follow the law.

Further, if the EQB failed to increase bond amounts for existing wells, then taxpayers would still be on the hook for all existing wells that cannot or will not be plugged by their owners. As discussed in Section II.A.1, Carbon Tracker estimates that Pennsylvania currently has a bonding shortfall of $12.15 billion. If bond amounts are not adjusted for existing wells, taxpayers would still be liable for this enormous closure obligation. Failing to apply adjusted

[16] *2020 Oil and Gas Annual Report*, Pa. Dep't of Envtl. Prot., https://storymaps.arcgis.com/stories/af368dfb17bd4f219ea0ee22bd4c514a (last visited Sept. 8, 2021).

bond amounts to existing wells would thus be contrary to the purpose of the bonding program and would constitute a capricious disregard of material evidence.

B. The EQB has the authority to apply increased bond amounts to existing unconventional wells

The plain text of 58 Pa. Cons. Stat. § 3225 ("Section 3225") authorizes the EQB to apply adjusted bond amounts to existing wells. Section 3225 was passed as a part of Act 13, the main law governing fracking. It requires bonds for both new and existing wells,[17] and states: "The amount of the bond required . . . may be adjusted by the Environmental Quality Board every two years to reflect the projected costs to the Commonwealth of *plugging the well* . . . ." 58 Pa. Cons. Stat. § 3225(a)(1) (emphasis added). In other words, the language sets out a required bond amount for new and existing wells, and states that the bond amount for each individual well can be adjusted by the EQB to reflect the projected cost of plugging it. This is made clear by the reference to "the well," which indicates that each well that requires a bond can have its bond amount changed. The EQB thus has the authority to adjust bond amounts for all existing unconventional wells.

IV. Increasing Well Bond Amounts Will Create Jobs, and Will Not Have an Outsized Effect on the Oil and Gas Industry

As described in Sections I-III, increasing well bond amounts to reflect actual plugging costs will protect the environment, public health, and the taxpayers of Pennsylvania. In addition, as evidenced by comparing projected bond increases to the unconventional well impact fee imposed by Act 13, increasing bond amounts will have only minor impacts on unconventional well operators. Furthermore, it will have positive effects on job creation.

[17] *See* 58 Pa. Cons. Stat. § 3225(a)(1) ("[U]pon filing an application for a well permit *and before continuing to operate an oil or gas well*, the owner or operator of the well shall file with the department a bond covering the well and well site on a form to be prescribed and furnished by the department.") (emphasis added). 71 Pa. Stat. and Cons. Stat. Ann. § 510-34 (West) exempts wells drilled prior to April 18, 1985 from bonding requirements, but no unconventional wells were drilled in that time period.

The unconventional well impact fee was a fee that the legislature allowed any county or municipality to impose on unconventional gas wells located within its boundaries.[18] This fee was imposed on all unconventional wells, including those drilled before the law was passed. For purposes of determining the fee amount, the fee schedule treated existing wells as if they had been spud in the calendar year prior to the imposition of the fee. 58 Pa. Cons. Stat. § 2302(b). Imposition of the impact fee had "imperceptible effects" on industry. Weber Report 4. A 2016 study found that well drilling underwent modest, if any, decline in the months after the fee's enactment.[19] Bond increases would have a similarly negligible effect. The Weber Report determined that increasing unconventional well bonds to $70,000 would only increase operator costs by one-fifth of the cost of the impact fee. Weber Report 18. A bond amount of $83,000 rather than $70,000 will increase operator costs slightly more, but likely not by much. Because well bond increases are projected to have an even smaller effect on unconventional operators than the minimally harmful impact fee, the bond increases will not have a major impact on unconventional operators.

In addition, ensuring that unconventional wells are plugged in a timely manner by increasing bond amounts will create jobs in the Commonwealth. For example, the Ohio River Valley Institute ("ORVI") found that plugging every known abandoned well in Pennsylvania would create 3,960 jobs over 20 years.[20] These would be good-paying jobs, with an average annual salary of $58,024. *Id.* at 32. Moreover, a report by Resources for the Future and Columbia University's School of International and Public Affairs found that "there is a clear match between the skills of unemployed oil and gas workers and the requirements needed to plug

[18] 58 Pa. Cons. Stat. § 2302; *Act 13 Impact Fee*, Pa. Pub. Util. Commission, https://www.puc.pa.gov/filing-resources/issues-laws-regulations/act-13-impact-fee/ (last visited Aug. 19, 2021).

[19] Katie Jo Black, Shawn J. McCoy, & Jeremy G. Weber, *When Externalities Are Taxed: The Effects and Incidence of Pennsylvania's Impact Fee on Shale Gas Wells*, 5 J. Ass'n Envtl. and Resource Economists 107 (2018).

[20] Ted Boettner, Ohio River Valley Inst., *Repairing the Damage from Hazardous Abandoned Oil & Gas Wells: A Federal Plan to Grow Jobs in the Ohio River Valley and Beyond,* 32-33 (2021), available at https://ohiorivervalleyinstitute.org/wp-content/uploads/2021/04/Repairing-the-Damage-from-Hazardous-AOG-Wells-Report-1.pdf.

orphaned and other abandoned wells properly."[21] ORVI found that the number of jobs created by plugging all abandoned wells in the Ohio River region would be more than the 12,770 oil and gas jobs lost in the region over the past five years.[22] As existing unconventional wells begin to stop producing at higher numbers, the number of jobs available in well plugging will only increase if operators are properly incentivized to plug their non-producing wells. Expanding job opportunities in well plugging is exactly the kind of just transition that many communities have been demanding for years. As President Biden stated in describing his proposal for a $16 billion fund to plug orphaned wells and mines across the country:[23]

> My American Jobs Plan will put hundreds of thousands of people to work . . . capping hundreds of thousands of, literally, orphan oil and gas wells that need to be cleaned up because they're abandoned—paying the same exact rate that a union man or woman would get having dug that well in the first place.[24]

The economic impact of acting on this petition would thus be generally positive.

V. The EQB Has the Authority to Act on This Petition

The EQB has the authority to act on this petition and should use its lawful authority to do so. Sections II and III of this petition set forth a clear description of the action requested, and suggested regulatory language is set forth in Attachment B. 25 Pa. Code § 23.1(a)(2)(i). Sections I-IV of this petition, along with the Weber Report at Attachment C, set forth the facts that mandate the EQB's action adopting the proposed regulation and describe the impacts of the proposed regulation, including the types of persons, businesses, and organizations likely to be impacted. *Id.* § 23.1(a)(3)-(a)(4). Sections V and VI will now set forth both the legal authority to

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[21] Daniel Raimi et al., Res. for Our Future & Columbia SIPA Ctr. on Glob. Energy Policy, *Green Stimulus for Oil and Gas Workers: Considering a Major Federal Effort to Plug Orphaned and Abandoned Wells,* 16 (2020), available at https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/OrphanWells_CGEP-Report_071620.pdf.

[22] Ohio River Valley Inst., *supra* note 20, at 32-33.

[23] *Biden Infrastructure Plan Would Spend $16 Billion To Clean Up Old Mines, Oil Wells*, PBS NewsHour (Apr. 1, 2021), https://www.pbs.org/newshour/nation/biden-infrastructure-plan-would-spend-16-billion-to-clean-up-old-mines-oil-wells.

[24] Remarks by President Biden on the American Jobs Plan (Mar. 31, 2021), available at https://www.whitehouse.gov/briefing-room/speeches-remarks/2021/03/31/remarks-by-president-biden-on-the-american-jobs-plan/.

adopt the proposed regulation and the constitutional mandate requiring its adoption. *Id*. § 23.1(a)(3). Finally, Attachment D lists well bond amounts in other states and at the federal level for the EQB's use during the Independent Regulatory Review process.

A. The EQB's well bonding statutory authority

Section 3225 governs the EQB's authority to increase bond amounts. The law sets specific bond amounts, but authorizes the EQB to adjust the amounts initially established by statute:

> The amount of the bond required shall be in the following amounts and may be adjusted by the Environmental Quality Board every two years to reflect the projected costs to the Commonwealth of plugging the well:
>
> (ii) For wells with a total well bore length of at least 6,000 feet:
>
> > (A) For operating up to 25 wells, $10,000 per well but no bond may be required under this clause in excess of $140,000.
> >
> > (B) For operating 26 to 50 wells, $140,000 plus $10,000 per well for each well in excess of 25 wells but no bond may be required under this clause in excess of $290,000.
> >
> > (C) For operating 51 to 150 wells, $290,000 plus $10,000 per well for each well in excess of 50 wells but no bond may be required under this clause in excess of $430,000.
> >
> > (D) For operating more than 150 wells, $430,000 plus $10,000 per well for each well in excess of 150 wells but no bond may be required under this clause in excess of $600,000.

58 Pa. Cons. Stat. § 3225(a)(1). The statute also states: "In lieu of individual bonds for each well, an owner or operator may file a blanket bond for the applicable amount under paragraph [3225(a)](1), on a form prepared by the department, covering all of its wells in this Commonwealth, as enumerated on the bond form." 58 Pa. Cons. Stat. § 3225(a)(2). Because only unconventional wells have a well bore length of greater than 6,000 feet, this petition will refer to such wells as unconventional wells. Section 3225 authorizes the EQB to act on this petition and adjust bond amounts.

B. Under the plain language of the statute, the EQB has authority to increase bond amounts

Under the plain language of Section 3225, the EQB has authority to adjust both individual and blanket bond amounts to whatever number reflects the cost of plugging a well. Section 3225(a)(1) authorizes the EQB to adjust bond amounts. The language in sub-sections 3225(a)(1)(ii)(A)-(D) that states "but no bond may be required under this clause in excess of" a certain amount does not set upper limits on what blanket bond amount the EQB may set for unconventional wells. This language is specific to the sub-clauses it is within, (a)(1)(ii)(A)-(D), and states what the initial blanket bond amounts are for well operators governed by each sub-clause. It does not restrict the EQB's authority to adjust blanket bond amounts, which is laid out in (a)(1). In other words, the "under this clause" language sets rules for what the initial bond amounts shall be, but does not restrict the EQB's authority when it adjusts bond amounts.

There is no language in the main clause (Section 3225(a)(1)) cabining the EQB's authority to adjust the blanket bond amounts to reflect the cost of plugging a well. While the main clause states that bonds "shall be in the following amounts," this sets an initial bond amount that the statute then authorizes the EQB to adjust. 58 Pa. Cons. Stat. § 3225(a)(1). The statute states that the "following amounts" that the bonds "shall be in" can "be adjusted by the Environmental Quality Board." *Id.* Further, the statute states that the EQB may adjust the bond amounts "to reflect the projected costs to the Commonwealth of plugging the well." *Id.* A bond amount of $5,600 per well, which would be the per-well bond amount for an operator who owns 25 unconventional wells if the current blanket bond amount could not be changed, does not "reflect the projected costs to the Commonwealth of plugging the well."

In addition, the language of Section 3225(a)(2), which allows operators to file "a blanket bond for the applicable amount under paragraph [3225(a)](1)" instead of individual bond amounts, *id.* § (a)(2), does not restrict the EQB's authority to adjust the initial blanket bond amounts that the legislature wrote into Section 3225(a)(1). This clause refers to the "applicable" blanket bond amount under paragraph (a)(1), and paragraph (a)(1) gives the EQB authority to adjust bond amounts. Accordingly, the EQB can use its authority under section (a)(1) to adjust the blanket bond amounts, and section (a)(2) then allows the operator to post that applicable blanket bond amount rather than individual bonds.

C. Canons of statutory construction support the EQB's authority to increase bond amounts

A restrictive reading of Section 3225 that severely limits the EQB's authority to increase blanket bond amounts would go against basic common sense. It would be nonsensical for the legislature to have authorized the EQB to adjust bond amounts to reflect the projected costs of well plugging, but then cabin its authority to adjust these amounts to such a degree that the authority given to the EQB is rendered meaningless in practice.

Three rules of statutory construction support the EQB's authority to raise blanket bond amounts under Section 3225 to whatever level it concludes reflects the cost of plugging a well. First, whenever possible, a statute should be read not to contradict itself. *See* 1 Pa. Cons. Stat. § 1933 ("Whenever a general provision in a statute shall be in conflict with a special provision in the same or another statute, the two shall be construed, if possible, so that effect may be given to both."). If a restrictive reading of Section 3225 were correct (i.e., that the EQB is not authorized to adjust the blanket bond amounts), there would be a direct conflict between the language authorizing the EQB to adjust bond amounts "to reflect the projected costs to the Commonwealth of plugging the well," § 3225(a)(1), and any purported limitation on increasing blanket bonds (which would keep bond amounts dramatically lower than the actual cost to the Commonwealth of well plugging). Because another reading of the statute is not only possible but also more coherent, the understanding of the statute that avoids this glaring conflict should prevail.[25]

Next are the canons against surplusage and absurdity. Pennsylvania law states:

> In ascertaining the intention of the General Assembly in the enactment of a statute the following presumptions, among others, may be used: (1) That the General Assembly does not intend a result that is absurd, impossible of execution or unreasonable. (2) That the General Assembly intends the entire statute to be effective and certain.

1 Pa. Cons. Stat. § 1922. A restrictive reading of Section 3225 that prevents the EQB from adjusting blanket bond amounts would effectively write the language stating that bond amounts may be raised to reflect the cost of plugging out of the statute, and render the EQB's authority to

[25] For this same reason, the section of the statute giving the EQB authority to adjust bond amounts and the section stating what the initial bond amounts shall be are not in irreconcilable conflict.

raise bond amounts essentially meaningless. This interpretation would also lead to an absurd situation where the EQB technically has authority to adjust bond amounts for individual wells, but any attempt to do so would affect a tiny fraction of operators in very random ways. Because the blanket bond cap essentially resets at 0, 26, 51, and 150 unconventional wells, under a restrictive reading of the statute any change in the bond amount for individual wells would affect operators who own that number of wells (or a few more), but no one else. For example, under this petition's request of $83,000 per unconventional well, any operator who owns 2-24 or 27-49 unconventional wells would see no increase in the amount they had to pay if they sought to drill an additional unconventional well, but an operator who owned one well, 25 wells, or 26 wells would have to pay between $57,000 and $83,000 more if they sought to drill an additional well. This would be an absurd result. These canons make it clear that Section 3225 gives the EQB the authority to increase the initial legislatively-determined blanket bond amounts.

VI. The Environmental Rights Amendment Requires the EQB To Act on This Petition and Raise Bond Amounts

The EQB has a constitutional obligation to act on this petition and increase well bond amounts. Article I, Section 27 of the Pennsylvania Constitution states:

> The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.

Pa. Const. art. I, § 27. This amendment creates a right of citizens to a clean environment, *Pa. Envtl. Def. Found. v. Commonwealth*, 161 A.3d 911, 931 (Pa. 2017) ("*PEDF*"), which the state is violating by not setting bond amounts high enough to ensure operators remediate abandoned wells.

Section 27 also creates an "environmental trust," with the state's natural environment as the corpus of the trust, the state as the trustee, and the people of Pennsylvania as the beneficiaries of the trust. *PEDF*, 161 A.3d at 932-33. In interpreting whether the environmental trust aspect of Section 27 has been violated, the Supreme Court has stated that the Commonwealth must act as a fiduciary, with the obligation to conserve and maintain the natural environment of the state for the benefit of the citizens of the state. *Id.* The current bond amounts violate the state's fiduciary

duties under Section 27. The EQB's failure to require adequate bond amounts has caused the state to be dotted with unplugged abandoned wells that spew pollution into the air and water. This degrades the state's natural resources in violation of Section 27.

A. Supreme Court Precedent Interpreting the Environmental Rights Amendment

The Pennsylvania Supreme Court issued its most definitive decision interpreting the environmental trust aspect of Section 27 in *Pennsylvania Environmental Defense Foundation v. Commonwealth*. In that case, the Supreme Court held that the state legislature violated the ERA when it took the royalties that oil and gas operators paid to the state (for permission to drill) from a fund used to pay for environmental restoration and moved much of it to the general fund to pay for priorities unrelated to the environment. The Supreme Court held that "[o]il and gas leases may not be drafted in ways that remove assets from the corpus of the trust or otherwise deprive the trust beneficiaries (the people, including future generations) of the funds necessary to conserve and maintain the public natural resources." *PEDF*, 161 A.3d at 936. In other words, the state cannot allow for the degradation of the natural environment without ensuring that proper funding is being devoted to rectify this degradation in the future—doing so would violate the state's trustee duties.

This precedent applies to the extremely low well bond amounts set by the state, which are not sufficient to pay for the actual cost of plugging wells. Here, unlike in *PEDF*, Pennsylvania is not taking the bonds that well operators post and spending them in areas unrelated to the environment. Rather, it is allowing operators to degrade the natural environment by drilling for oil and gas, while not requiring them to post bond amounts at the level necessary to restore the environment and prevent ongoing impacts once that drilling is complete. In other words, Pennsylvania is not requiring drillers to put up the funding "necessary to conserve and maintain the public natural resources." and thus is degrading the corpus of the trust.

The Supreme Court's decision in *Robinson Township, Washington County v. Commonwealth* ("*Robinson Township*") further demonstrates how Pennsylvania's insufficient bonding amounts violate Section 27. The plurality opinion in that case held that "[t]he explicit terms of the trust require the government to 'conserve and maintain' the corpus of the trust. The plain meaning of the terms conserve and maintain implicates a duty to prevent and remedy the

degradation, diminution, or depletion of our public natural resources." *Robinson Twp., Washington Cty. v. Commonwealth*, 83 A.3d 901, 957 (Pa. 2013) (internal citation omitted).[26] The court concluded that the parts of Act 13 that preempted localities from regulating oil and gas activities violated Section 27:

> [W]e do not quarrel with the fact that competing constitutional commands may exist, that sustainable development may require some degradation of the corpus of the trust . . . . But, Act 13's blunt approach fails to account for this constitutional command at all and, indeed, exacerbates the problem by offering minimal statewide protections while disabling local government from mitigating the impact of oil and gas development at a local level.

Id. at 980. The court overturned this aspect of Act 13 because it did not allow localities to properly mitigate environmental harm from oil and gas drilling, which had the effect of degrading the corpus of the trust. Similarly, here, the EQB's failure to increase the current low bond amounts results in thousands of unplugged abandoned and orphaned wells across the state by both incentivizing operators to leave abandoned wells unplugged and by not providing the state with the funding to plug orphaned wells itself. This harms the Commonwealth's environment and degrades the corpus of the trust in violation of Section 27.

Both *PEDF* and *Robinson Township* indicate that if the Commonwealth allows for the degradation of its natural resources through oil and gas drilling, it must ensure the proper funding and authority to remediate that harm to satisfy its trustee obligations under the Environmental Rights Amendment. But the current bond amounts set by the state are inadequate to ensure preservation of the natural environment. As discussed in Section II.B, *supra*, the current bonding amounts for unconventional wells are more than eight times lower than the actual cost of plugging ($10,000 versus $83,000), and that is without accounting for blanket bonds that dramatically reduce the required bond amount per well. As explained in Section II.A.1, *supra*, the state has covered only a small fraction of total well closure costs through its bonding program—one analysis pegs the amount covered at 0.4 percent. And as explained in Section II.A.2, *supra*, allowing non-full cost bonding has and will continue to result in large numbers of abandoned wells remaining unplugged, and the environment around those wells remaining

[26] While *Robinson Township* was a plurality opinion that did not have direct precedential effect, the majority in *PEDF* stated that it relied on "the statement of basic principles thoughtfully developed in that [*Robinson Township*] plurality opinion." *PEDF*, 161 A.3d at 930.

degraded. Thus, the EQB's failure to impose full-cost bonding violates the Environmental Rights Amendment.

B. Legislative History of the Environmental Rights Amendment

In addition to case law, the legislative history of the Environmental Rights Amendment and the context in which it was adopted also show how the state's current actions violate the ERA. Through the nineteenth and much of the twentieth centuries, the Pennsylvania government facilitated a boom in coal mining, originally with no obligation to clean up the mines after production ceased and no bonds required, and later with limited but still weak clean-up obligations and low bond amounts.[27] This resulted in a large number of abandoned mines polluting the state's natural resources. *Id.* at 909-10. These abandoned coal mines created massive environmental problems that persist to this day, which the Supreme Court recounted in *PEDF*. 161 A.3d at 917 (explaining that the state had to deal with "over 250,000 acres of abandoned surface mines and about 2,400 miles of streams contaminated with acid mine drainage, which did not meet water quality standards") (quoting *Robinson Twp.*, 83 A.3d at 961).

The Supreme Court explained in *PEDF* that Section 27 was passed in large part to deal with this problem of abandoned coal mines:

> The drafters and the citizens of the Commonwealth who ratified the Environmental Rights Amendment, aware of this history, articulated the people's rights and the government's duties to the people in broad and flexible terms that would permit not only reactive but also anticipatory protection of the environment for the benefit of current and future generations.

Id. at 919 (quoting *Robinson Twp.*, 83 A.3d at 963). There is a clear parallel between the historical problem of abandoned mines and the looming problem of abandoned wells. Pollution resulting from overly lax regulation of abandoned wells is exactly the kind of problem the Environmental Rights Amendment is meant to address. Because non-full cost bonding does not prevent the abandonment of oil and gas wells, and because allowing this abandonment to occur

[27] John C. Dernbach, *Pennsylvania's Implementation of the Surface Mining Control and Reclamation Act: An Assessment of How "Cooperative Federalism" Can Make State Regulatory Programs More Effective*, 19 U. Mich. J. L. Reform 903, 910 (1986).

violates the ERA, as demonstrated by recent Supreme Court precedent and the intent of the drafters, the EQB must adopt this petition and impose full-cost bonding on operators.

C. If Section 3225 is interpreted to prohibit the EQB from acting on this petition, that law violates the Environmental Rights Amendment

The ERA applies to the legislature in the same manner as it applies to executive bodies. *See, e.g.*, *PEDF*, 161 A.3d at 932 n.23 ("Trustee obligations are not vested exclusively in any single branch of Pennsylvania's government, and instead all agencies and entities of the Commonwealth government, both statewide and local, have a fiduciary duty to act toward the corpus with prudence, loyalty, and impartiality."). If Section 3225 were to be interpreted as putting hard caps on the blanket bond amounts that the EQB can set on unconventional wells, it would violate the ERA for the same reasons that a decision by the EQB to refuse to use its authority to raise bond amounts would violate the ERA. In both cases, the Commonwealth would be allowing oil and gas production to degrade the environment without ensuring that the environment could be restored after production ceased, thus violating its trustee duties. This is because the initial blanket bond amounts set by Section 3225 do not come close to covering well plugging costs. For example, an operator that owns 150 unconventional wells has to pay $2,867 per well under the current blanket bond amounts, which is only 3.5 percent of the $83,000 that the average unconventional well costs to plug. *See supra* Section II.B. A statute that sets well bond amounts that are drastically lower than the cost of plugging a well, and then fails to give the relevant regulatory agency the authority to increase those bond amounts, would not pass muster under the ERA.

CONCLUSION

Abandoned wells pollute Pennsylvania communities, harm public health, exacerbate climate change, and reduce property values. The current well bonding system, as DEP itself has acknowledged numerous times, does not come anywhere close to requiring full-cost bonding. It thus is inadequate to prevent operators from abandoning wells, and leaves the Commonwealth without adequate funding to plug orphaned wells. Dr. Jeremy Weber thoroughly reviewed the data and concluded that it costs, on average, $83,000 to plug an unconventional well if it is assumed that plugging contracts will be the same average size that they have been over the past

ten years. The EQB should grant this petition and initiate a rulemaking to adjust bonds for unconventional wells to this amount. It also should make the blanket bond amount an operator can pay equal to the sum of the cost of the individual well bonds that the operator would otherwise have to pay, and the EQB should apply all these changes to both new and existing wells. Data from the imposition of the unconventional well impact fee indicates that doing so would have minimal impacts on unconventional well operators, and other analyses indicate it would create thousands of jobs for Pennsylvanians over the next twenty years. The EQB has full authority under Act 13 to grant this petition. Failure to increase well bond amounts would not only disregard substantial evidence demonstrating the need to increase bond amounts to reflect actual plugging costs, but would also violate the Commonwealth's obligations under the Environmental Rights Amendment. To fulfill its constitutional obligations, to protect the health and well-being of all Pennsylvanians, and to safeguard Pennsylvanians' hard-earned tax dollars, the EQB must grant this petition.

Dated: September 14, 2021

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that on the 14th day of September, 2021, I filed the foregoing Petition with the Environmental Quality Board by mail via the United States Postal Service and by e-mail.

/s/ Ankit Jain
Ankit Jain

Attachment B

Proposed Regulatory Language

25 Pa. Code § 78.302a REQUIREMENT TO FILE A BOND FOR UNCONVENTIONAL WELLS

(a) For an unconventional well that has not been plugged, the owner or operator shall file a bond in the amount of $83,000 per well.

(b) In lieu of individual bonds for each well, an owner or operator may file a blanket bond covering all of its wells in this Commonwealth. The blanket amount shall be computed as the sum of the applicable individual bond or security amounts required for each well.

(c) This requirement shall apply to existing wells requiring a bond under 58 Pa. Cons. Stat. § 3225.

(d) By January 3, 2025, the Department shall submit a report to the Environmental Quality Board evaluating whether the Board should adjust bond amounts further. The Department's report will include a recommendation on whether the Board should adjust the bond amounts. If the recommendation is to adjust bond amounts, the Department will develop a proposed rulemaking for Board consideration within six months after the Department submits its report to the Board.

    1) The Department's report shall be made available to the public

    1) Within thirty days of the Department submitting the report to the Board, any member of the public may submit to the Department written comments on the report

    2) The Department shall undertake this same process, under the same deadlines, every odd-numbered year after 2025.

    1) The Department may issue one joint report to fulfill its obligations under this provision and under 25 Pa. Code § 78.302(d)

Attachment C

Weber Report

Bonding Requirements for Oil and Gas Wells

BONDING REQUIREMENTS FOR OIL AND GAS WELLS IN PENNSYLVANIA: COST-BASED RECOMMENDATIONS

A REPORT TO THE PENNSYLVANIA ENVIRONMENTAL QUALITY BOARD

JEREMY G. WEBER, PhD

SIERRA CLUB

Bonding Requirements for Oil and Gas Wells In Pennsylvania: Cost-Based Recommendations

Jeremy G. Weber, PhD[1]

Contents

[1] Jeremy G. Weber (j.weber@pitt.edu) is an economist and Associate Professor at the University of Pittsburgh Graduate School of Public and International Affairs. This report was supported by funding from the Sierra Club. The analysis and recommendations herein are those of the author, as are any errors.

Executive Summary

Pennsylvania law requires that all oil and gas well operators properly decommission their wells at the end of the well's useful life, an act often referred to as well plugging. Since 1985, it has also required that operators set aside money, a bond, before drilling so as to guarantee funds for the well's plugging. The law sets bond amounts but gives the Pennsylvania Environmental Quality Board (EQB) the authority to adjust amounts "every two years to reflect the projected costs to the Commonwealth of performing well plugging."[2]

From 1989 to 2020, the Commonwealth has paid to plug more than 3,000 wells, spending $15,100 per well on average and a minimum of $3,400 per well. By comparison, the current bond amount for a conventional well is $2,500 for an operator with few wells and, because of blanket bond provisions, $250 for an operator with 100 wells. Using data on the wells the Commonwealth has paid to plug, this report projects the cost to the Commonwealth of plugging wells in the future and makes three recommendations to the Environmental Quality Board:

1. **Adjust the bond amount to $25,000 per conventional well and $70,000 per unconventional well for the 2021-2022 period.** These amounts match projected plugging costs for a well plugged in this period and, under current law, should apply to new wells and wells drilled after April 17, 1985. The projected cost for conventional wells is based on the historical cost incurred by the Commonwealth and the observed growth rate in plugging costs. It is also consistent with what a major operator paid to plug its own wells in the 2018-2020 period. Costs to the Commonwealth, however, will likely be higher if future plugging contracts cover fewer wells than they have historically. The unconventional well amount is based on cost relationships observed in the data and differences in the characteristics of conventional and unconventional wells.
2. **Revisit bond amounts every two years to consider new information on plugging costs and to update bond amounts accordingly.** Plugging costs rose over the last three decades, growing 3.2 percent per year after accounting for inflation and changes in the types of wells being plugged. In addition to a general rise in costs, changes in the types of wells that are being plugged and the scale of plugging can also affect projected costs. Periodic consideration of new information is especially important for unconventional wells for which there is currently limited publicly available data on plugging costs.
3. **Discontinue the use of blanket bonds or bond caps.** Blanket bonds or caps create a large discrepancy between the projected cost of plugging and bond amounts. Moreover, financially secure operators already pay less to meet bond requirements in the form of lower rates charged by private insurers ("sureties").

Current bond amounts expose the Commonwealth to the risk of having to pay plugging costs for many wells. If adopted, the recommended amounts ensure that well operators bear the full financial responsibility of plugging their wells. This will continue to be the case if the Environmental Quality Board reconsiders bond amounts biennially using updated cost projections.

Adjusting bonding amounts will also encourage and enable more plugging, which restores well sites to alternative uses and reduces the risk that unplugged abandoned wells leak methane, oil, brine, or metals-rich liquids into their surroundings. This will free residents and municipalities to farm, build, or

[2] 58 Pa. Cons. Stat. § 3225.

simply enjoy the full extent of their land unencumbered by tanks, pipes, or contamination and the associated risks. This will benefit local economies as properties appreciate in value and the tax base expands.

The recommended adjustment to unconventional well bonds would increase operator costs by one-fifth of the cost of the unconventional well Impact Fee. The adjustment for conventional wells is smaller in absolute terms but might cause some wells to shift to more financially secure operators.

Introduction

Since 1921, the Commonwealth of Pennsylvania has required that oil and gas well operators decommission their wells when abandoning them.[3] Subsequent enforcement was limited and operators abandoned many wells over the rest of the 20th century without proper decommissioning, in part because of energy price drops that left operators without money to continue in business and plug old wells.[4]

Since 1985, the Commonwealth has required that an operator set aside funds, known as bonds, before drilling. The Commonwealth releases the operator from the bond requirement once the operator properly decommissions the well, which involves restoring the well site and filling the well with cement, an activity often referred to as plugging.[5] Most oil and gas producing states have bond requirements so as to encourage compliance with the law and to fund plugging when an operator is financially unable to do so.[6] Bonds therefore act as insurance that protects state governments and taxpayers from having to pay for plugging when operators become financially distressed.

Pennsylvania law gives the Environmental Quality Board the authority to adjust bond amounts "every two years to reflect the projected costs to the Commonwealth of performing well plugging."[7] The statement recognizes that unplugged wells abandoned by defunct operators become the responsibility of the Commonwealth, which then has to pay for plugging. It also recognizes that the bond amount should match the cost of plugging, so that operators—not the Commonwealth and its taxpayers—pay for plugging.

From 1989 to 2020, the Commonwealth paid to plug more than 3,000 wells. Using the associated cost data, this report projects the cost to the Commonwealth of plugging wells in coming years and makes three recommendations to the Environmental Quality Board. First, the Board should adjust the bond amount to $25,000 per conventional well and $70,000 per unconventional well for the 2021-2022 period. The amounts match projected plugging costs for a well plugged in this period and, under current law,

[3] Act 322 of 1921 introduced the first plugging requirements for gas wells. Similar requirements for oil wells had existed since the late 1800s. 58 Pa. Con. Stat. § 3203 defines an abandoned well as "any well that has not been used to produce, extract or inject any gas, petroleum or other liquid within the preceding 12 months, or any well for which the equipment necessary for production, extraction or injection has been removed, or any well, considered dry, not equipped for production within 60 days after drilling, redrilling or deepening, except that it shall not include any well granted inactive status."

[4] Weber, McClure, and Simonides, *The Boom, the Bust, and the Cost of Cleanup: Abandoned Oil and Gas Wells in Pennsylvania and Implications for Shale Gas Governance*.

[5] Through the rest of the report, I will use "plugging" to refer to all that is involved in decommissioning a well according to state standards.

[6] Davis, *Policy Monitor—Bonding Requirements for US Natural Gas Producers.*

[7] 58 Pa. Con. Stat. § 3225.

should apply to new wells and wells drilled after April 17, 1985. Second, it should revisit bond amounts every two years to consider new information on plugging costs and to update bond amounts accordingly. Plugging costs rose over the last three decades, growing 3.2 percent per year after adjusting for inflation and changes in the types of wells being plugged. Lastly, the Board should discontinue the use of blanket bonds or bond caps because they create a discrepancy between bond amounts and projected plugging costs.

By encouraging and enabling more well plugging, adjusting bond amounts will reduce the risk that abandoned wells leak methane, oil, brine, or metals-rich liquids into their surroundings. Abandoned wells have also been shown to discourage building in their vicinity. Well plugging and site restoration frees local residents and property owners to farm, build, or simply enjoy the full extent of their land unencumbered by tanks, pipes, or contamination and the associated risks. This has broad benefits for local economies in the form of higher property values and a larger tax base.

The recommended adjustment to unconventional well bond amounts would increase operator costs by far less than did the unconventional well Impact Fee, which the Commonwealth introduced in 2012 and applied retroactively to all unconventional wells.[8] Despite increasing costs by more than would the recommended bond adjustment, the Impact Fee had imperceptible effects on drilling and production. The recommended adjustment for conventional wells is smaller in absolute terms but might cause some wells to shift to operators that are more financially secure.

In the next sections, the report explains the purpose of plugging wells, the role of bonding, and current bond policy. It then presents the methods, data, and findings for the projected cost to the Commonwealth of plugging wells in the 2021-2022 period. The final sections address the role of blanket bonds, the wells to which adjusted bond amounts should apply, and the likely effects of the adjusted amounts on the oil and gas industry in Pennsylvania.

The Purpose of Plugging

Unplugged abandoned wells create a pathway for subsurface gases or liquids to migrate into groundwater, the soil, or to the surface. Deterioration of the steel casing surrounding a well bore—or the cement surrounding the casing—opens this pathway for migration.[9] Plugging wells and restoring their sites addresses problems caused by wells already leaking and constraining land use. It also largely eliminates risk from wells that may cause damage in the future, a risk that grows as wells age and their steel and concrete deteriorate.

Several studies and cases illustrate the health risks posed by unplugged abandoned wells and therefore the benefit of plugging them. Water in and around unplugged wells can contain pollutants, such as barium, chloride, and arsenic.[10] In a sample of 46 abandoned wells discharging water on the Navajo

[8] 58 Pa. Con. Stat. § 3225.
[9] Alboiu and Walker, *Pollution, management, and mitigation of idle and orphaned oil and gas wells in Alberta, Canada*.
[10] Woda et al., *Methane concentrations in streams reveal gas leak discharges in regions of oil, gas, and coal development.*

Nation, 15 wells had water with levels of arsenic above EPA standards.[11] Arsenic is a carcinogen and even short-term exposure can harm health.[12] Further, methane leaking into groundwater can create foul-smelling and toxic hydrogen sulfide when it oxidizes.[13] The potential for groundwater contamination is illustrated by a study of oil-and-gas-related groundwater contamination events in Texas and Ohio. The study found that unplugged abandoned wells accounted for 14 percent and 22 percent, respectively, of contamination events over the study period, generally the 1980s through the early 2000s.[14]

Unplugged abandoned wells also leak gases into the air, particularly methane. Emissions of methane can harm air quality when methane oxidizes and creates ozone. Ozone is harmful when inhaled, causing damage to the heart and lungs and worsening chronic conditions such as asthma.[15] Further, if methane leaks into enclosed spaces it can cause an entire house to explode, though this is not common.[16] Globally, methane is a potent greenhouse gas, with roughly 30 times more warming potential than carbon dioxide over 100 years and as much as 87 times higher over 20 years.[17] A study of methane leaks from abandoned oil and gas wells in Pennsylvania found that such wells account for as much as seven percent of the annual anthropogenic methane emissions in the Commonwealth. To put the number in perspective, it is equivalent to the annual greenhouse gas emissions from 200,000 to 250,000 passenger cars.[18]

In addition to the environmental and health risks, unplugged abandoned wells take up space and are an eyesore on the landscape, appearing as uncultivated or unmowed islands in fields or backyards. Wellheads, which are made up of pipes and valves, often extend about six feet into the air and can be accompanied by metal tanks, pipes, and pumps, all of which are removed as part of plugging. By removing well equipment and the risks associated with an open well, plugging expands land-use possibilities for the surrounding acreage. A recent study found that, over nearly fifty years, there was roughly twice as much building activity in the two acres surrounding wells that were plugged compared to the two acres surrounding wells that were not plugged.[19] This illustrates how unplugged wells constrain or deter local residents from fully using their property.

Forgoing construction on and investment in land with unplugged wells has broad implications for community well-being because it suppresses the local tax base that funds local schools, roads, and other services. The same study estimates that by depressing investment, an unplugged well reduced the market value of the typical surrounding property by around $22,000 (12 percent). In the case of the school district in the study area with the most abandoned unplugged wells—McGuffy School District—this tax base

[11] U.S. Environmental Protection Agency, *Technical Memorandum: Investigation of Abandoned Wells on Navajo Nation*.
[12] U.S. Environmental Protection Agency, "Drinking Water Standard for Arsenic."
[13] Dusseault, Jackson, and MacDonald, *Towards a Road Map for Mitigating the Rates and Occurrences of Long-Term Wellbore Leakage;* U.S. Department of Labor, "Hydrogen Sulfide".
[14] Kell, *State Oil and Gas Agency Groundwater Investigations*.
[15] *Nuvolone, Petri, and Voller, The effects of ozone on human health*.
[16] Quinton, "Why 'Orphan Oil and Gas Wells Are a Growing Problem for States."
[17] U.S. Environmental Protection Agency, "Understanding Global Warming Potentials."
[18] Kang et al., *Direct measurements of methane emissions from abandoned oil and gas wells in Pennsylvania.*
[19] Harleman, Weber, and Berkowitz, *Environmental Hazards and Local Investment: A Half-Century of Evidence from Abandoned Oil and Gas Wells.*

effect translates into $112 less school revenues per student each year.[20] The forgone revenue across all schools and local governments in the county exceeds $500,000 annually.[21]

The Purpose of Bonds

Oil and gas operators are legally bound to plug their wells when they abandon them, and the Pennsylvania Department of Environmental Protection can fine operators that do not comply with plugging requirements. Fines, however, are meaningless when applied to operators that have dissolved or have no means to pay them. The upfront nature of bonds avoids this problem. Because operators post bonds as a requirement for receiving a permit to drill a new well, the bond amount is secured even if the operator later falls into financial distress. Bonds, therefore, act as an insurance policy that protects the Commonwealth from having to use public revenues to pay an operator's plugging liabilities.

The history of oil and gas development and policy in Pennsylvania underscores the value of such insurance. The Commonwealth has had plugging requirements for both oil and gas wells since the 1920s, and enforcing the requirements became easier in 1955 when the Commonwealth added permitting requirements, which allowed it to establish each well's location and ownership. Despite those policies, an estimated 20 percent of wells drilled between 1955 and 1984 (when bonding requirements were introduced) were abandoned without plugging.[22] Many of these wells will likely become the responsibility of the Commonwealth to plug.

For the Commonwealth and its taxpayers to fully avoid the burden of plugging costs, the bond amount must cover plugging costs on average.[23] Some wells will cost more than the average and others less, but if set correctly, the savings from cheap wells will cover the extra costs of expensive wells. If instead the bond amount is below average plugging costs, the Commonwealth's plugging program will run a deficit and require another revenue source to cover its costs.

Current Bond Amounts

The law governing both conventional and unconventional wells states that bond amounts "may be adjusted by the Environmental Quality Board every two years to reflect the projected costs to the Commonwealth of plugging the well."[24] Moreover, the law governing bond amounts for conventional wells directs the Environmental Quality Board to "undertake a review of the existing bond requirements for conventional oil and gas wells."[25]

[20] Ibid.
[21] This estimate is based on the analysis in Harleman, Weber, and Berkowitz but not reported in the paper.
[22] Weber, McClure, and Simonides, *The Boom, the Bust, and the Cost of Cleanup: Abandoned Oil and Gas Wells in Pennsylvania and Implications for Shale Gas Governance*.
[23] Setting bond amounts equal to average plugging costs would not be appropriate if operators were more likely to leave high-cost wells unplugged. This is possible but hard to establish.
[24] 58 Pa. Con. Stat. § 3225.
[25] 72 P.S. § 1606-E.

Current bond amounts, however, are the unadjusted amounts initially specified by law. The law currently requires a $2,500 bond for each conventional well drilled on or after April 18, 1985.[26] In lieu of the $2,500 per well bond, the law allows operators to post a "blanket bond" of $25,000.[27] This allows operators with more than 10 wells to post a smaller total bond using a blanket bond instead of a per well bond. With 100 wells, for example, an operator would post $250 per well[28] instead of $2,500 per well.

In the late 2000s, operators began drilling more and more wells in the Marcellus and then Utica shale formations. Exploiting the formations required unconventional methods, namely horizontal drilling and hydraulic fracturing, and such wells became known as unconventional wells. In 2012, the Commonwealth adopted laws specific to unconventional wells. The law currently sets a $10,000 bond for each unconventional well, but also caps the total bond amount for an operator with many wells, with the cap acting as a type of blanket bond.[29] The caps vary with operator size. An operator with 50 wells need only post $290,000 in bonds, or $5,800 per well.[30] An operator with more than 150 wells need only post $600,000. Thus, an operator with 240 unconventional wells faces a per well bond amount of $2,500.[31]

Well operators can satisfy bond requirements in different ways, including a corporate surety bond or a deposit of cash, certificates of deposit, or U.S. Treasury bonds.[32] A surety bond acts like an insurance policy. In general, the operator pays an insurer (the surety) a percent of the bond amount each year, and the surety agrees to pay a third party (in this case the Commonwealth) the bond amount if conditions specified in the bond are met (in this case the failure of the operator to plug its well). The rate a surety elects to charge and the bond amount determine the cost of the bond incurred by the operator. At a 5 percent rate, a $10,000 bond costs an operator $500 each year.[33] Rates depend on an operator's financial health, with more financially secure firms facing lower rates and therefore lower costs to satisfy the same bond requirement.

Methods for Projecting Plugging Costs for 2021-2022

The focus of this report is projecting the per well plugging cost that the Commonwealth is likely to incur from plugging wells in the 2021-2022 period. The projection, in turn, is to aid the Environmental Quality Board in adjusting bond amounts to match the projected costs to the Commonwealth of performing well plugging. This section explains the methodology used to project this cost.

Conventional Plugging Costs

To project the cost of plugging a conventional well in the 2021-2022 period, I start by calculating the sample average cost per well for plugging from the 1989–2020 period (in 2020 dollars). This is the

[26] 25 Pa. Code § 78.302.
[27] 72 P.S. § 1606-E.
[28] $25,000/100 wells.
[29] Bond amounts are less for unconventional wells with a total bore length less than 6,000 feet, which applies to few if any unconventional wells since they are generally greater than 6,000 feet in vertical length in addition to several thousand feet in horizontal length.
[30] $5,800 = $290,000/50 wells.
[31] $2,500 = $600,000/240 wells.
[32] 52 Pa. Con. Stat. § 3225.
[33] 0.05 x $10,000.

total cost across all contracts divided by the total number of wells plugged. It would be a reasonable projection of average plugging costs in 2021-2022 if inflation-adjusted costs were constant over time, but they are not—costs have consistently risen over time. To project costs for 2021-2022, I estimate the growth rate in plugging costs using a regression model to account for changes in the location and types of wells being plugged over time. I then apply the estimated growth rate in plugging costs to the sample average well, which was plugged in 2005. See Appendix A for estimation of the growth rate and the calculation of the projected cost.

The key assumption of this approach is that the average well that *has been* plugged by the Commonwealth has characteristics similar to those of the average well that *will be* plugged by the Commonwealth, at least when considering characteristics that affect plugging costs. I test this assumption in two ways. First, I compare the projected cost of plugging a conventional well with the plugging costs incurred over the 2018-2020 period by a large operator of conventional wells in Pennsylvania. Second, I compare the characteristics of wells plugged by the Commonwealth with those of conventional wells drilled over the 2010-2018 period.

Unconventional Plugging Costs

Unlike the case of conventional wells, the Commonwealth of Pennsylvania has plugged no unconventional wells, nor am I aware of other states in the Appalachian basin that have done so. This is because unconventional gas wells, also known as shale gas wells, are relatively new to the region, having only been drilled on a large scale starting in the late 2000s. Private plugging of unconventional wells in Pennsylvania has occurred, but the associated cost data is not publicly available. If collected moving forward, this information could inform future decisions by the Environmental Quality Board.

The cost of plugging conventional wells in Pennsylvania may nonetheless provide a reasonable foundation for estimating unconventional costs. The Commonwealth applies similar plugging regulations to both well types. In coal areas, for example, regulations for both wells require a 200-foot section of cement around the bottom of the surface casing, followed by sections of cement and non-porous material through the rest of the vertical portion of the well bore.[34] Firms plugging both conventional and unconventional wells in Pennsylvania will also face similar material and labor costs.

Given the similarity in plugging regulations and prices for materials and labor, I follow the same methodology for unconventional wells as for conventional wells with one difference. I adjust the sample average plugging cost before applying the growth rate in costs. The adjustment accounts for two large differences between sample conventional wells and unconventional wells. First, unconventional wells are deeper than the average conventional well plugged from 1989 to 2020, which increases costs. Second, essentially all unconventional wells in Pennsylvania are gas wells, which historically have cost more to plug than oil wells. See Appendix B for details on the adjustments and regression model used to assess the effect of depth and well type on plugging costs.

[34] 25 Pa. Code § 78.92(b) and § 78a.92(b). In the case of an unconventional well whose bore extends horizontally, the operator must then place a mechanical plug to block off the vertical part of the well from the horizontal part.

Data

The Pennsylvania Department of Environmental Protection (DEP) provided a dataset with all wells that it has paid to have plugged since 1989, when it plugged its first well, through November of 2020. The dataset contains 3,134 wells and includes, among other variables, the well permit number, the contract number, and the total cost of the contract under which the well was plugged. I put all contract costs in 2020 dollars using the Consumer Price Index (CPI-U). I exclude 35 out-of-scope wells for reasons described in Appendix C, leaving 3,099 wells covered by 255 contracts.

The DEP dataset does not include each well's depth, which is a determinant of plugging costs. To assign depth to each well, I combined an additional DEP-provided dataset of the location of DEP-plugged wells with geospatial data from the Pennsylvania Department of Conservation and Natural Resources (DCNR) on oil and gas fields and pools, which includes each pool's average producing depth.[35] I mapped the DEP-plugged wells over the DNCR pools and assigned to each well the average depth of the pool in which it is located. In doing so, I estimated the depth of 3,060 wells covered by 226 contracts.

Using the well permit number in the DEP plugging data, I added two variables from other state data sources. These were the earliest year when the well appeared in any state records, which is a rough measure of when the well was drilled, and an indicator for whether the well was in a coal region. Older and more deteriorated wells are generally more expensive to plug. Wells in coal regions can also involve different plugging practices, which can affect costs. Incorporating the additional variables improves parts of the analysis by better accounting for differences in well characteristics that can affect cost. For example, it aids in estimating the growth rate in plugging costs apart from changes in the types of wells being plugged over time. The additional variables, along with the depth variable, are available for 3,040 wells from 211 contracts.

The data described above are used to create a contract-level dataset, which is the basis of the analysis. This is a practical necessity because DEP plugging contracts generally only have a total cost for the entire contract, not a unique cost for each well. Because the focus of this report is on the typical well, not the typical contract, I weight contract values by the number of wells in the contract, so that the resulting statistics represent the average well.[36] By comparison, the average of unweighted contract values reflects the average contract.

Values presented in the report reflect the largest sample of wells and contracts possible. Thus, the simple average cost per well is based on the largest sample of 3,099 wells (255 contracts). The average cost per foot of depth is based on the 3,060 wells (226 contracts) for which depth data are available. Analysis involving the two additional well variables uses 3,040 wells (211 contracts).

[35] The oil and gas pool geospatial data can be found by searching the DCNR's elibrary at www.dcnr.pa.gov/ELibrary/Pages/default.aspx.

[36] The well-weighted contract average is equivalent to summing the total costs across all contracts and dividing by the number of wells, which is why the weighted contract average refers to the average well, not the average contract.

Findings: Projected Costs for Conventional Wells

Over the 1989-2020 period the average well plugged cost the Commonwealth $15,118 (Table 1, the "Weighted" column). This does not reflect current plugging costs since the average year of plugging is 2005. The cost per well for the average contract (Table 1, "Unweighted" column) is higher and reflects economies of scale in plugging discussed in detail in a later section. Because most wells are plugged under a large, lower-cost contract, the plugging cost of the average well is lower than for the average contract.

Costs range substantially across contracts, with per well costs ranging from $3,422 to nearly $485,000. The standard error of the weighted average cost, however, is fairly small, at $472. This means that a sample of wells randomly drawn from the same population of previously plugged abandoned wells would likely have an average cost in the range of $14,200 to $16,000.

Table 1. Summary Statistics for Well Plugging Contracts

	Average			
Variable	Weighted	Unweighted	Minimum	Maximum
Plugging Cost Per Well ($)	15,118	49,008	3,422	484,677
Plugging Cost Per Foot ($)	8	20	1	219
Depth Per Well (Feet)	1,925	1,832	450	7,174
Contract Size (Wells)	55	12	1	179
Year Plugged	2005	2005	1989	2020
Emergency Contract (0/1)	0.01	0.08	0.00	1.00
Well Type				
Share Oil Wells	0.83	0.43	0.00	1.00
Share Gas Wells	0.12	0.36	0.00	1.00
Share Oil & Gas Wells	0.04	0.13	0.00	1.00
Share Other	0.01	0.09	0.00	1.00
Share of Wells in Coal Regions	0.06	0.22	0.00	1.00
Estimated Year Drilled	1995	1988	1891	2015
Number of Contracts		211 to 256		
Number of Wells		3,040 to 3,099		

Notes: The data are drawn from various datasets of the Pennsylvania Department of Environmental Protection and Department of Conservation and Natural Resources. All tabulations are by the author. As noted in the text, not all information is available for every well or contract. The weighted average is the contract average weighted by the number of wells in the contract. All monetary values are in 2020 dollars.

As mentioned in the methods section, it is important to adjust the plugging cost of the sample average well for changes in cost over time. Figure 1 shows a scatter plot of plugging costs per foot (in 2020 dollars, log scale) and the year plugging occurred, with the data adjusted for differences in contract and well characteristics (See Appendix A for details). It shows that plugging costs rose over the three-decade

period even after adjusting for inflation. The slope of the best-fit-line line (estimated in log scale) gives the real annual growth rate, which is 3.2 percent.[37] Performing the same analysis but without adjusting for inflation gives a nominal growth rate of 5.6 percent.

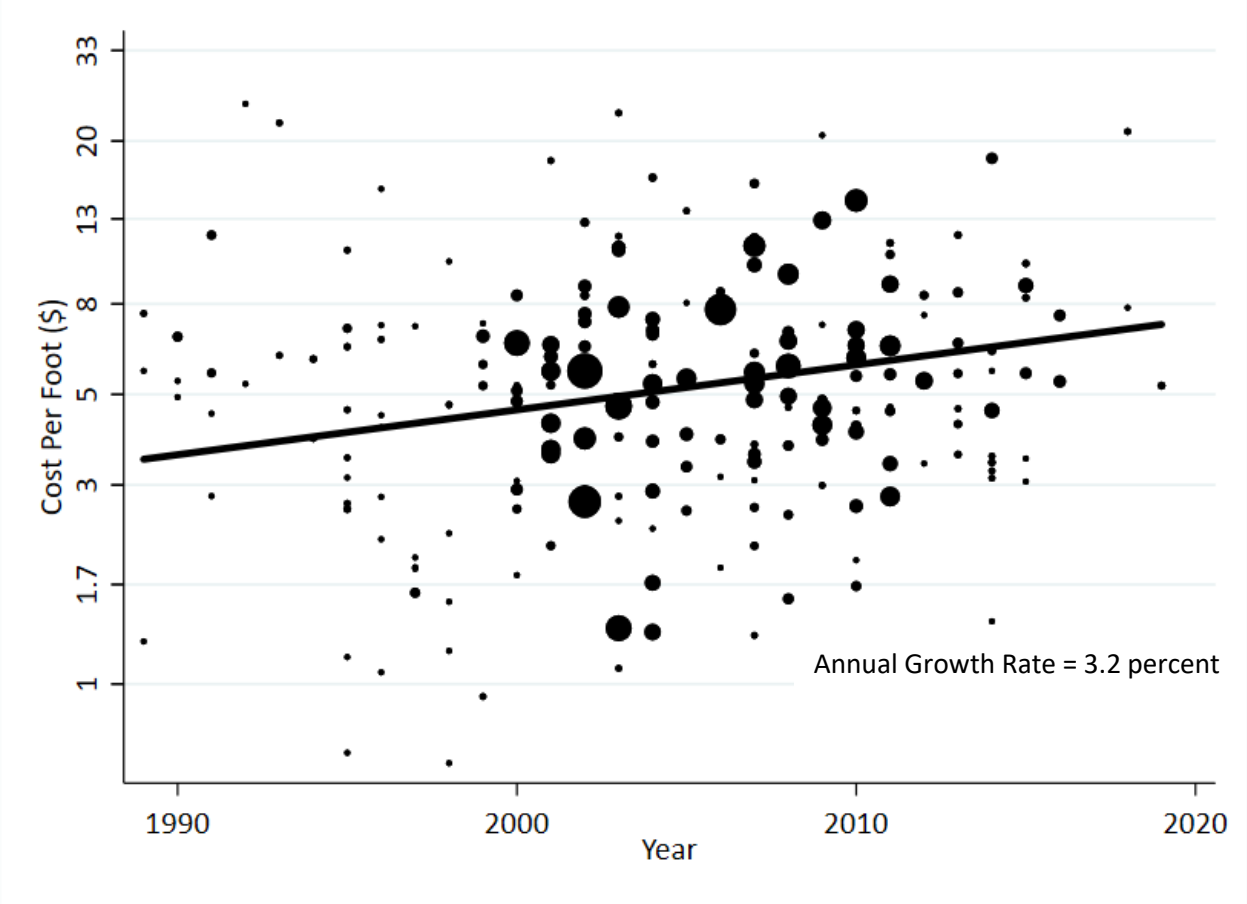

Figure 1. Inflation-Adjusted Plugging Costs Have Grown Over Time

Notes: The vertical axis is plugging cost per foot in 2020 dollars and is shown on a log scale, increasing by increments of roughly 0.5 log points. Each dot represents a well plugging contract. The data shown have been adjusted to account for changes in contract and well characteristics over time. See Appendix A for details. The size of the dots reflects the weight given to the observation (the contract) based on the number of wells in the contract. Larger dots indicate contracts with more wells.

The average plugging cost per well combined with the real and nominal plugging cost growth rates provide what is needed to estimate the plugging cost for 2020 and project the cost for 2021-2022. Doing so gives an estimated 2020 plugging cost of $23,829 per well (in 2020 dollars) and a projected 2021-2022 cost of $25,164 per well (in 2021 dollars).

[37] Plugging and site restoration standards have changed over time, mostly due to Act 13 of 2012. Breaking the study period into before and after Act 13 reveals a growth rate of 3.0 percent before 2012 and 8.5 percent after 2011. That the global average (pooling data from both periods) is 3.2 percent reflects the greater weight given to earlier years when more wells were plugged. I use the global average growth rate as it should better reflect the growth rate moving forward. It is likely that Act 13 caused a temporary increase in the growth rate, with the rate returning to its long-run average after the full incorporation of the changes in plugging practices.

The projected cost for 2021-2022 supports the recommendation of a conventional bond amount of 25,000 per well for the 2021-2022 period. The Environmental Quality Board should revisit the amount every two years, taking into account updated information on plugging costs. The recommended $25,000 amount could become outdated in several years because of inflation and rising real costs. For example, if plugging costs continue to grow at their historical rate, conventional well plugging costs would rise to more than $31,000 by the end of 2025 (in 2025 nominal dollars).[38] In addition, the composition of wells needing to be plugged can change over time, resulting in a higher or lower average cost.

Assessing the Projections

As noted in the methods section, the reliability of the 2021-2022 projection depends in part on whether sample wells are unique in ways that affect plugging costs. One way to gauge their uniqueness is to compare their plugging costs to those of other wells, such as those plugged by the private sector.

A comparison with recent private sector plugging costs suggests that wells plugged by the Commonwealth are not unique in ways that have large effects on plugging costs. Diversified Gas and Oil is a large operator of conventional wells in Appalachia, and in August of 2020 it released a report providing its spending on wells plugged from 2018 through the second quarter of 2020. For the 192 wells that it plugged in the Appalachian region, it reports an average cost of $24,280 per well. Not all of the wells were in Pennsylvania, but Diversified also reports an estimate of per well costs by state, reporting $23,638 for Pennsylvania wells in coal regions and $19,259 for wells outside of them.[39] The costs are similar to the estimated 2020 cost based on wells plugged by the Commonwealth ($23,829).

Another way to gauge the uniqueness of the wells plugged by the Commonwealth is to compare their characteristics with those of conventional wells drilled in recent years. The comparison should reveal how conventional drilling has evolved, which is important because adjusted bond amounts would apply to recently drilled and soon-to-be-drilled wells. To conduct this comparison, I used data from the DEP and analyzed all wells drilled between 2010 and 2018, comparing them to the previously discussed dataset of plugged wells.

On the whole, the comparison also suggests that the plugged well sample is not unique (i.e., is roughly consistent with more recent conventional wells). The average wells of each sample have similar depth and likelihood of being in a coal region. This is notable given the difference in well age across the two samples. The average estimated year drilled is 1995 for plugged wells and 2011 for recently drilled wells. The primary difference between recently drilled wells and wells plugged by the state is the hydrocarbon focus, with the recently drilled wells focused on gas plays, or a mix of oil and gas, and fewer wells in pure oil plays. On the whole, then, the sample of wells plugged by the DEP are likely to provide reasonable estimates of the plugging costs that the Commonwealth is likely to incur in the near future. At the same time, there are some differences between older wells and recently drilled wells, which highlights the value of the Environmental Quality Board periodically revisiting bond amounts with updated cost data.

[38] = $25,000 x (1.056)^4, where 0.056 refers to the nominal growth rate in plugging costs.
[39] Diversified Gas & Oil, *Asset Retirement Supplement for the ARO Liability.*

Table 2. Comparing Plugged Wells and Recently Drilled Conventional Wells

	Average Values		
	Plugged Wells	Recently Drilled Wells	Difference
Depth (Feet)	1,925	2,087	162
Oil Well (0/1)	0.83	0.57	-0.26
Gas Well (0/1)	0.12	0.21	0.09
Oil and Gas Well (0/1)	0.04	0.16	0.12
Other Well (0/1)	0.01	0.08	0.07
Well in Coal Region (0/1)	0.06	0.06	0.00
Estimated Year Drilled	1995	2011	16
Number of Wells	3,040	2,923	

Notes: Data are from various datasets of the Pennsylvania Department of Environmental Protection and Department of Conservation and Natural Resources. All tabulations are by the author. The Estimated Year Drilled refers to the first year that the well appears in state records.

Findings: Projected Costs for Unconventional Wells

I project a plugging cost of $70,000 for an unconventional well in 2021. The number reflects the same methodology used to project costs for conventional wells but with two adjustments to account for differences between unconventional wells and the conventional wells reflected in the DEP plugging data.

The first difference is that unconventional wells are deeper, which increases plugging costs.[40] Plugged wells have an average depth of 1,925 feet compared to an estimated 6,300 feet for unconventional wells.[41] Statistical modeling of the plugging cost data indicates that each foot in depth adds $1.90 in cost, which gives an adjustment of $8,313.[42] The second adjustment is for well type. Most of the conventional wells plugged were oil wells whereas essentially all unconventional wells are gas wells. The same statistical model that relates depth to plugging costs shows that natural gas wells cost an average of $21,376 more to plug than other wells. The resulting adjustment is $18,803.[43] These two adjustments sum to a slightly more than $27,000 increase in cost of plugging from the sample average conventional well.

To arrive at the $70,000 projection, I add the total adjustment to the sample average conventional well cost and then apply the same growth rates in plugging costs as estimated for conventional wells. See Appendix B for details of the calculations and statistical modeling. As with the projected cost for conventional wells, the projection and recommended bond amount for unconventional wells apply to the 2021-2022 period. The Environmental Quality Board should revisit the amount every two years, taking into account updated information on plugging costs. This is especially important in the case of unconventional wells because there is currently no publically available data on the cost of plugging unconventional wells in Pennsylvania.

[40] Ho et al., *Managing environmental liability: an evaluation of bonding requirements for oil and gas wells in the United States.*

[41] Weber, McClure, and Simonides, *The Boom, the Bust, and the Cost of Cleanup: Abandoned Oil and Gas Wells in Pennsylvania and Implications for Shale Gas Governance*.

[42] $8,313 = (6,300 feet – 1,925 feet) x $1.9 per foot. See Appendix B for a discussion of this calculation.

[43] $18,803= (1.0 – 0.12036) x 21,376 per gas well, where .12036 is the weighted contract average share of gas wells (see Table 1).

Assessing the Projection

There is more uncertainty over the projection for unconventional wells than for conventional wells because of the lack of data on unconventional well plugging costs. Yet, the projection is arguably the most well-founded of any projection for unconventional wells in Pennsylvania.

A 2011 study estimated the cost of plugging unconventional wells in Pennsylvania based on well plugging data from Wyoming from 1997 to 2007, and reported that plugging a single unconventional well would cost about $110,000.[44] The authors, however, did not account for differences in terrain and labor and material costs between Wyoming and Pennsylvania. Costs for plugging in Pennsylvania may be different than incurred in other states. For example, one study of plugging costs reports that a drilling rig, which is used to prepare a well for plugging, can cost $85 an hour in Kansas and $240 an hour in Pennsylvania. [45] The estimate of $110,000 also assumed that the horizontal portion of unconventional wells needs to be plugged. Current Department of Environmental Protection regulations cited above make it clear that this is not the case in Pennsylvania—operators need only put a mechanical plug near the bottom of the vertical portion of the well.

A forthcoming study that uses Pennsylvania conventional well plugging data estimates unconventional well plugging costs ranging from about $92,000 to $129,000.[46] These estimates, however, are conditional on wells being plugged in fairly small groups, resulting in small contract sizes. As the next section discusses, per well plugging costs decrease with contract size, and this report's projections are based on the historical average contract size.

The authors of the forthcoming study note that site restoration costs may differ between conventional and unconventional wells.[47] Unconventional wells are found on large pads that host multiple wells whereas conventional wells are more scattered across the landscape. The net effect of the differences on plugging costs (including site restoration) could be positive or negative–larger pads would require more restoration costs but ease of site access and clustering of wells on a pad would reduce it. Because there is no firm way to estimate the impact of this factor, it is not reflected in this report's projection.

Contract Size and Economies of Scale in Plugging

Both the conventional and unconventional well projections are based upon the average well in the DEP plugged well dataset, which is associated with an average contract size of 55 wells.[48] (The focus on the average well is because the recommended bond amount seeks to match the projected plugging cost for the average well, not the average contract.) The projections, therefore, assume that future wells

[44] Mitchell and Casman, *Economic incentives and regulatory framework for shale gas well site reclamation in Pennsylvania.*
[45] Ho et al., *Managing environmental liability: an evaluation of bonding requirements for oil and gas wells in the United States.*
[46] Weber, McClure, and Simonides, *The Boom, the Bust, and the Cost of Cleanup: Abandoned Oil and Gas Wells in Pennsylvania and Implications for Shale Gas Governance*.
[47] Weber, McClure, and Simonides, *The Boom, the Bust, and the Cost of Cleanup: Abandoned Oil and Gas Wells in Pennsylvania and Implications for Shale Gas Governance*.
[48] The average contract does not have 55 wells. Rather, the average well is plugged under a contract with 55 wells.

will be plugged under similarly sized contracts. The assumption is important because larger contracts have lower average costs. The lower cost stems from at least two sources. First, a large contract provides steady work for well plugging firms, potentially for an entire year. Plugging firms, which tend to be small, value this stability and therefore offer lower bids for larger contracts. Second, wells in the same contract are often near each other, which allows a firm to spread the cost of moving equipment over multiple wells. Clustering can also allow a firm to use the same staging area and access roads for multiple wells, saving labor and equipment time.[49]

Economies of scale in plugging are evident in the data. Figure 2 shows a scatter plot of plugging costs per well (vertical axis) and contract size (horizontal axis), with a best-fit curve shown as a solid black line. Costs decline dramatically as contract size increases from 1 to 15 wells. However, the rate of the decline slows greatly afterward, with contracts of 100 wells having only marginally lower costs per well than contracts of 50 wells.

The declining economies of scale shown in Figure 2 imply that the potential for an overstatement of costs is low since larger-than-expected contracts will bring only marginally lower cost. In contrast, the potential for understatement of costs is large if most wells in the future are plugged under small contracts. Over the entire sample, 1989-2020, the typical well was plugged under a contract covering 55 wells. However, the largest contracts in the data occurred in the 2000-2011 period when the Pennsylvania Department of Environmental Protection had greater funding (through the Growing Greener legislation).[50] Since 2011, a decrease in funding has translated into smaller contracts, with a more recent wells plugged under a contract with 14 wells. This highlights how greater funding for plugging, perhaps through higher bond amounts, could reduce the average plugging cost per well incurred by the Commonwealth.

Contract sizes have varied over time and may increase or decrease in the future. Given uncertainty over future contract sizes, this report's recommended bond amounts are based on the historical contract size for wells plugged by the Commonwealth. However, assuming the more recent contract size of 14 wells would increase the projected plugging cost and recommended bond amount to $38,000 for conventional wells and $83,000 for unconventional wells. The adjustment is based on the estimated non-linear relationship between contract size and per well plugging costs shown in Appendix Table B1.[51]

[49] These details are informed by an interview of an executive of a firm specializing in well plugging in the Appalachian basin.

[50] The level and sources of funding for well plugging can be seen by visiting: www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/LegacyWells/Pages/Well-Plugging-Program.aspx.

[51] The adjustment is a $7,711 increase, which I add to the sample average cost per well. The growth rate in plugging costs is then applied to this adjusted average cost as described by equations (A1-A2) and (B1-B2).

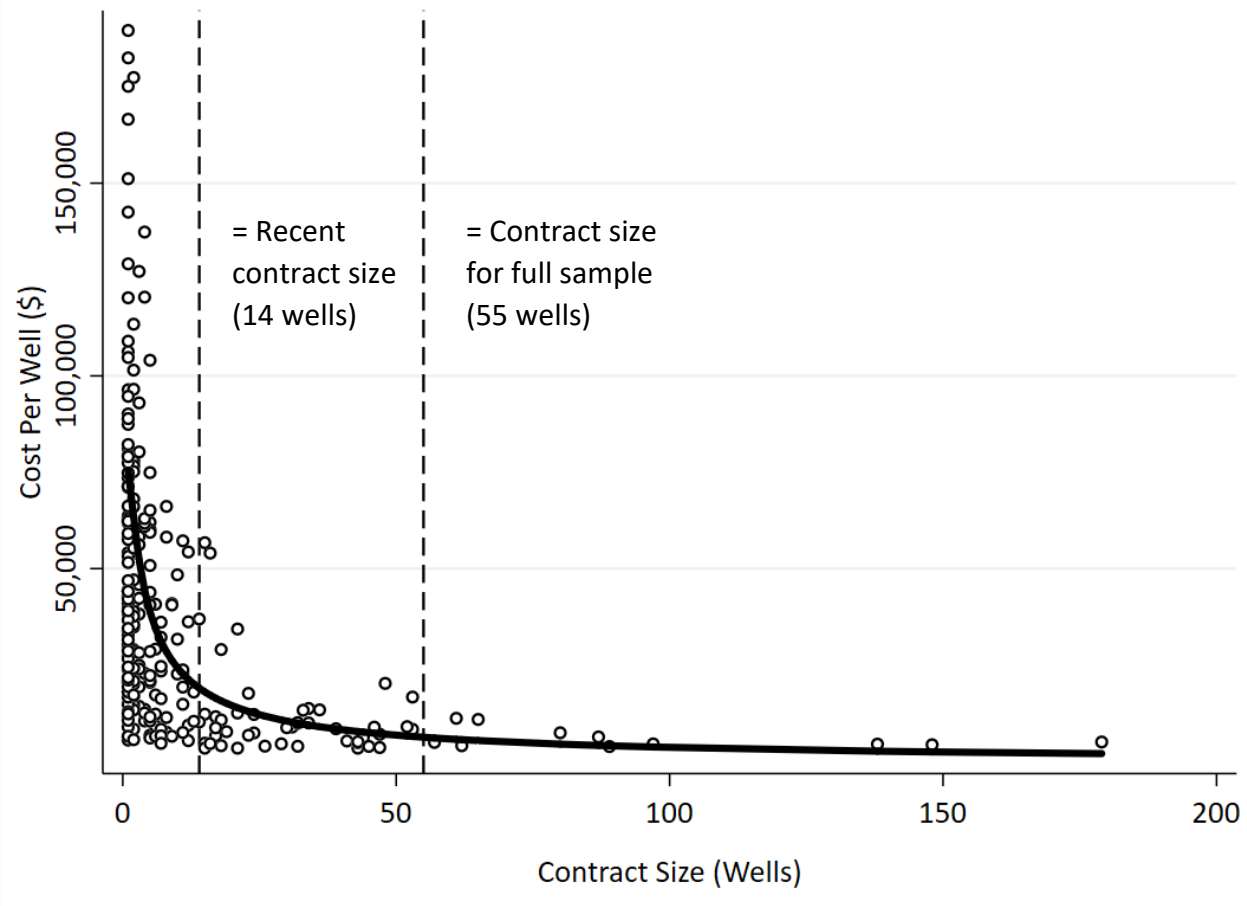

Figure 2. Plugging Costs Decline with Contract Size

Notes: The vertical axis is cost per well in 2020 dollars. Each dot represents a well plugging contract. For clarity of exposition, the vertical axis is limited to a maximum cost of $200,000 per well.

Blanket Bonds

As noted in the section on current bond amounts, blanket bonds (for conventional wells) and bond caps (for unconventional wells) imply that per well bond amounts can be much lower than the commonly cited bond amounts of $2,500 and $10,000 per well. Blanket bonds may have been justified by noting that they limit the total financial burden of bonds on large and financially stable operators. Alternatively, large plugging projects have a lower average cost, also justifying a lower bond amount.

Neither justification is warranted given the bond amounts recommended in this report. With surety bonds, larger—and presumably more financially secure—operators pay less to comply with bonding requirements. This is because sureties base their rates on an operator's finances and the risk that it defaults on its plugging obligations. Thus, a surety bond equal to plugging costs allows lower-risk firms to pay less while also ensuring that the Commonwealth is able to cover the costs of plugging if the operator defaults on its obligations.

Regarding the second potential justification, economies of scale in plugging occur in the range of 1 to 15 wells as shown in Figure 2. There are little, if any, economies of scale in plugging after 50 or so wells, meaning that average plugging costs remain unchanged as contract size increases beyond this size.

Blanket bonds, in contrast, presume that average costs attenuate to zero as contracts grow larger. This is clearly not the case.

If blanket bonds are allowed in their current form, projected plugging costs will exceed, perhaps by a large amount, bond amounts received by the Commonwealth. This report therefore recommends discontinuing the use of blanket bonds or caps and instead recommends that the Commonwealth apply the recommended per well bond amounts to operators of all sizes. Doing so will ensure that the Commonwealth spends, on average, as much on plugging as it receives from forfeited bonds.

To What Wells Should Adjusted Bond Amounts Apply?

Under Pennsylvania statute, bonding requirements apply to all wells in existence after April 17, 1985.[52] Applying adjusted bond amounts in a manner consistent with current law means applying them to new wells and those drilled after the 1985 date, only distinguishing between conventional and unconventional wells as the law does.

This application of adjusted amounts is also consistent with the scope that existing law gives the Environmental Quality Board to adjust bond amounts. The law states that bond amounts "may be adjusted every two years to reflect the projected costs to the Commonwealth of performing well plugging."[53] Because the Board's authority to adjust bond amounts is rooted in projected plugging costs, an uneven application of the adjustment could be justified if there were a basis for expecting new wells to have very different plugging costs than existing wells. The comparison of old and recently drilled wells previously presented in this report suggests no clear basis for the distinction. Thus, if the bond amount were not applied retroactively, the Commonwealth's plugging program would still have insufficient funds to plug the wells that become its responsibility in coming years. Further, this report recommends that the EQB revisit bond amounts every two years, so that it can adjust bond amounts based on any differences in plugging costs between new wells and existing wells that new data may reveal.

The Likely Effect of Bond Adjustments on the Oil and Gas Industry

This section describes the likely effects of adjusted bond amounts on the oil and gas industry based on the experience of Pennsylvania when it introduced its per well Impact Fee for unconventional wells and based on the experiences of Texas and North Dakota when they increased bond amounts. The experiences suggest that the adjustments will improve environmental outcomes, have little effect on aggregate industry activity, and potentially shift wells among operators.

To gauge likely impacts, I first illustrate the potential cost increase associated with adjusted bond amounts. I assume that operators currently post $1,000 for the typical conventional well and $5,000 for

[52] 58 Pa. Con. Stat. § 3225.
[53] 58 Pa. Con. Stat. § 3225.

an unconventional well.[54] I further assume a well life of 30 years, a discount rate of 5 percent, and a bond rate of 5 percent.[55]

The adjusted bond amount would increase annual costs by $3,250 per unconventional well, which has a present value of $50,000 over the life of a 30-year well (Table 3). To put the present value cost in perspective, it is about one-fifth that of the unconventional well Impact Fee. Operators in Pennsylvania pay an Impact Fee of about $50,000 per unconventional well in its first year and about $250,000 over the life of the well.[56]

The industry's response to the introduction of the comparatively more costly Impact Fee suggests that adjusted bond amounts would not affect the number of wells drilled or production. A 2018 study found no systematic change in these outcomes around the introduction of the Impact Fee and compared to areas across the border in West Virginia and Ohio, which did not change their fees or taxes over the same period.[57] The authors did find that leasing declined but attributed this decline primarily to timing of the Fee, which was introduced when natural gas prices were very low and credit lines tight.

Table 3. The Estimated Cost of Bonds at Current and Adjusted Levels

	Well Type	
	Conventional	Unconventional
Assumptions		
Rate on Surety Bond (%)	5	5
Discount Rate (%)	5	5
Current Bond Amount ($ Per Well)	1,000	5,000
Recommended Bond Amount ($ Per Well)	25,000	70,000
Estimates ($ Per Well)		
Current Annual Cost	50	250
Current Present Value of Costs Over 30 Years	769	3,843
New Annual Cost	1,250	3,500
New Present Value of Costs Over 30 Years	19,216	53,804
Change in Annual Cost of Bonding ($ Per Well)	1,200	3,250
Change in Total Cost of Bonding ($ Per Well)	18,447	49,960

[54] Assuming the use of blanket bonds, these per well bond amounts would correspond to a conventional operator with 25 wells ($1,000 = $25,0000 / 25 wells) and an unconventional operator with 120 wells ($5,000 = $600,000 / 120 wells). The cost of current bond amounts would be higher for smaller operators and lower for larger operators.

[55] There is limited data on the bond rates paid by oil and gas operators in Pennsylvania; however, one surety reports on its website that a lower-risk applicant will likely "pay no more than 5% of the bond amount." See www.bryantsuretybonds.com/oil-and-gas-surety-bond. Operators can satisfy bond requirements in different ways (e.g., depositing U.S. Treasury Bonds) and will presumably adopt the lowest cost option. If surety bonds represent the cheapest option, they will provide an accurate indication of actual cost; if not, they will overstate it.

[56] Black, McCoy, and Weber, *When externalities are taxed: The effects and incidence of Pennsylvania's impact fee on shale gas wells.*

[57] Ibid.

Estimates from another recent study show a muted effect of higher bond amounts on unconventional oil and gas activity. The study explored the effect of North Dakota's policy changes, which, among other things, increased per well bond amounts from $20,000 to $50,000 for all existing and new wells.[58] It found that higher bond amounts along with increased regulation had no statistically discernable effect on drilling or production.

The adjusted bond amount would increase annual costs by $1,200 per conventional well, or about $18,000 over the life of a 30-year well (in present value terms). A study of the Texas experience provides insight into what might happen to the conventional well industry. In the early 2000s, Texas introduced a bonding requirement of $2 per foot. In the short term the requirement caused about five percent of operators to exit the market.[59] Exiting operators were small on average and had poor environmental records. Over time, the requirement shifted wells across operators, with about four percent of wells operated by small operators shifting to new operators. As a result, the number of unplugged and abandoned wells decreased by 70 percent and violation of water regulations fell by a quarter. This is a plausible outcome for Pennsylvania—operators unable to pay to the insurance against leaving a well unplugged could exit the market, and their wells could shift to more financially secure operators. Such a shift would protect the Commonwealth from bearing plugging costs since operators unable to pay for insurance (bonds) are probably unable to pay to plug their wells.

It is possible that the adjustment could prematurely shift some existing wells to the responsibility of the Commonwealth. This would happen if the adjustment bankrupts an operator and no other operator wants to acquire the acreage and wells. For such marginal wells and operators, it is likely that the bond adjustment simply changes when the transfer to the Commonwealth happens, not whether it happens. Moreover, with the adjustment the Commonwealth gains financial protection in cases where operators currently can afford the new bonds on existing wells but will eventually fall into financial distress and abandon their wells without plugging them.

It is also worth noting that if Pennsylvania adjusted bond amounts upward it would not be unique among major oil and gas producing states. In addition to North Dakota's bond amount increase referenced above, in 2019 the state increased bond amounts on injection wells from $50,000 to $100,000 and reduced the number of inactive wells that can be covered under a blanket bond.[60] In the same year, Alaska also increased its bond amounts considerably, and Mississippi introduced an annual fee on idle wells.[61]

Conclusion

Thanks to the Pennsylvania Department of Environmental Protection's orderly recording of its plugging activity and costs, much can be said about the well-plugging costs that the Commonwealth has incurred and is likely to incur moving forward. The law prescribing bond amounts appears to anticipate analysis of such data and its consideration by the Environmental Quality Board so that bond amounts can be adjusted to reflect the projected costs to the Commonwealth.

[58] Lange and Redlinger, *Effects of stricter environmental regulations on resource development.*
[59] Boomhower, *Drilling Like There's No Tomorrow*.
[60] Industrial Commission of the State of North Dakota, "Case No. 27828 Order No. 30278". https://www.dmr.nd.gov/oilgas/or30278.pdf
[61] Peltz and Saunders, "How oil & gas states did (and did not) protect land and water in 2019".

Based on analysis of the cost data, this report recommends for the 2021-2022 period a bond amount of $25,000 per conventional well and $70,000 per unconventional well. This adjustment—and subsequent reviews and adjustments by the EQB—will help protect residents and property owners in oil and gas producing areas who would otherwise be harmed or constrained by unplugged abandoned wells. It will also protect the Commonwealth and its taxpayers from shouldering the liabilities of private oil and gas operators that fall into financial distress. By adopting this report's recommendations, the EQB can therefore restore the financial responsibility of well plugging to well operators and remove it from the Commonwealth.

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Appendix A: Conventional Well Plugging Costs

I estimate the plugging cost for a conventional well in the 2021-2022 period by adjusting the sample average plugging cost for changes in costs over time. Let $\bar{c}$ be the sample average cost per well over the 1989-2020 period, $\bar{y}$ the year that the average well was plugged, and $\hat{r}_r$ the estimated real annual growth rate in plugging cost, accounting for any changes in well characteristics over time. The estimated plugging cost for a conventional well in 2020 is then:

$$Estimated\ Cost\ (Con)_{\ 2020} = \bar{c} \cdot (1 + \hat{r}_r)^{(2020-\bar{y})} \quad \text{(A1)}$$

If $\hat{r}_n$is the estimated nominal growth rate in plugging costs (unadjusted for inflation), the projected plugging cost for a conventional well in 2021-2022[62] (in 2021 dollars) is then:

$$Projected\ Cost\ (Con)_{\ 2021-22} = Estimated\ Cost\ (Con)_{\ 2020} \cdot (1 + \hat{r}_n) \quad \text{(A2)}$$

I estimate the real growth rate in plugging costs using the following regression where the unit of analysis is the contract but the regression is weighted by contract size. The dependent variable is the natural log of plugging costs per foot.

$$Ln(Plugging\ Cost\ Per\ Foot_{it}) = \delta Year\ Plugged_{it} + X_{it}\gamma + \delta_c + \varepsilon_{it} \quad \text{(A3)}$$

The term δ_c is a county fixed effect based on the modal county of wells in contract *i* executed in year t. The county fixed effect makes for comparisons of plugging costs within the same county, thereby holding constant factors such as remoteness, terrain, and geology. This accounts for the possibility that plugging costs changed over time because the location of wells being plugged also changed.

The variable Year Plugged is the calendar year (e.g. 2005) when wells in contract *i* were plugged. The vector X includes other variables associated with the contract and its wells and that may affect plugging costs. In its most comprehensive form it includes the natural log of the number of wells in the contract (Contract Size), the shares of wells in the contract of various types (e.g. gas wells), a variable indicating an emergency contract, the share of wells in a coal region, and the average estimated year drilled of contract wells as indicated by the first year the well appears in state records. Their effect on plugging costs is captured by the vector of coefficients in γ. The term ε_{it} captures all variation in the log of plugging costs per foot not captured by the variables in the model.

Multiplying the estimated coefficient on the variable Year Plugged ($\hat{\delta}$) by 100 gives the percent change in per foot plugging costs for each 1-year increase in Year Plugged. Because plugging costs are already adjusted for inflation, this coefficient gives the real annual growth rate in plugging costs over the period holding constant all the other variables in the model. Put differently, $\hat{\delta} = \hat{r}_r$.

Table A1 shows the results from three regressions based on equation A3. The first column includes all the wells in the DEP plugging summary data with depth data, the second includes only wells with additional variables and the third uses this smaller sample and includes two additional control variables. The estimated growth rate—the coefficient on Year Plugged—changes little as the sample is restricted

[62] I consider plugging costs over the 2021-2022 period to equal the cost estimated for the last day of 2021, which is what is given by the formula that applies the nominal annual growth rate to the estimated 2020 plugging cost, assuming that the 2020 cost estimate reflects costs on the last day of 2020.

and more variables are added. The main estimate is 3.2 percent with a 95 percent confidence interval of 2.6 percent to 3.7 percent.

Table A1. Plugging Costs Per Foot (Ln) and Contract and Well Characteristics

	1	2	3
Year Plugged	0.031	0.031	0.032
	(0.002)	(0.003)	(0.003)
Ln(Contract Size)	-0.437	-0.433	-0.399
	(0.012)	(0.012)	(0.013)
Share Oil Wells	-1.116	-1.250	-1.212
	(0.672)	(0.901)	(0.695)
Share Gas Wells	-0.674	-0.803	-1.189
	(0.671)	(0.898)	(0.716)
Share Oil and Gas Wells	-0.944	-1.069	-1.413
	(0.672)	(0.902)	(0.706)
Emergency Contract	-1.064		
	(0.708)		
Share Wells in Coal Region			-0.683
			(0.175)
Estimated Year Drilled			0.011
			(0.001)
Control for County	Yes	Yes	Yes
Number of Contracts	226	211	211
Number of Wells	3,060	3,040	3,040
Adjusted R-Squared	0.51	0.50	0.64

Notes: Robust standard errors are in parenthesis. The regression is based on contract-level data but weighted by the number of wells per contract. The sample of contracts analyzed in columns 2 and 3 does not have any emergency contracts, which is why no results are reported for that variable.

As noted in the main text, the data depicted in Figure 1 are adjusted for changes in contract and well characteristics over time. This is done by excluding the variable Year Plugged from the regression in column 3 of Table A1, in which case the resulting regression error $\hat{\varepsilon}$ reflects variation in plugging costs holding constant factors other than time. Figure 1 then depicts $\hat{\varepsilon}$ on the vertical axis and Year Plugged on the horizontal axis.

Appendix B: Unconventional Well Plugging Costs

I estimate the cost of plugging an unconventional well by adjusting the sample average conventional cost ($\bar{c}$) for differences in the characteristics of the two well types. Let $\bar{X}_{con}$ and $\bar{X}_{un}$ be vectors of the characteristics of the average conventional and unconventional well and let $\hat{\beta}$ be the relationship between a one unit change in a variable in X on per well plugging costs. This adjustment for differences in average well characteristics, such as well depth, can be incorporated into equation (B1) to estimate the cost of plugging an unconventional well in 2020:

$$Estimated\ Cost\ (Un)_{\ 2020} = \bar{c} \cdot \left((\bar{X}_{un} - \bar{X}_{con}) \cdot \hat{\beta}\right) \cdot (1 + \hat{r}_r)^{(2020-\bar{y})} \quad \text{(B1)}$$

Similarly, the projected cost for 2021-2022 (in 2021 dollars) would be:

$$Projected\ Cost\ (Un)_{\ 2021-22} = Estimated\ Cost\ (Un)_{\ 2020} \cdot (1 + \hat{r}_n) \quad \text{(B2)}$$

The real and nominal growth rates ($\hat{r}_r$ and $\hat{r}_n$) are the same as those used for conventional wells and described in Appendix A. I estimate the relationship between per well costs (at the contract level) and well characteristics, given by β, using the regression equation:

$$Plugging\ Cost\ Per\ Well_{it} = Z_{it}\beta + \delta_c + \epsilon_{it} \quad \text{(B3)}$$

where δ_c is a county fixed effect that accounts for any differences in average plugging costs across counties. In its most comprehensive form, the vector Z includes the average depth of wells in the contract, the contract size and the contract size squared (to capture declining economies of scale), the share of contract wells that are gas wells, a variable indicating an emergency contract, the share of wells in a coal region, and the average estimated year drilled of contract wells as indicated by the first year the well appears in state records. The term ϵ_{it} captures all variation in plugging costs per well not captured by the variables in the model.

Table B1 shows the results from two regressions based on equation B3. The unit of analysis is the contract, but the regression is weighted by contract size. Column 1 shows the results of a simple model that only includes depth, contract size, and the year plugged (and no county fixed effect). Column 2's results are based on a model with county fixed effects and the comprehensive version of Z. I use the $\hat{\beta}$ from this more comprehensive model when making the adjustment in equation (B1) because the comprehensive model should more reliably estimate the effects of well depth and type on plugging costs. These are the two characteristics incorporated into the adjustment because they most differ between sample wells and the typical unconventional well.

Based on the short model, an additional foot of depth adds $5.00 to plugging costs. Adding more variables reduces the coefficient on average depth to $1.90, but also shows that contracts with a greater share of natural gas wells have higher costs, suggesting that a contract consisting of all gas wells costs about $21,000 more per well than a contract with no gas wells.

Table B1. Contract and Well Characteristics and Plugging Costs Per Well

	1	2
Average Well Depth (Feet)	5.0	1.9
	(0.5)	(0.5)
Contract Size (Number of Wells)	-681.2	-270.4
	(34.1)	(26.3)
Contract Size Squared	3.1	1.2
	(0.2)	(0.1)
Year Plugged	335.2	278.2
	(132.9)	(105.4)
Share Gas Wells		21,376.1
		(3,545.7)
Share of Wells in Coal Regions		-5,852.3
		(13,524.1)
Estimated Year Drilled		102.0
		(43.9)
Control for County	No	Yes
Number of Contracts	226	211
Number of Wells	3,060	3,040
Adjusted R-Squared	0.27	0.27

Notes: Robust standard errors are in parenthesis. The regression is based on contract-level data but weighted by the number of wells per contract.

Appendix C: Data

The following contracts and wells were removed from the Pennsylvania Department of Environmental Protection's well plugging summary dataset, which left 3,099 wells:

- 1 contract that was in process and had no cost data (7 wells).
- 1 contract where it was noted that site restoration but not plugging occurred (1 well).
- 20 wells across various contracts where instead of a plugging date, it was noted: "not plugged," "not a well," "prev plugged," "stray gas," "unable to locate," "water," "gas drip," or "well not found." Because they were not plugged, these wells were ignored when calculating average values for each contract.

Mapping the DEP wells onto oil and gas pool outlines permitted approximating each well's depth. Some wells could not be mapped onto pools but where other wells in the same contract had depth data, I imputed missing depth data with the contract mean depth. After imputation, depth data were available for 3,060 of the 3,099 wells left after the above exclusions.

I created two additional variables from data not found in the DEP plugging summary dataset. These were an indicator for whether the well was in a coal region and the estimated year the well was drilled as indicated by the first year that the well was observed in state records. Data for both variables were obtained through the Department of Conservation and Natural Resources' EDWIN database. The database is a repository of oil and gas well data from multiple sources, including from various Department of Environmental Protection reports.

Attachment D

Well Bond Amounts
by State

<table>
<tr><th>State</th><th>Program</th></tr>
<tr><td>Federal (Bureau of Land Management)</td><td>Any operator that seeks to drill wells on federal land must sign a lease to do so with the Bureau of Land Management (BLM). 43 C.F.R. Part 3100 describes the process of obtaining a lease from BLM to drill a well. Prior to commencing drilling on the leased land, the operator must submit a bond to BLM whose return is conditioned on the operator following all lease requirements, including plugging of the well and restoration of the land after production has ceased. 43 C.F.R. Subpart 3104 governs the bond requirements.

For individual wells, an operator shall provide a bond of not less than $10,000 for each well, or

For multiple wells, an operator shall provide one of the following blanket bonds:
a. Not less than $25,000 to cover all wells in any one state;
b. Not less than $150,000 to cover all wells nationwide, and

BLM state offices have the authority to increase (or decrease) individual bond amounts as the office feels necessary, provided that the new bond amount does not exceed “the total of the estimated costs of plugging and reclamation, the amount of uncollected royalties due to the Service, plus the amount of monies owed to the lessor due to previous violations remaining outstanding.” 43 C.F.R. § 3104.5.

BLM has adopted a policy of reviewing bond amounts for all statewide and nationwide bonds every five years, and increasing or decreasing the bond amount based on a set formula (with some discretion to disregard the formula). Memorandum from the Assistant Dir., Energy, Minerals, and Realty Mgmt., Bureau of Land Mgmt., to all Field Officials (Nov. 15, 2018), https://www.blm.gov/policy/im-2019-014#_ftn7.</td></tr>
<tr><td>Alabama</td><td>The State Oil and Gas Board of Alabama is a regulatory agency that promotes protection and conservation of the environment. The board enforces the state rules and regulations through oversight of oil and gas drilling, operation, exploration, and production; Class II injection wells; and underground storage of gas in reservoirs in Alabama. The Oil and Gas Board of Alabama Administrative Code 400-1-1-.01 thru 400-7-1-.23 defines the regulations process for oil and gas permits. Chapter 400-1-2 details the process of well permitting, and Section 400-1-2-.03 explains the bond requirement.

<table><tr><td>Measured Depth (ft)</td><td>Amount of bond req’d</td></tr><tr><td>0 - 5,000</td><td>$5,000</td></tr><tr><td>5,001 - 10,000</td><td>$10,000</td></tr><tr><td>10,001 - 15,000</td><td>$15,000</td></tr><tr><td>15,001 - 20,000</td><td>$30,000</td></tr><tr><td>Greater than 20,000</td><td>$50,000</td></tr><tr><td colspan="2">The Board may, however, accept a blanket bond in the amount of one hundred thousand</td></tr></table></td></tr>
</table>

<table>
<tr><td></td><td>dollars ($100,000.00).</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Alaska</td><td>Alaska oil and gas operators that drill, produce, and maintain oil, gas, and geothermal wells must obtain a Permit to Drill from the Alaska Oil and Gas Conservation Commission (AOGCC). The Commission manages certain oil and gas operations in the state, whether it is federally owned, state owned, or privately owned. The permit covers operators of exploratory, stratigraphic test, development wells, injection, and other service wells related to oil, gas and geothermal activities. A part of the permit process includes obtaining a single well or blanket surety bond.

Alaska Admin. Code tit. 20, § 25.025.

<table><tr><td># Permitted Wells</td><td>Bond Amount</td></tr><tr><td>1 - 5 wells</td><td>$400,000 per well</td></tr><tr><td>6-20 wells</td><td>$2,000,000 plus $250,000 per well</td></tr><tr><td>21 - 40 wells</td><td>$6,000,000 blanket bond</td></tr><tr><td>41 - 100 wells</td><td>$10,000,000</td></tr><tr><td>101 - 1,000 wells</td><td>$20,000,000</td></tr><tr><td>Over 1,000 wells</td><td>$30,000,000</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Arizona</td><td>The Arizona Department of Environmental Quality, Oil and Gas Conservation Commission is responsible for the issuing of permits and operator compliance with state laws and regulations for oil and gas new well operations, re-entering an abandoned well, drilling, and production. The Department requires a performance bond before drilling of new wells, re-entering an abandoned well, or assuming the responsibility of an existing well.

Arizona Administrative Code (A.A.C.) R12-7-103

<table><tr><td>For individual wells, an operator shall provide a $10,000 bond for each well drilled to a total depth of 10,000 feet or less or a $20,000 bond for each well drilled deeper than 10,000 feet, or</td></tr><tr><td>For multiple wells, an operator shall provide one of the following blanket bonds to cover all wells:
a. $25,000 for 10 or fewer wells;
b. $50,000 for more than 10 but fewer than 50 wells; or
c. $250,000 for 50 or more wells.</td></tr></table></td></tr>
</table>

<table>
<tr><th>State</th><th>Program</th></tr>
<tr><td>California</td><td>Oil and gas well operators in California are regulated by the Department of Conservation‘s (DOC) Division of Oil, Gas, & Geothermal Resources. The Division oversees the drilling, operation, maintenance, plugging and abandonment of oil, gas, and geothermal wells. Oil and gas operators in California must file individual or blanket bonds with the Department.

CA PRC 3204

<table><tr><td>Twenty-five thousand dollars ($25,000) for each well that is less than 10,000 feet deep.</td></tr><tr><td>Forty thousand dollars ($40,000) for each well that is 10,000 or more feet deep.</td></tr></table></td></tr>
<tr><th>State</th><th>Program</th></tr>
<tr><td>Colorado</td><td>The Colorado Department of Natural Resources, State Land Board, Oil & Gas Conservation Commission (COGCC) is responsible for the issuing of permits and operator compliance with state laws and regulations for oil and gas well drilling, exploration, operation and plugging. The Commission requires a surety bond prior to the assignment or permit to drill new wells, deepening of wells, and the plugging of wells.

2 CO ADC 404-1 - 700 Series (Rule 706)

<table><tr><td>Individual</td><td>$10,000 for wells less than 3,000 feet deep and $20,000 for wells equal to or more than 3,000 feet deep</td></tr><tr><td>Blanket</td><td>A $60,000 blanket bond for less than 100 wells, or a $100,000 blanket bond for more than 100 wells</td></tr><tr><td colspan="2">The Commission may increase the required assurance under special circumstances, per Rule 702.a (2 CCR 404-1:702(a))</td></tr></table></td></tr>
<tr><th>State</th><th>Program</th></tr>
<tr><td>Florida</td><td>The State of Florida Department of Environmental Protection, Oil and Gas Program is the permitting authority for mining and minerals regulation programs. The oil and gas program details can be found in Chapter 377 of the Florida Statutes and Rules 62C-25 through 30 of the Florida Administrative Code. FS 377.22(f) gives the Department the authority to require bonds, and Rule 62C-26.002 details the requirement.

Rule 62C-26.002, F.A.C.
or
Fla. Admin. Code r. 62C-26.002

<table><tr><td>Well Depth (Feet)</td><td>Security Required</td></tr></table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>0 - 9,000</td><td>$50,000</td></tr>
<tr><td>9,001 or more</td><td>$100,000</td></tr>
<tr><td colspan="2">In lieu of furnishing a separate security for each particular well, an owner or operator may file with the Department a blanket bond for multiple operations within the State in the amount of $1,000,000.00. Each blanket bond may cover up to ten wells.</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Georgia</td><td>In order to work on oil and gas wells in Georgia, operators need to obtain a permit from the state Department of Natural Resources. One of the main criteria that you have to fulfill to get a permit is to post a surety bond. It serves as a protection mechanism for the state that you will operate the oil and gas well drilling in accordance with state regulations.

Ga. Code Ann., § 12-4-47 (sets the maximum)

Ga Comp. R. & Regs. 391-3-13-.04

<table>
<tr><td>Permit Depth</td><td>Amount of Bond</td></tr>
<tr><td>Less than 5,000 feet</td><td>$20,000</td></tr>
<tr><td>5,000 - 10,000 feet</td><td>$40,000</td></tr>
<tr><td>10,000 - 15,000 feet</td><td>$60,000</td></tr>
<tr><td>Over 15,000 feet</td><td>$80,000</td></tr>
<tr><td colspan="2">“[A] blanket bond in the amount of $100,000 may be substituted. . . . The Director may require that the blanket bond not be applicable for any well left open after rig removal.”</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Idaho</td><td>The Idaho Department of Lands, Oil & Gas Conservation Commission regulates drilling, explorations, and production of oil and gas wells. The Commission requires a surety bond before any drilling of new wells, plug back, or deepening of an existing well.

IDAPA 20.07.02.220.

<table>
<tr><td>Individual</td><td>“[N]ot less than ten thousand dollars ($10,000) plus one dollar ($1) for each foot of planned well length . . . .”</td></tr>
<tr><td>Blanket</td><td>- $50,000 (up to 10 wells)
- $100,000 (11 to 30 wells)
- $150,000 (over 30 wells)</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
</table>

<table>
<tr><td>Illinois</td><td>The Illinois Department of Natural Resources, Office of Oil and Gas Resource Management, regulates the permitting, drilling, operating, and plugging oil and gas production wells. The Department requires surety bonds or another form of security from oil and gas drillers to help protect Illinois' oil and gas resources, the environment, land, and water resources.

62 Ill. Adm. Code 240.1500.

<table><tr><td>Individual</td><td>- $1,500 for a well < 2000 ft
- $3,000 for a well > 2000 ft</td></tr><tr><td>Blanket</td><td>- $25,000 for up to 25 wells
- $50,000 for up to 50 wells
- $100,000 for all wells</td></tr><tr><td>Other</td><td>- $10,000 before a permit is issued, authorizing a person to operate
- $2,500 for each individual permit (or $25,000 blanket bond) to be filed before a permit is issued to drill a test hole or monitoring of a well</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Indiana</td><td>The Indiana Department of Natural Resources requires a permit for drilling, deepening, operating, or converting a well for oil and gas purposes. The Department requires a security from well operators to ensure compliance with respect to plugging of the well, filling in of all excavations, the removal of concrete bases, discarding machinery and materials, cutting off of the surface casing, and restoration of the surface as nearly as possible to its former condition prior to drilling.

Indiana Code (IC) 14-37-6

<table><tr><td>Individual</td><td>$2,500</td></tr><tr><td>Blanket</td><td>$45,000</td></tr></table></td></tr>
<tr><td>Iowa</td><td>The Iowa Department of Natural Resources oversees the administration of the state’s laws and regulations governing oil, gas, and metallic mineral exploration and production. The Department requires a conformance bond from any operators in this field.

Iowa Admin. Code 561-17.5(458A)

<table><tr><td>Individual</td><td>$15,000</td></tr><tr><td>Blanket</td><td>$30,000</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Kansas</td><td>The Kansas Corporation Commission, Conservation Division regulates oil and gas</td></tr>
</table>

<table>
<tr><td></td><td>production in the state, including exploration and production activities and intrastate gas storage.The Division requires a form of financial assurance before any drilling of new wells, deepening, repairing, re-drilling, or plugging and abandoning of an existing well.

K.S.A. 55-155, K.A.R. 82-3-120

<table>
<tr><td>$.75 times the total aggregate depth (in feet) of all wells</td></tr>
<tr><td>OR

< 2,000 feet in depth:
- 1 to 5 wells $7,500
- 6 to 25 wells $15,000
- Over 25 wells $30,000

> 2,000 feet in depth:
- 1 to 5 wells $15,000
- 6 to 25 wells $30,000
- Over 25 wells $45,000</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Kentucky</td><td>KRS 353.590 governs bond requirements in Kentucky.

<table>
<tr><td>Individual</td><td>Shallow Wells - $2/foot
Vertical Deep Wells - $25,000
Horizontal Deep Wells - $40,000</td></tr>
<tr><td>Blanket</td><td>Shallow Wells
- 1 - 25 Wells = $20,000
- 26 - 100 = $50,000
- 101 - 500 = $200,000
- 501 - 1000 = $300,000
- 1001 - 1025 = $320,000
- 1026 - 1100 = $350,000
- 1101 - 1500 = $500,000
- 1501 - 2000 = $600,000
- 2001 - 2025 = $620,000
- 2026 - 2100 = $650,000
- 2101 - 2500 = $800,000
- 2501 - 3000 = $900,000
- 3001 - 3025 = $920,000
- 3026 - 3100 = $950,000
- 3101 - 3500 = $1,100,000
- 3501 - 4000 = $1,200,000
- 4001 - 4025 = $1,220,000
- 4026 - 4100 = $1,250,000
- 4101 - 4500 = $1,400,000</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>- 4501 - 5000 = $1,500,000
Vertical Deep Wells
- $200,000 for every ten wells
Horizontal Deep Wells
- $320,000 for every ten wells</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Louisiana</td><td>The Louisiana Department of Natural Resources, Office of Conservation, regulates oil and gas production in the state, including exploration and production activities and intrastate gas storage. The Office requires a form of financial assurance before any new drilling of wells, deepening, operation, plugging and abandoning of an existing well.

La. Admin Code. tit. 43, Pt XIX, § 104.

Individual Well by Footage
<table>
<tr><td>Depth</td><td>Land</td><td>Coastal</td><td>Offshore</td></tr>
<tr><td><3,000 ft</td><td>$2 ft</td><td>$8 ft</td><td>$12 ft</td></tr>
<tr><td>3,001 – 10,000 ft</td><td>$5 ft</td><td>$8 ft</td><td>$12 ft</td></tr>
<tr><td>>10,000 ft</td><td>$4 ft</td><td>$8 ft</td><td>$12 ft</td></tr>
</table>
Blanket Bond – Prior to August 12, 2016
<table>
<tr><td># Wells</td><td>Land</td><td>Coastal</td><td>Offshore</td></tr>
<tr><td><10</td><td>$25,000</td><td>$250,000</td><td>$500,000</td></tr>
<tr><td>11-99</td><td>$125,000</td><td>$1,250,000</td><td>$2,500,000</td></tr>
<tr><td>>100</td><td>$250,000</td><td>$2,500,000</td><td>$5,000,000</td></tr>
</table>
Blanket Bond – After August 12, 2016
<table>
<tr><td># Wells</td><td>Land</td><td>Coastal</td><td>Offshore</td></tr>
<tr><td><10</td><td>$50,000</td><td>$250,000</td><td>$500,000</td></tr>
<tr><td>11-99</td><td>$250,000</td><td>$1,250,000</td><td>$2,500,000</td></tr>
<tr><td>>100</td><td>$500,000</td><td>$2,500,000</td><td>$5,000,000</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Maryland</td><td>Applicants for a permit to drill a well must file a financial assurance with the Maryland Department of the Environment in order to receive their permit. Md. Code Ann., Env’t § 14-111 (West) and COMAR 26.19.01.06 set the requirements for bond amounts.
<table>
<tr><td>Individual</td><td>$50,000 per well, but “not less than the most recent closure cost estimate provided by the permit holder . . . .” The amount, however, cannot exceed $100,000 per well</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>Blanket</td><td>$500,000</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Michigan</td><td>The Michigan Department of Environmental Quality, Oil, Gas and Minerals Division is responsible for the issuing of permits and operator compliance with state laws and regulations for oil and gas well operations, plugging, deepening, converting, and drilling. The Department requires a conformance bond prior to the drilling of any new wells, deepening of wells, and the plugging of wells.

MCL 324.61525 and Mich. Admin. Code R 324.212 set the bond requirements

<table><tr><td>Individual</td><td>- < 2000 ft deep - $10,000
- 2,000 - 4,000 ft - $40,000
- 4,000 - 7,500 ft - $50,000
- > 7,500 ft - $60,000</td></tr><tr><td>Blanket
(100 well max)</td><td>- < 2,000 ft deep - $100,000
- 2,000 - 4,000 ft - $200,000
- > 4,000 ft deep - $250,000</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Mississippi</td><td>The Mississippi Oil and Gas Board regulates oil and gas production in the state. The Board issues operator permits; collects and tracks inactive and active well data and maintains well field maps; conducts inspections for new wells, plugging and abandoning of wells; and provides a financial responsibility element in the event an operator fails to perform the duties to meet the state requirements. The Board requires a form of financial responsibility before new drilling of wells, operation, plugging and abandoning of an existing well.

26 Miss. Admin. Code Pt. 2, R. 1.4
(Formerly cited as MS ADC 26-2:1.4)

Individual Well

<table><tr><td>Depth in Feet</td><td>Bond Required</td></tr><tr><td>Zero to 10,000 ft</td><td>$20,000</td></tr><tr><td>10,001 to 16,000 ft</td><td>$30,000</td></tr><tr><td>16,001 or more ft</td><td>$60,000</td></tr><tr><td>Blanket Bond</td><td>$100,000</td></tr></table>
Submerged Offshore Lands

<table><tr><td>Number of Wells</td><td>Bond Required</td></tr><tr><td>Each Well</td><td>$100,000</td></tr><tr><td>Blanket Bond</td><td>$200,000</td></tr></table></td></tr>
</table>

<table>
<tr><th>State</th><th>Program</th></tr>
<tr><td>Missouri</td><td>The Missouri Department of Natural Resources, Oil and Gas Council regulates oil and gas production including drilling, deepening, plug-back, or recomplete well operations. The Department requires a form of financial assurance before the drilling of wells, deepening, operation, plug-back, and recomplete of an existing well.

10 Mo. Code of State Regulations 50-2.020

Individual
<table>
<tr><td>Well Depth</td><td>Bond Amount</td></tr>
<tr><td>0 - 500 ft</td><td>$1,100</td></tr>
<tr><td>501 - 1,000 ft</td><td>$2,200</td></tr>
<tr><td>1,001 - 2,000 ft</td><td>$3,300</td></tr>
<tr><td>2,001 - 5,000 ft</td><td>$4,400</td></tr>
<tr><td>5,000 ft</td><td>$5,500 + $2 for each additional foot</td></tr>
</table>
Blanket
<table>
<tr><td>Well Depth</td><td>Bond Amount</td></tr>
<tr><td>0 - 800 ft</td><td>$22,000 for up to 40 wells</td></tr>
<tr><td>800 - 1,500 ft</td><td>$25,000 for up to 10 wells</td></tr>
<tr><td colspan="2">Wells with a depth greater than 1,500 ft must be bonded individually</td></tr>
</table></td></tr>
<tr><th>State</th><th>Program</th></tr>
<tr><td>Montana</td><td>The Montana Board of Oil and Gas Conservation regulates oil and gas production including drilling, re-entering, well operations, deepening, plugging, and restoration. The Board requires a form of financial responsibility before the drilling of wells, deepening, operation, or re-entering and plugging of an existing well.

Mont.Admin.R. (ARM) 36.22.1308

Individual
<table>
<tr><td>Well Depth</td><td>Bond Requirement</td></tr>
<tr><td>< 2,000 ft</td><td>$1,500</td></tr>
<tr><td>2,500 - 3,501 ft</td><td>$5,000</td></tr>
<tr><td>> 3,501 ft</td><td>$10,000</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>
<table><tr><td>The Board has the option to increase surety bond amounts for an individual well from:
$1,500 to $3,000;
$5,000 to $10,000;
$10,000 to $20,000</td></tr></table>

Blanket
<table><tr><td>$50,000 - May be increased to $100,000 at the discretion of the Board</td></tr></table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Nebraska</td><td>The Nebraska Oil and Gas Conservation Commission regulates oil and gas production including drilling, producing, well operations, re-entering, plugging, and land restoration. The Commission requires a form of financial responsibility before drilling of new wells, deepening, operation, or re-entering and plugging of an existing well.

Neb. Admin. R. & Regs. Tit. 267, Ch. 3, § 004

<table>
<tr><td>Individual</td><td>$10,000</td></tr>
<tr><td>Blanket</td><td>$100,000</td></tr>
</table>
</td></tr>
<tr><td>Nevada</td><td>The Nevada Commission of Mineral Resources, Division of Minerals regulates oil, gas and geothermal production or injection including re-drilling, deepening, drilling, abandoning, and production of minerals at well sites. The Division requires a form of financial responsibility in order to obtain a permit for oil, gas, or geothermal drilling.

NAC 522.230

<table>
<tr><td>Individual</td><td>$10,000</td></tr>
<tr><td>Blanket</td><td>$50,000</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>New Mexico</td><td>The New Mexico Energy, Minerals, and Natural Resources Department, Oil Conservation Division requires a surety bond prior to the drilling of new wells, deepening of wells, and the plugging of wells.

19.15.8.9 NMAC

<table>
<tr><td>Individual</td><td>$25,000 + $2/ft</td></tr>
<tr><td>Blanket</td><td>1-10 wells - $50,000
11-50 wells - $75,000
51-100 wells - $125,000
100+ wells - $250,000</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>State</th><th>Program</th></tr>
<tr><td>New York</td><td>The New York Department of Environmental Conservation, Division of Mineral Resources is responsible for the issuing of permits and operator compliance of state laws and regulations for oil and gas well operations and solution mining, plugging, deepening, converting, drilling, and surface restoration. The Division requires a plugging and surface restoration bond prior to the drilling of any new wells, deepening of wells, and converting and the plugging of wells.

6 CRR-NY 551.4; 551.5; 551.6

<table>
<tr><td>< 2,500 ft deep</td><td>- 1 - 25 Wells = $2,500 per well, not exceeding $25,000
- 26 - 50 = $25,000, plus $2,500 per well in excess of 25 wells, not exceeding $40,000
- 51 - 100 = $40,000, plus $2,500 per well in excess of 50 wells, not exceeding $70,000; or
- 100 + wells = $70,000, plus $2,500 per well in excess of 100 wells, not exceeding $100,000</td></tr>
<tr><td>2,500 - 6,000 ft</td><td>- 1 - 25 Wells = $5,000 per well, not exceeding $40,000
- 26 - 50 = $40,000, plus $5,000 per well in excess of 25 wells, not exceeding $60,000
- 51 - 100 = $60,000, plus $5,000 per well in excess of 50 wells, not exceeding $100,000; or
- 100 + wells = $100,000, plus $5,000 per well in excess of 100 wells, not exceeding $150,000</td></tr>
<tr><td>> 6,000 ft</td><td>- The Division is empowered to set an amount for each well “based upon the anticipated costs of plugging and abandoning that well” up to $250,000
- Or a blanket bond of $2,000,000</td></tr>
</table>
</td></tr>
<tr><th>State</th><th>Program</th></tr>
<tr><td>North Carolina</td><td>The North Carolina Department of Environmental Quality’s Oil and Gas Commission is responsible for adopting rules on oil and gas exploration in North Carolina. The Commission requires financial assurance to be filed with the state prior to any drilling operation.

N.C.G.S.A. § 113-378 and 15A NCAC 05H.1402

<table>
<tr><td>Plugging & Abandonment Bond</td><td>$5,000 + $1/ft</td></tr>
<tr><td>Environmental Damage Bond</td><td>$1,000,000, but the Commission may set a higher bond amount if it determines the well would be cited in an “environmentally sensitive area.”</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>The bonds may be aggregated.</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>North Dakota</td><td>The North Dakota Industrial Commission, Department of Natural Resources, Oil and Gas Division regulates drilling, exploration, and production of oil and gas wells. It is also responsible for the issuing of permits and operator compliance, well completion, drilling, and production. The Division requires a form of security before any drilling of new wells, plugging, or deepening of an existing well.

North Dakota Administrative Code 43-02-03-15.2

<table><tr><td>Individual</td><td>$50,000, but if < 2,000 ft, may be approved with a smaller bond

$100,000 for wells used for “commercial injection operations”</td></tr><tr><td>Blanket</td><td>$100,000, so long as it meets certain requirements</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Ohio</td><td>The Ohio Division of Oil and Gas Resources Management is responsible for the issuing of permits and operator compliance of state laws and regulations for oil and gas well drilling, operation, exploration, and plugging. The Division requires a surety bond prior to the drilling of any new wells, deepening of wells, and the plugging of wells.

OAC 1501:9-1-03

<table><tr><td>Individual</td><td>$5,000</td></tr><tr><td>Blanket</td><td>$15,000</td></tr></table></td></tr>
<tr><td>Oklahoma</td><td>The Oklahoma Corporation Commission, Oil & Gas Conservation Division regulates oil and gas drilling, re-drilling, deepening, abandoning, and production at well sites, commercial pits, seismic operations, and commercial soil farming. The Division requires a form of financial security in order to obtain a permit for oil or gas drilling, deepening, re-entering, plugging, and abandoning of wells.

Okla. Admin. Code 165:10-1-12

“An operator may file a blanket surety bond in the principal amount of $25,000.00 in U.S. dollars. . . as surety. In the alternative, the operator may file a surety bond of a lesser amount but that is sufficient to cover the total estimated cost of properly plugging and abandoning each and every well . . . .”</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Oregon</td><td>The Oregon Department of Geology and Mineral Industries oversees mining operations</td></tr>
</table>

<table>
<tr><td></td><td>within the state. The Department requires every person who engages in the drilling, redrilling, or reworking of any well to file a bond prior to the approval of any drilling application.

OAR 632-010-0205

<table><tr><td>< 10,000 feet deep</td><td>$25,000</td></tr><tr><td>> 10,000 feet deep</td><td>$50,000</td></tr><tr><td>Blanket</td><td>$150,000</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>South Carolina</td><td>The South Carolina Water Resources Commission regulates bond amounts in the state. Before any person shall be granted a well drilling permit, such person shall file with the Commission a reasonable performance bond.

S.C. Code of Regulations R. 121-8.6

<table><tr><td>Up to 10,000 ft</td><td>$20,000</td></tr><tr><td>10,000 - 15,000 ft</td><td>$30,000</td></tr><tr><td>15,000 - 20,000 ft</td><td>$40,000</td></tr><tr><td>20,000+ ft</td><td>$50,000</td></tr><tr><td>Submerged Land</td><td>$100,000</td></tr><tr><td>Blanket</td><td>$100,000</td></tr></table></td></tr>
<tr><td>South Dakota</td><td>The South Dakota Department of Environment and Natural Resources, Minerals & Mining Program Board requires that a performance surety bond be obtained for wells drilled or permitted after July 1, 2013.

SDCL § 45-9-15

<table><tr><td>Individual</td><td>$50,000</td></tr><tr><td>Blanket</td><td>$100,000</td></tr></table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Tennessee</td><td>The Tennessee Department of Environment and Conservation, Division of Water Resources, Oil and Gas Program is responsible for the issuing of permits and operator compliance with state rules and regulations for oil and gas well drilling, re-drilling, operations, plugging, and abandonment. The Program requires a surety bond for the plugging of each well and maintaining and restoring well sites.</td></tr>
</table>

<table>
<tr><td></td><td>
Tenn. Comp. R. & Regs. 0400-52-01-.01 and .02

Individual
<table>
<tr><td>Up to 2,500 ft</td><td>$2,000</td></tr>
<tr><td>2,500 - 5,000 ft</td><td>$3,000</td></tr>
<tr><td>Over 5,000 ft</td><td>$3,000 + $1/ft over</td></tr>
</table>

Blanket
- $20,000 up to 10 wells with a maximum depth of 5,000 feet
- $30,000 for up to 10 wells with a maximum depth of 10,000 feet
- If well depth exceeds 10,000 feet, the well is not eligible to be included in a blanket bond.
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Texas</td><td>
The Texas Oil and Gas Railroad Commission is responsible for the permitting, compliance, enforcement, and environmental cleanup programs for the state. Operators of wells are required to obtain either a bond or other form of financial assurance or financial guarantee depending on the number of wells the operator has.

16 TAC § 3.78(a)(4) and (g)

Individual
<table>
<tr><td>$2 / ft</td></tr>
</table>

Blanket
<table>
<tr><td>10 or fewer wells</td><td>$25,000</td></tr>
<tr><td>11 - 99 wells</td><td>$50,000</td></tr>
<tr><td>100 or more wells</td><td>$100,000</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Utah</td><td>
The Utah Department of Natural Resources, Division of Oil, Gas, and Mining is responsible for issuing permits and ensuring operator compliance with state rules and regulations for oil and gas well drilling, re-drilling, operations, plugging and abandonment, deepening, and repairing. The Division requires a surety bond for the plugging of each dry or abandoned well, repairs to wells, and maintaining and restoring well sites.

U.A.C. R649-3-1
</td></tr>
</table>

<table>
<tr><td></td><td>
Individual
<table>
<tr><td>Up to 1,000 ft</td><td>$1,500</td></tr>
<tr><td>1,000 - 3,000 ft</td><td>$15,000</td></tr>
<tr><td>3,000 - 10,000 ft</td><td>$30,000</td></tr>
<tr><td>More than 10,000 ft</td><td>$60,000</td></tr>
</table>
Blanket
<table>
<tr><td>Less than 1,000 ft</td><td>$15,000</td></tr>
<tr><td>More than 1,000 ft</td><td>$120,000</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Virginia</td><td>
The Commonwealth of Virginia, Department of Mines, Minerals, and Energy, Division of Gas and Oil is responsible for the issuing of permits and operator compliance with state rules and regulations for oil and gas well drilling, operations, plugging, and abandonment. The Division requires a surety bond for the plugging of each well and maintaining and restoration of well sites.

Senate Bill 1453, § 45.2-1633, passed in March 2021, goes into effect on October 10, 2021 and repeals and replaces VA Code Ann. § 45.1-361.31
<table>
<tr><td>Individual</td><td>$10,000/each well
+ $2,000/acre of disturbed land
The statute is ambiguous on whether the Department can increase this bond amount if it believes the cost of plugging the well is higher; the Department unambiguously has this authority in the Tidewater region of Virginia</td></tr>
<tr><td>Blanket</td><td>- Up to 10 wells - $25,000
- 11 wells to 50 wells - $50,000
- 51 wells to 200 wells - $100,000
- 200 or more wells - $200,000
The Department may choose not to allow an operator to submit a blanket bond and require individual bonds</td></tr>
</table>
</td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Washington</td><td>
The Washington Department of Natural Resources, Division of Geology and Earth Resources requires the filing of a bond with the state before drilling.

WAC 344-12-060
</td></tr>
</table>

<table>
<tr><td></td><td><table>
<tr><td>Individual</td><td>Not less than $50,000 each</td></tr>
<tr><td>Blanket</td><td>Not less than $250,000</td></tr>
</table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>West Virginia</td><td>The West Virginia Department of Environmental Protection, Office of Oil and Gas is responsible for the issuing of permits and operator compliance with state laws and regulations for oil and gas well operations, exploration, drilling, storage, and production. The Office requires a performance bond prior to the drilling of any new wells, deepening of wells, and the plugging of wells.

W. Va. Code, § 22-6-26

<table>
<tr><td>Individual</td><td>$5,000</td></tr>
<tr><td>Blanket</td><td>$50,000</td></tr>
</table></td></tr>
<tr><td>State</td><td>Program</td></tr>
<tr><td>Wyoming</td><td>The Wyoming Oil and Gas Conservation Commission, Office of State Oil and Gas regulates drilling, re-drilling, repairing, operating, deepening, plugging, and abandoning of wells. It is also responsible for the issuing of permits. The agency requires a bond to ensure the plugging of wells.

WY Rules and Regulations 055.0001.3 § 4(b)

<table>
<tr><td>Individual</td><td>$10/foot</td></tr>
<tr><td>Blanket</td><td>$100,000</td></tr>
</table></td></tr>
</table>

Attachment E

Gillian Graber
Affidavit

AFFIDAVIT OF GILLIAN GRABER

Pursuant to 18 Pa. Cons. Stat. § 4904, I, Gillian Graber, state as follows:

1. I have personal knowledge of the statements contained herein and could competently testify to them if called as a witness.

2. I live with my family in Trafford Borough in Westmoreland County, Pennsylvania. We have lived here for eight years. We moved here with the intention of raising our children in a healthy environment and neighborhood.

3. We chose Trafford because it is still a close drive to Pittsburgh but is more of a residential suburban community with great schools, parks, a quaint ice cream shop on the corner, and a semi-private road where my kids could learn how to ride their bikes safely. This working-class community fits our needs perfectly as it is also close to my in-laws, who are our source of child care. When looking for a home we intentionally steered clear of other locations like Plum Borough in Allegheny County because it was upwind from the Cheswick Power Plant. Having previously lived on a busy road, we were concerned about the air our children breathe and wanted to ensure their access to clean air.

4. I am a member of the Sierra Club. I support the Sierra Club's mission and goals to encourage the public to explore, enjoy, and protect the wild places of the earth; to practice and promote the responsible use of the earth's ecosystem and resources; to educate and enlist humanity to protect and restore the quality of the natural environment; and to use all lawful means to carry out these objectives.

5. I also currently serve as the Executive Director of Protect PT (Penn-Trafford). I founded the organization, along with other Penn-Trafford community members, in December

2014 to fight a fracking well pad that was proposed in the community less than a half-mile from my home. My husband and I were particularly concerned about air quality living near unconventional gas development. The more we learned about fracking, and the health impacts and detriment to our community that it poses, the more we wanted to fight this proposal for a well pad near our home. Additionally, this well pad was the closest we had ever seen to such a densely populated suburban neighborhood like ours. This means that hundreds of children would be exposed to this pollution in addition to our children. As a mother and home owner, I worried that this idyllic neighborhood would soon become an industrial zone. While the operator is still attempting to move the project forward, until now we have successfully stopped that well pad from being constructed.

6. However, there are hundreds of conventional wells scattered across my community that were drilled before I moved to Trafford. This includes both actively producing wells and wells that are legally abandoned, but are not plugged. Based on a Sierra Club analysis I saw, there are three wells within two miles of my home that the Pennsylvania Department of Environmental Protection ("DEP") has listed as abandoned but not plugged, and nineteen wells within five miles of my home that DEP has listed as abandoned but not plugged. In addition, there are two wells within two miles of my home that are listed as active but that have not produced any oil or gas for at least a year, which means they are legally abandoned and must be plugged, and twenty-one of these wells within five miles of my home. This mean that in total, there are forty-six wells that are not plugged, but should be, within a five-mile radius of our home. I believe, and am very concerned that, there are dozens to even hundreds of additional abandoned wells that DEP does not even have records for within five miles of my home.

7. In addition, based on a Sierra Club analysis I have reviewed, I am aware that there are five wells within five miles of the Protect PT office that DEP has listed as abandoned but not plugged; one well within two miles of my office that is listed as active but has not produced for over three years; and six such wells within five miles of my office. Additional orphan wells that have not been identified by DEP are likely located within five miles of my office, based upon neighbor accounts.

8. Because there are so many conventional wells in my community, I have no doubt that there are also numerous abandoned and active wells near areas where I recreate and spend time with friends and family. In fact, there are so many abandoned wells in the community that with every new proposed well pad, the operators must survey the neighbors about what abandoned wells are on their property. In one case, while taking a walk two Protect PT members found that at the location of a proposed well pad there was at least one abandoned well that the operator had not identified in their survey.

9. I did not realize the extent to which these oil and gas wells are impacting the health of my family until we participated in a study with Environmental Health News ("EHN") in 2019. Because we do not live extremely close to any fracked wells, my family was supposed to be part of the control group that did not have contact with dangerous fracking chemicals. EHN analyzed the pollutants we had been exposed to against people who live closer to fracked wells. However, our reports showed alarming amount of dangerous pollutants in our bodies. My daughter, particularly, had a very high rate of dangerous pollutants in her body.

10. We were tested three times, and each time every member of my family had levels of mandelic acid (a metabolite of ethylbenzene and styrene) detected in our urine that exceeded

the 95th percentile for the general U.S. population. Ethylbenzene and styrene can cause liver, kidney, or circulatory system problems and increase the risk of cancer. We also all had levels of hippuric acid (a metabolite of toluene and cinnamaldehyde), 2-Methylhippuric acid (a metabolite of xylene), phenylglyoxylic acid (a metabolite of ethylbenzene and styrene), and trans, trans-muconic acid (a metabolite of benzene) above the U.S. median. We often far exceeded the U.S. median for these chemicals. In several instances we even exceeded the 95th percentile for these chemicals in at least one family members' urine sample. These chemicals can cause health effects such as nervous system damage, kidney damage, nausea, circulatory system problems, anemia, and an increased risk of cancer.

11. Additionally, as part of this study we wore air sampling monitors for periods of six to eight hours. We wore these monitors on two separate occasions. The air monitor results indicated that we were all exposed to benzene, ethylbenzene, and naphthalene levels that are above the risk limit set by the California Office of Environmental Health Hazard Assessment; a risk limit that indicates an increased cancer risk of at least one in a million. At high enough exposures, these chemicals can also cause conditions such as anemia, liver and kidney problems, neurological damage, and eye damage.

12. Water from our hose and bathtub were also tested. Only five of the 40 chemicals tested have regulatory limits, and our water samples did not exceed those regulatory limits. However, our water samples did exceed the median among the other nineteen samples analyzed in the study for several pollutants, including heptane, 1,2,3-trimethylbenzene, and naphthalene. While we use reverse osmosis to purify our drinking water, we do not have that system set up for

our showers or our hose, and it is unclear what the consequences will be from our higher exposure to these chemicals.

13. I cannot know for certain how these pollutants got in my body, especially since the oil and gas industry refuses to give us data on the kinds of chemicals they use in their operations. However, I believe a lot of this pollution comes from the conventional wells, both abandoned and actively producing, all around us. Many of these wells are very old and have limited reserves left, so the owners have fracked the wells to stimulate production. It is known that the pollutants that were found in our bodies are carcinogenic and are associated with oil and gas drilling. I believe specifically that the use of the dangerous chemicals employed in fracking has resulted in harmful pollutants migrating into our water supply and into the air.

14. The operators of these wells also store the condensate from drilling in condensate tanks that vent pollutants into the atmosphere, and these tanks are often not properly maintained. Recently, the DEP charged an operator near my office with multiple violations because they kept a condensate tank on the well pad for years and did not maintain it. As a result, the condensate overflowed and spilled into a nearby stream.

15. I believe that my family and I are also being exposed to methane, benzene, toluene, and other pollutants as a result of leaks from both active and abandoned wells. Methane can turn into ozone, which can damage the heart and lungs; benzene can cause anemia, increase cancer risk, and can have significant harmful developmental effects in children; and toluene can cause nervous system or liver problems and increase cancer risk. We worry about living around these wells that have constant, low, ambient-level leaks because we just do not know if the leaks are infiltrating our air or water.

16. I am incredibly worried about how the pollution my family and I have been exposed to will impact our long-term health. My fear is that I'm going to get cancer and that my kids are going to get cancer. It is shocking how often we hear about kids and adults that have been diagnosed with cancer in our area. It is the same types of cancer too—types of leukemias, Ewing's sarcomas, and osteosarcomas—that are usually very rare. For example, one of my friend's grandmothers died several years ago from a very rare form of leukemia, and research shows that one of the ways that form of leukemia can manifest is from exposure to fracking chemicals. My friend is certain that this is how her grandmother developed leukemia, and because of it they became interested in supporting our work at Protect PT. Another friend that knows the kind of work I do a has contacted me on two separate occasions to tell me that someone they grew up with in this area was either diagnosed with cancer or that their child was. Last year, he even sent me a picture of a fundraising poster for a third grader in Norwin School District that was diagnosed with cancer.

17. It is hard to overstate the fear you are forced to live with when you and your family are exposed to these kinds of chemicals every day that you know are incredibly dangerous, and that you see are already sickening your friends and neighbors. It takes an incredible mental toll. No one should have to fear exposing their children to an increased risk of cancer just because of the place they choose to live. No mother should have to go through this, but so many are and no one is doing anything about it.

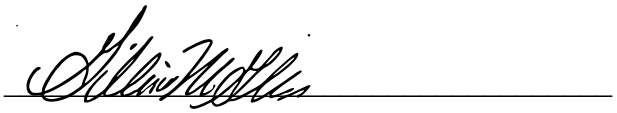
18. It's not just our health that these wells impact. They also impact our ability to enjoy the natural environment. Now that I know what the big, green condensate tanks are and what negative consequences rusty well pipes can cause, it worries me every time I see them,

which is all the time; they are all over the place. There is a well in a stream next to a nearby park, for example. I cannot walk in the woods near my home without seeing a gas well. I often wonder, "Am I being exposed just by walking along this path?" I get out in nature to avoid pollution, but that's where many of these wells are.

19. I believe if abandoned wells are properly plugged, some portion—and perhaps a very large portion—of the pollution that I am currently exposed to would be mitigated. The abandoned wells that are currently spewing chemicals into the groundwater and air would stop emitting pollutants, including the dangerous fracking chemicals with which many of these wells have been stimulated. The operator or state also must remediate the well pad when they close an abandoned well, which includes removing the condensate tanks and other polluting aspects of the drilling operation. This would greatly reduce the pollution my family and I are exposed to and reduce our risk of long-term disease. For this reason, I believe properly incentivizing and funding the closure of abandoned wells would reduce the harms I have described throughout this affidavit. It also would prevent me, and other taxpayers, from paying for the clean-up because it would make it less likely that operators leave plugging responsibilities to the state. I do not want these abandoned wells in my area polluting my air and water, and I absolutely do not want to have to pay for the cleanup. I do not want to see what happened with the mining industry, which caused hundreds of red creek beds from mine drainage that will never be remediated, happen again.

The foregoing is true and correct to the best of my knowledge, information and belief. I understand that any false statements made are subject to the penalties of 18 Pa. Cons. Stat. § 4904 relating to unsworn falsification to authorities.

Executed on this 9th day of September 2021.



Gillian Graber

Attachment F

Ann Lecuyer
Affidavit

AFFIDAVIT OF ANN LECUYER

Pursuant to 18 Pa. Cons. Stat. § 4904, I, Ann Lecuyer, state as follows:

1. I have personal knowledge of the statements contained herein and could competently testify to them if called as a witness.

2. I live with my family—my husband and four children—in Trafford Borough in Westmoreland County, Pennsylvania. We have lived here for five years. I grew up in Plum Borough, about ten miles away from my current home.

3. We decided to move to Trafford because it has a small school, the neighborhood has sidewalks, and there are a lot of playgrounds, so it's nice for young children. It seemed like a wonderful, idyllic community.

4. I am a member of the Sierra Club. I also was on the staff of the organization Protect Penn-Trafford (Protect PT) from 2017 to 2020.

5. I met Gillian Graber, the Executive Director of Protect PT, through my kids' school. My kids and her children went to the same school. I was very worried about a proposed fracking well in our community that Protect PT was fighting, so I ended up getting hired part-time to work with the organization. I eventually became the Project Outreach Coordinator, planning the programming, writing grants, and doing anything else the organization needed.

6. Today I work as a birth doula, coaching moms through their pregnancy. I have been doing this work in some capacity for the past twenty-two years.

7. My community is covered in oil and gas wells—there are numerous abandoned and active conventional wells near my home. Based on a Sierra Club analysis I have seen, there are four wells within a three-mile radius of my home that the Pennsylvania Department of

Environmental Protection ("DEP") has listed as abandoned but not plugged, and sixteen such wells within five miles of my home. In addition, there are ten wells within a three-mile radius of my home that are listed as active but that have not produced any oil or gas for at least a year (which means they are legally abandoned and must be plugged), and twenty-two such wells within five miles of my home. When I researched the issue in 2019, I learned that there are scores of wells listed as active within five miles of my home and over fifty active wells within a mile of my home--many that have not been inspected in the last ten years. Given how many abandoned wells there are across the state that DEP does not have records for and how many abandoned and active wells there are in my area, I believe there are likely hundreds of additional abandoned wells within five miles of my home.

8. In 2019, I participated in a study run by Environmental Health News ("EHN") that was intended to examine the health impacts of oil and gas drilling in the region. The results showed that all three times we were tested, every member of my family had levels of mandelic acid (which is a metabolite of ethylbenzene and styrene) detected in our urine that exceeded the ninety-fifth percentile for the general U.S. population. Eighty-seven percent of our family's samples also exceeded the ninety-fifth percentile for phenylglyoxylic acid (a metabolite of ethylbenzene and styrene); and more than half of our samples exceeded the ninety-fifth percentile for trans, trans-muconic acid (a metabolite of benzene). These chemicals can cause health effects such as liver, kidney, and circulatory system problems; anemia; and an increased risk of cancer. We also all had levels of several additional pollutants, such as hippuric acid (a metabolite of toluene and cinnamaldehyde) that exceeded the U.S. median.

9. As part of the study my family also wore air sampling monitors for several hours two separate times. Nine out of ten of those air monitor results showed that we were exposed to levels of benzene, ethylbenzene, and naphthalene that increased our risk of cancer by at least one in a million. This is based on a benchmark set by the California Office of Environmental Health Hazard Assessment, assuming that the person is consistently exposed to this level of a chemical over the course of their lifetime. These chemicals, at high enough exposures, can also cause (among other things) anemia, liver and kidney problems, and neurological damage.

10. I always wondered how living next to so many wells was impacting my family's health. Finding out just how many toxic chemicals we had in our bodies was extremely stressful. I am concerned these pollutants will increase our risk of cancer or some other dangerous disease. I have considered moving to protect myself and my family from the pollution we are being exposed to living in this area. But I don't know where we would go. My family is here in Pennsylvania and it feels like much of the state is dealing with the same problem our community is. And this is a problem in a lot of other areas in the country too. So, I've stayed put. But I'm always wondering in the back of my mind about what pollutants we are being exposed to that we cannot see and how I can protect my kids from that exposure. Now, every time I see a well, it is stressful for me because it makes me think about the air pollution I'm exposing myself and my family to. And I see wells all the time—pretty much every time I leave my house. To be exposed to this level of air pollution every day, both at home and, for my kids, at school, is very dangerous.

11. Since moving to Trafford, I have also noticed that my asthma has gotten much worse. I have always had asthma, but it was never this severe. I had to go to the emergency room

by ambulance once in November of 2018 because of an asthma attack, and that had never happened before. My doctor has since prescribed me additional maintenance medication for my asthma that has made the situation better, but I still have more problems with my asthma now than I did before moving to Trafford. Having to go to the emergency room because of difficulty breathing was very scary, and it is frustrating to have to deal with additional difficulties with my asthma on a regular basis.

12. We live in a valley between two hills, and I believe that this traps air pollution in and makes it worse. I am concerned that whatever pollutants are coming up from these wells are sitting in the air and we are breathing it in, increasing our cancer risks and exacerbating my asthma. I don't know how else these dangerous pollutants could have entered our body but from the oil and gas wells. The wells are all around us and the pollutants found in our body are known to be emitted by oil and gas wells.

13. As a birth doula I think all the time about how to ensure healthy births. I have seen the literature on the especially large impact that pollution from oil and gas wells can have on prenatal development. It can cause preterm birth, low birth weight and heart complications, among other problems. I am concerned for the pregnant moms that have to deal with this and for the health of their children.

14. After I got the results from the EHN study, I researched the wells around me to see if I could find any evidence of problems that could have caused the pollution my family and I experienced. I looked at the inspection dates and production reports for every well within a few miles of my house (I do not remember the exact distance). I found out there were numerous wells that no one had inspected in a long time, and several that also had no production reports

associated with them so, to my understanding, were legally required to be plugged. I called DEP and told them about what I had found. They told me they would look into it and get back to me. They never got back to me, and I had to call two or three more times until they finally told me that they had sent an inspector out to a few of the wells I identified and the inspector had found that the wells were fine and were not leaking. They did not say anything about the wells that were not producing and were supposed to be plugged. In my opinion, DEP just does not have the resources to properly enforce the laws regulating oil and gas wells and their plugging.

15. I believe that plugging abandoned oil and gas wells will reduce the pollution my family and I are exposed to. It is known that unplugged abandoned wells leak, and plugging them would stop this leakage. This should lower the health risks my family and I face living next to these abandoned wells. Because of my observations of DEP's inability to ensure operators plug wells, I believe the best way to ensure the abandoned wells in my community are plugged is a higher bond amount that would incentivize operators to plug their abandoned wells themselves. I believe ensuring abandoned wells are plugged should be a top priority for the state.

The foregoing is true and correct to the best of my knowledge, information and belief. I understand that any false statements made are subject to the penalties of 18 Pa. Cons. Stat. § 4904 relating to unsworn falsification to authorities.

Executed on this 13th day of September 2021

Ann Lecuyer

Attachment G

Legacy Well Issues

(Office of Oil and Gas Management, Pennsylvania Department of Environmental Protection)

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Oil and Gas Management

Legacy Well Issues

Air Quality Technical
Advisory Committee
December 12, 2019

Discussion Outline

- DEP Well Plugging Program
- Well Plugging Funding and Financial Liability Estimates
- Plugging Projects
- Plugging Program Initiatives
- Path Forward

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“Legacy Well”

Any previously undiscovered, unregistered or unpermitted historical well. The status may be active, shut-in, abandoned, or plugged.

Source: State Museum of Pennsylvania

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Regulatory History of Well Plugging

- **1859** – First commercial well drilled, “Drake well”, Titusville, PA
- **1878** – Wells first required to be plugged with wood and sediment
- **1881** – Plugging requirements updated: Fill well with sand or rock sediment and wooden plugs above third producing sand
- **1921** – Plugging requirements updated
  - Fill with sand or rock sediment and each producing strata plugged with wood plug
  - Requires venting of wells through coal layers
  - Allows for casing to be pulled with tubing and packer in place
- **1952** – API standards for cement and well plugging published
- **1956** – Well permitting begins; modern plugging requirements
- **1984** – Modern environmental plugging requirements
- **1989** – First well plugged in DEP plugging program

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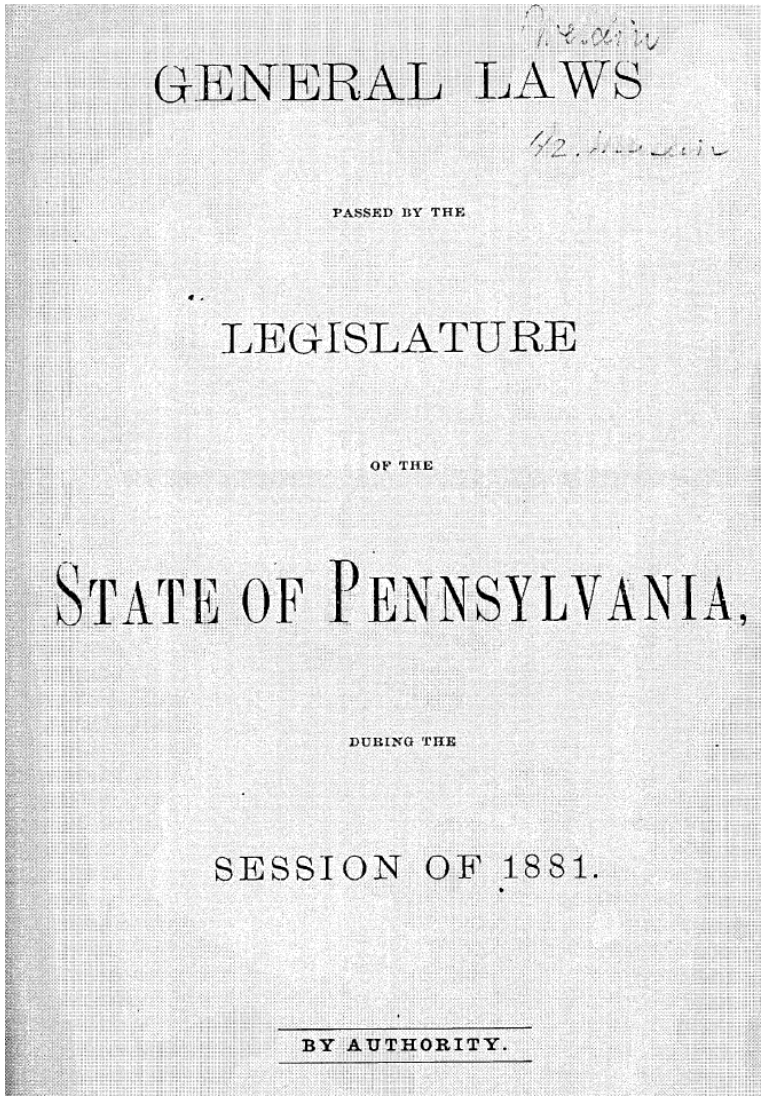
Regulatory History of Well Plugging



GENERAL LAWS

PASSED BY THE

LEGISLATURE

OF THE

STATE OF PENNSYLVANIA,

DURING THE

SESSION OF 1881.

BY AUTHORITY.

No. 101.

AN ACT

Regulating the mode of plugging abandoned oil wells, and providing a penalty for the violation thereof.

Abandoned oil wells to be plugged.

SECTION 1. *Be it enacted, &c.*, That whenever any well shall have been put down for the purpose of exploring for and producing oil, upon abandoning or ceasing to operate the same, the owner or operator shall, for the purpose of excluding all fresh water from the oil-bearing rock and before drawing the casing, fill up the well with sand or rock sediment to the depth of at least twenty feet above the third sand or oil-bearing rock, and drive a round, seasoned, wooden plug at least two feet in length, equal in diameter to the diameter of the well below the casing, to a point at least five feet below the bottom of the casing, and, immediately after the drawing of the casing, shall drive a round wooden plug into the well at the point just below where the lower end of the casing shall have rested, which plug shall be at least three feet in length, tapering in form and to be of the same diameter at the distance of eighteen inches from the smaller end as the diameter of the well below the point at which it is to be driven; after it has been properly driven shall fill in on top of same with sand or rock sediment to the depth of at least five feet.

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Regulatory History of Well Plugging

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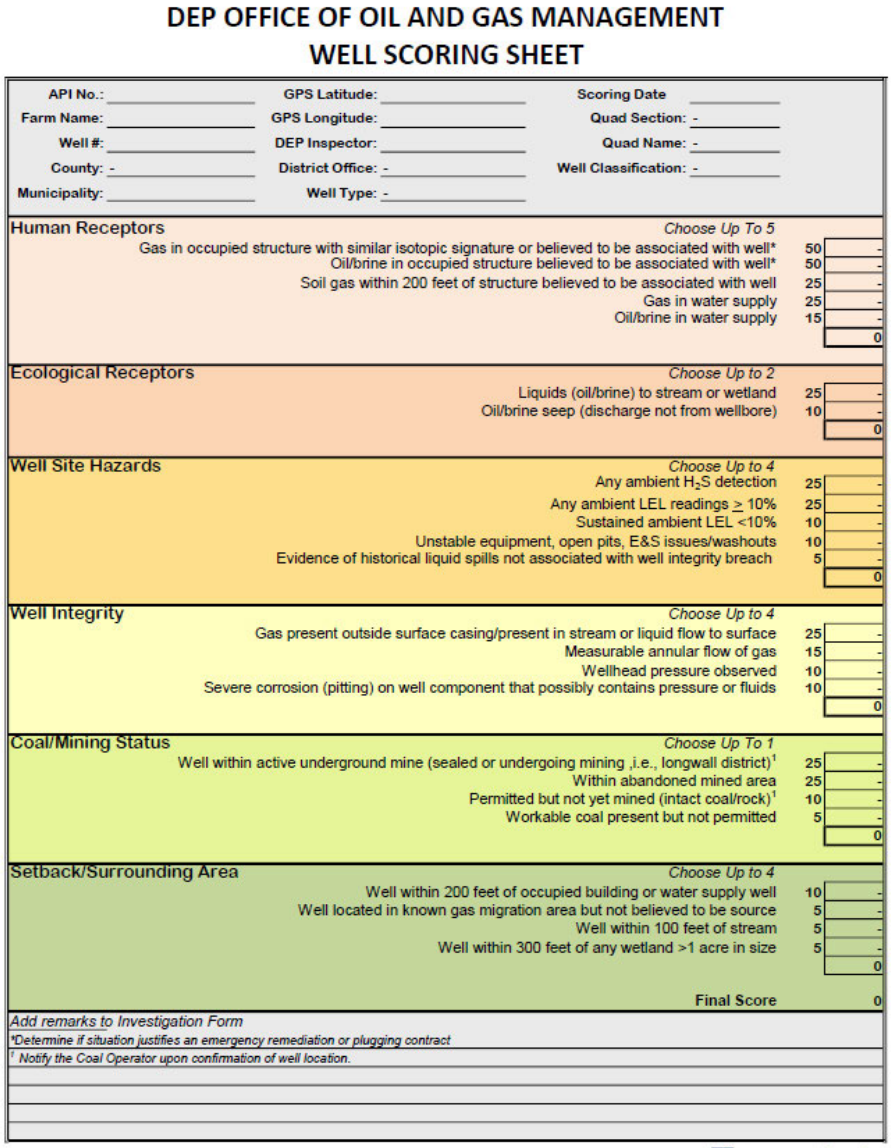
Current DEP Plugging Program

1. Abandoned/Orphan well is identified
2. Field inspection performed by OGI: wells are assigned score based on environmental/health and safety concerns, now including methane emissions
3. Wells are selected for plugging (high-risk focus)
4. Contracts are generated/bid out
5. Winning bidder plugs wells
6. Wells are inspected by OGI during plugging operations, and before contract is closed out
7. Wells re-inspected 1 year post-plugging

Well Plugging Prioritization

- Risk Score Based on
  - Human Receptors
  - Ecological Receptors
  - Well Site Hazards
  - Well Integrity
  - Coal/Mining Status
  - Setback/Surrounding



DEP OFFICE OF OIL AND GAS MANAGEMENT
WELL SCORING SHEET

API No.:		GPS Latitude:		Scoring Date	
Farm Name:		GPS Longitude:		Quad Section:	-
Well #:		DEP Inspector:		Quad Name:	-
County:	-	District Office:	-	Well Classification:	-
Municipality:		Well Type:	-		

Human Receptors	*Choose Up To 5*		
	Gas in occupied structure with similar isotopic signature or believed to be associated with well*	50	
	Oil/brine in occupied structure believed to be associated with well*	50	
	Soil gas within 200 feet of structure believed to be associated with well	25	
	Gas in water supply	25	
	Oil/brine in water supply	15	
			0
Ecological Receptors	*Choose Up to 2*		
	Liquids (oil/brine) to stream or wetland	25	
	Oil/brine seep (discharge not from wellbore)	10	
			0
Well Site Hazards	*Choose Up to 4*		
	Any ambient H_2S detection	25	
	Any ambient LEL readings ≥ 10%	25	
	Sustained ambient LEL <10%	10	
	Unstable equipment, open pits, E&S issues/washouts	10	
	Evidence of historical liquid spills not associated with well integrity breach	5	
			0
Well Integrity	*Choose Up to 4*		
	Gas present outside surface casing/present in stream or liquid flow to surface	25	
	Measurable annular flow of gas	15	
	Wellhead pressure observed	10	
	Severe corrosion (pitting) on well component that possibly contains pressure or fluids	10	
			0
Coal/Mining Status	*Choose Up To 1*		
	Well within active underground mine (sealed or undergoing mining ,i.e., longwall district)[1]	25	
	Within abandoned mined area	25	
	Permitted but not yet mined (intact coal/rock)[1]	10	
	Workable coal present but not permitted	5	
			0
Setback/Surrounding Area	*Choose Up to 4*		
	Well within 200 feet of occupied building or water supply well	10	
	Well located in known gas migration area but not believed to be source	5	
	Well within 100 feet of stream	5	
	Well within 300 feet of any wetland >1 acre in size	5	
			0
	Final Score		0

Add remarks to Investigation Form

**Determine if situation justifies an emergency remediation or plugging contract*

[1] Notify the Coal Operator upon confirmation of well location.

Revised: July 2019

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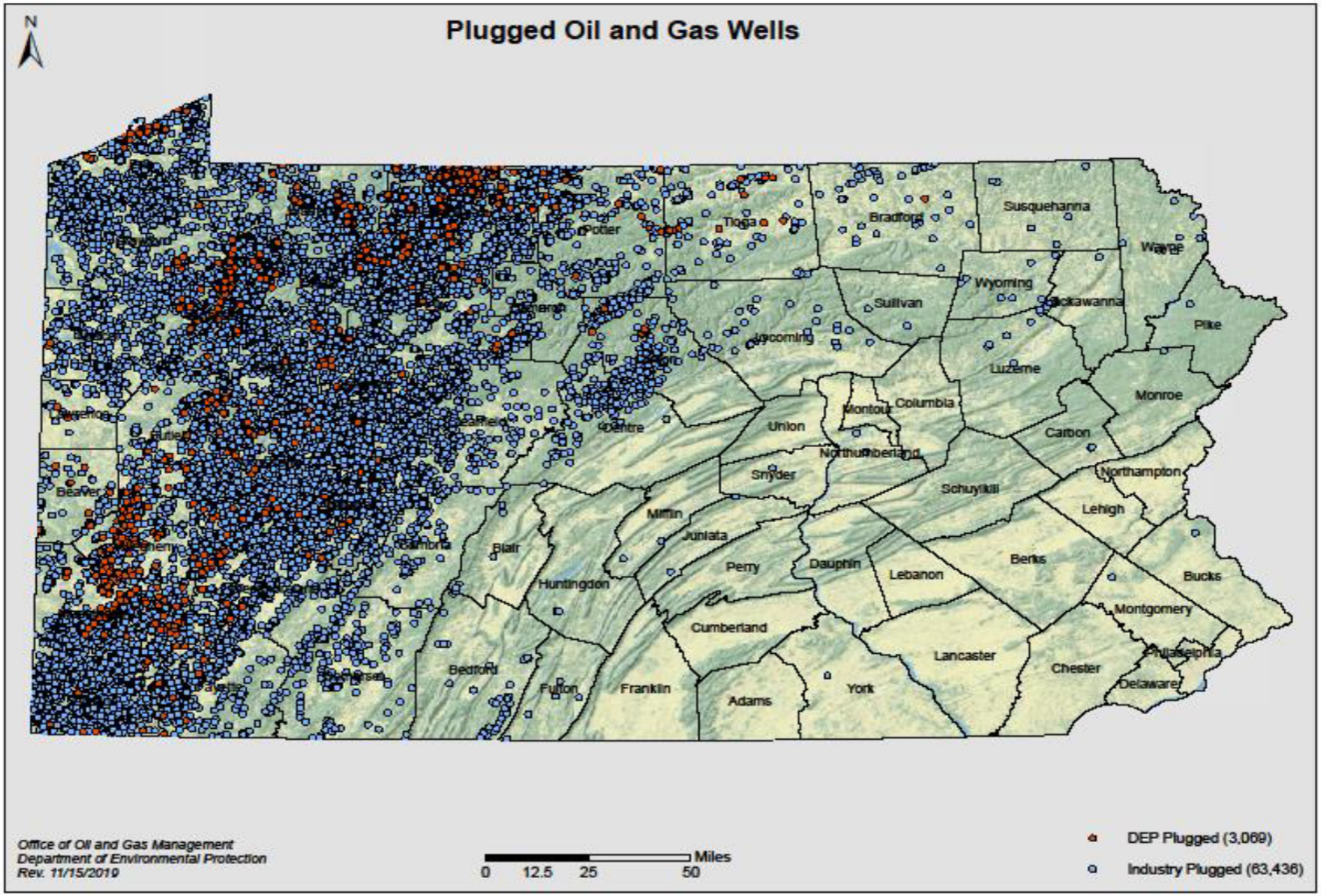
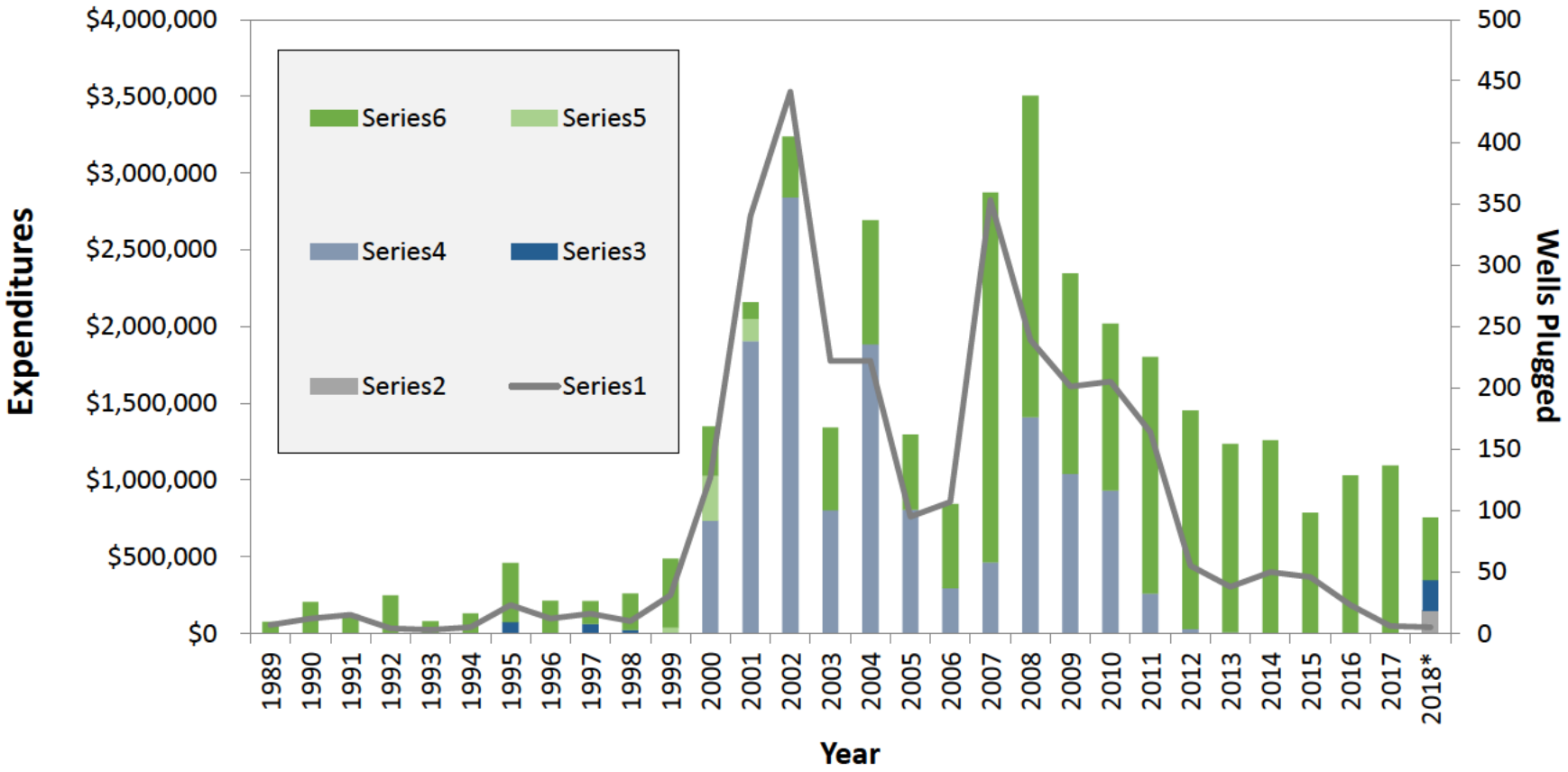
Plugged Oil and Gas Wells



A Brief Overview of the Legacy Well Story

DEP Plugging Program Funding

- Since 1985, DEP has received $150-$250 surcharges for every drilling permit



DEP Plugging Program

Oil and Gas Act of 1984

- Established Abandoned Well Fund
  - $50 Permit Surcharge

Act 78 of 1992

- Established Orphan Well Plugging Fund
  - $100 Permit Surcharge on Oil Wells
  - $200 Permit Surcharge on Gas Wells

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Well Count in Pennsylvania

- Dilmore et al. (2015) and Engelder (2017) have estimated that somewhere between 330,000 and 350,000 wells were likely drilled in the commonwealth between 1859 and 2016
- Kang et al.'s (2016) estimate more than doubles the upper end of this range

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Plugging Liabilities in Pennsylvania

- 113,000 active permits and 13,000 wells on O&A list means between 100,000 to 560,000 legacy wells that have not yet been accounted for – “best-fit” estimate is **200,000** wells remaining to plug

- Total potential liability: **$6.6 BILLION**

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Liability Forecasting

Cost Modeling

- A conservative estimate of $33,000 per well has been derived from reviewing contract costs.
- Liability forecasting changes significantly based on per-well cost assumptions
  - At $33,000 per well, DEP's plugging liability ranges somewhere between $280 MM (8,500 wells) and $6.6 B (200,000 wells)

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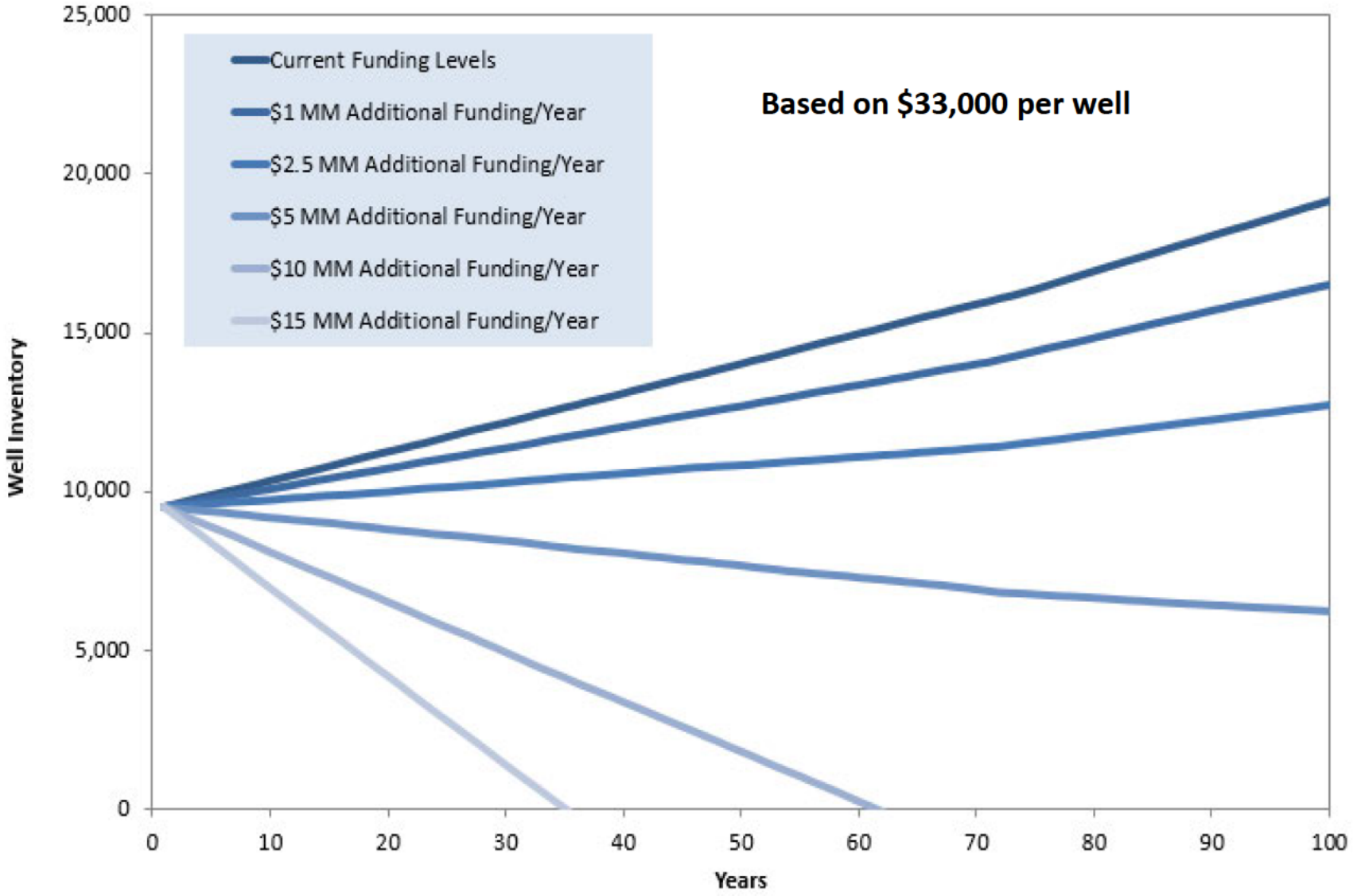
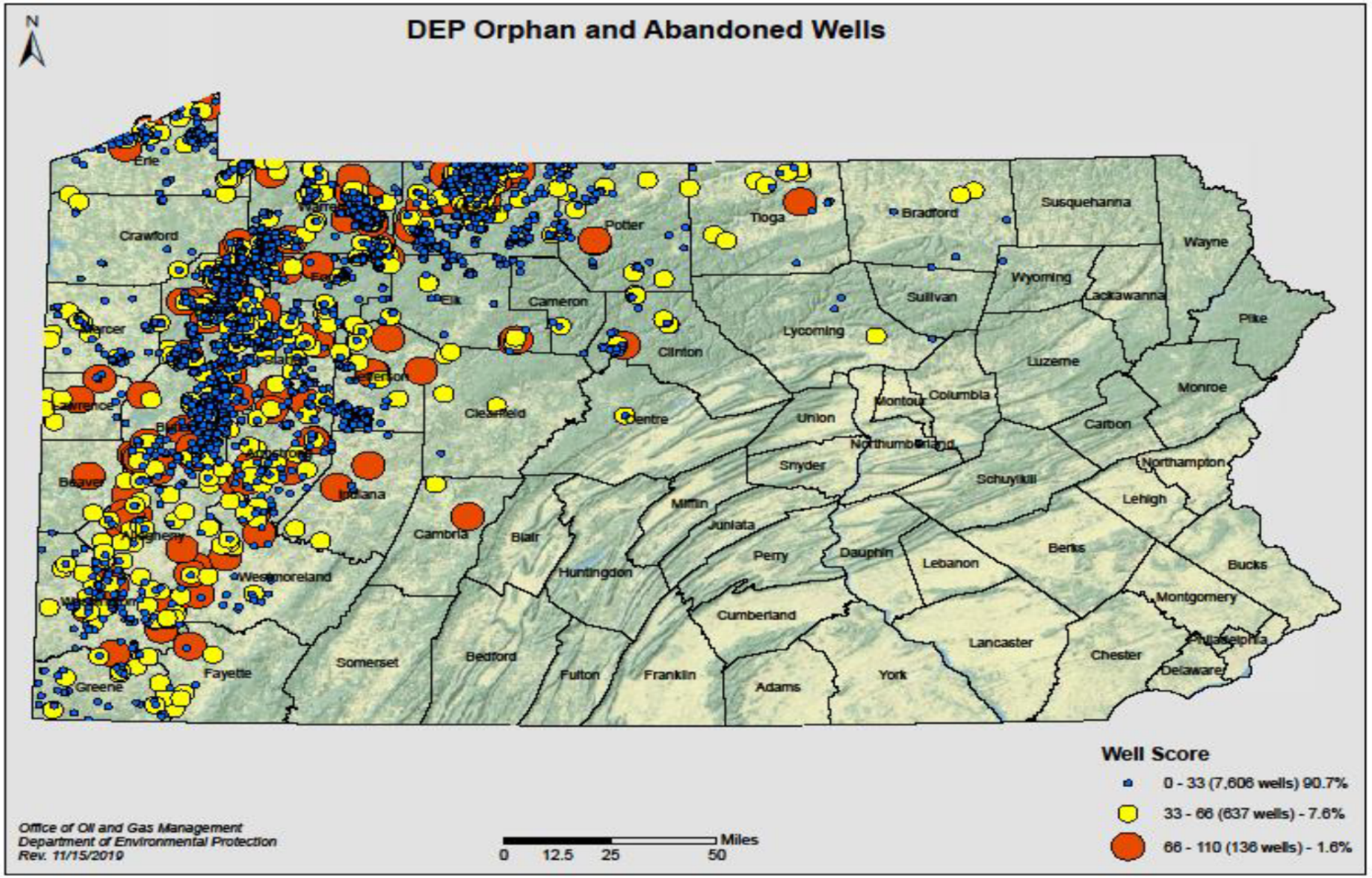
Liability Forecasting



Plugging Liabilities in Pennsylvania



Plugging Liabilities in Pennsylvania

High Risk

- Unknown risks to public health, safety and the environment
- Wells located within 1,500’ of hydraulic fracturing present a significant risk of communication (“area of review” regulations in Chapter 78a)
- Wells are not being maintained in any way which creates highest risk and cost to plug/remediate

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Plugging Liabilities in Pennsylvania

- What can happen when an orphan or abandoned well is not properly plugged?

  Discharges of oil and/or brine to land surface or surface water, or impacts to groundwater

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Plugging Liabilities in Pennsylvania

Intermediate Risk

- Approximately 51,000 active status conventional wells with production or mechanical integrity reporting non-compliance (~5,400 operators)
  - February 15 annually, hydrocarbons and waste produced
  - February 15 annually, mechanical integrity assessment
- Likely high number of abandoned wells
- Includes many home use wells
- Wells may not be properly maintained which creates significant risk and cost to plug/remediate

Plugging Liabilities in Pennsylvania

Lowest Risk

- Active status conventional wells in compliance with production or mechanical integrity reporting
- Active status unconventional wells (11,975 as of 3/22/19)
- Low risk with some unknowns or integrity issues
- Significant impact of low commodity prices
- Bond coverage for wells drilled after April 1985

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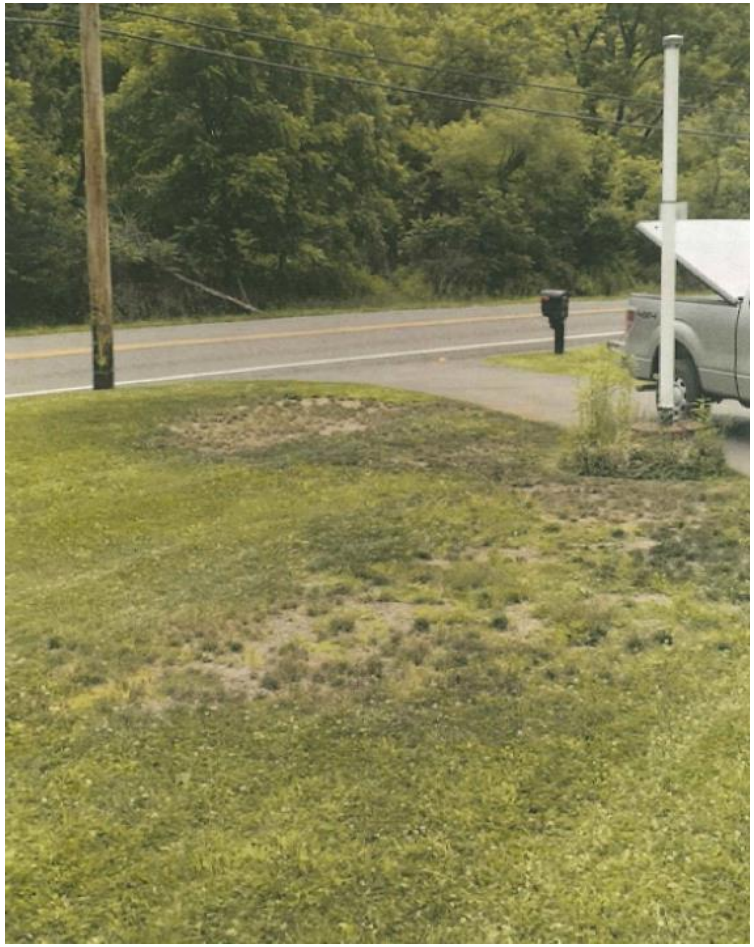
Managing a Looming Crisis

DEP Emergency Contracts

- Antaki Well: $425,000



Managing a Looming Crisis

DEP Emergency Contracts

- Antaki Well:$14,000

Managing a Looming Crisis

DEP Emergency Contracts

- John Barron Well: $179,000

Managing a Looming Crisis

DEP Emergency Contracts

- John Barron Well: $179,000

Managing a Looming Crisis

DEP Emergency Contracts

- John Barron Well: $179,000

Managing a Looming Crisis

DEP Emergency Contracts

- Monahan Well: $160,000

Managing a Looming Crisis

DEP Emergency Contracts

- Monahan Well: $160,000

Managing "Priority" and "Opportunity" Wells

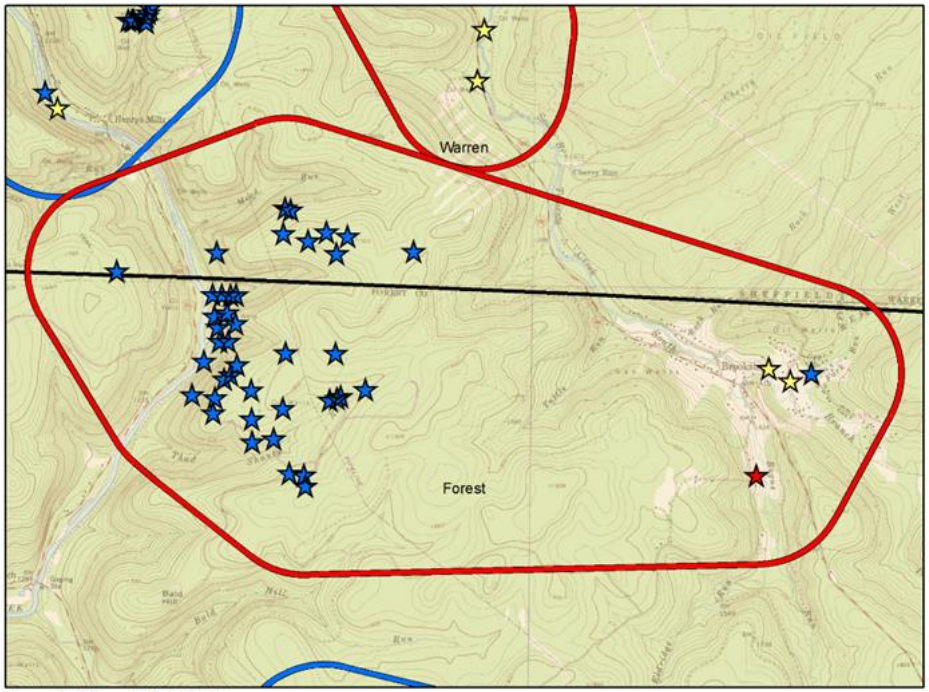
How can resources be extended most effectively?

- As the summary tables below indicate, it is estimated that plugging all 120 Priority Wells individually would cost approximately $5.7 million
- By grouping "priority" (high risk) wells with other nearby "opportunity" wells, 13x the number of wells could be plugged for only 7x the total cost

Well Scores	Number of Wells	Sum of Low Cost 2017	Sum of High Cost 2017
High (>66)	120	$2,664,157.00	$5,777,969.01
Intermediate (34 - 66)	509	$10,604,050.39	$19,758,784.01
Low (<34)	7540	$94,606,792.86	$192,934,105.08
Grand Total	8169	$107,875,000.25	$218,470,858.10

Column1	Number of Projects	Number of Wells in Project	Sum of Low Cost 2017	Sum of High Cost 2017
Grand Total	85	1565	$20,281,920.20	$40,742,308.41

Example Partnership Projects



Plugging Project Name: 197L

Priority Ranking: 19 / 85

Opportunity Ranking: N/A

Number of Abandoned / Orphan Wells: 45

Estimated Number of Water Supplies: 2

Estimated Number of Residents: 105

Environmental Justice Area: Yes

Project Value (Low): $674,521.59

Project Value (High): $1,318,357.56

High Resolution Cost Control: Yes

Congressional District:
Thompson, Glenn W. (5)

House District:
Rapp, Kathy L. (65)

Senate District:
Hutchinson, Scott E. (21)

Designated Use Streams (miles):

Cold Water Fishery: 5.5

Trout Stocking: 0

Warm Water Fishery: 0

High Quality: 8.3

Exceptional Value: 0

Recreational Areas (acres):

State or National Parks: 0

State or National Forest: 3119.7

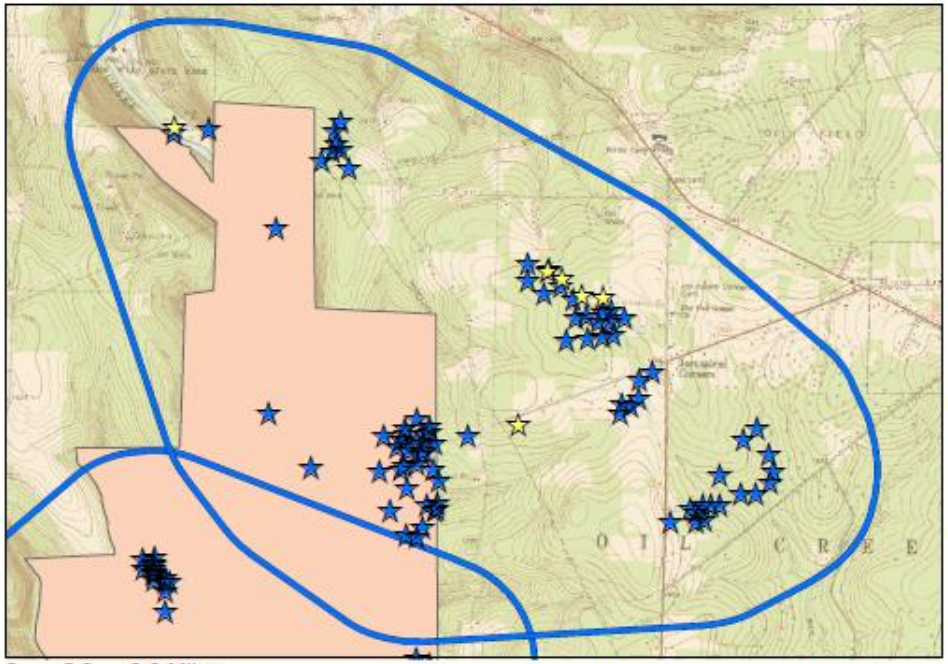
Fish and Game / State Game Lands: 0

Project Facts:

This project profile considers water resources, sensitive environments, recreational areas, and commonwealth residents in the vicinity of abandoned and orphan wells that DEP is responsible for plugging. These characteristics were used to rank this project relative to many other potential plugging projects throughout Pennsylvania. The project profile provides key statistics on the number of abandoned and orphan wells, water supplies, residents, legislative districts, stream miles, and recreational areas for the location. It also assigns a project value and assesses whether or not the location coincides with an Environmental Justice area. Project value information was developed in consideration of historical DEP plugging contract amounts. If the project falls in an area where DEP has completed a greater amount of prior work, the project is designated as having "High Resolution Cost Control."

Example Partnership Projects

Plugging Project Name: 161L



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Primary County: Venango
Primary Municipality: OILCREEK
Priority Ranking: N/A
Opportunity Ranking: 11 / 415
Number of Abandoned / Orphan Wells: 85
Estimated Number of Water Supplies: 17
Estimated Number of Residents: 254
Environmental Justice Area: No
Project Value (Low): $904,566.35
Project Value (High): $1,665,306.37
High Resolution Cost Control: Yes
Congressional District:
Thompson, (5)
House District:
James, (64)
Senate District:
Hutchinson, (21)

Designated Use Streams (miles):

Cold Water Fishery: 16.3
Trout Stocking: 0
Warm Water Fishery: 0
High Quality: 0
Exceptional Value: 0

Recreational Areas (acres):

State or National Parks: 1228.7
State or National Forest: 0
Fish and Game / State Game Lands: 0

Plugging Program Initiatives

- Collaboration and Partnerships Critical
- Good Samaritan Act/COGWA
- Commonwealth Financing Authority
  - Orphan and Abandoned Well Plugging Program
- DCNR Addressing Funding Gaps
  - State Forests and State Parks and wells in the vicinity
- Oil Spill Liability Trust Fund
- Developers/Municipalities

CFA OAWP Program Summary

CFA Distribution of Marcellus Legacy Fund

Program	2013					2014				
	# Apps	# Appr Apps	Amt of Grant	Percent Approval Rate	Percent of Total $	# Apps	# Appr Apps	Amt of Grant	Percent Approval Rate	Percent of Total
GREENWAYS, TRAILS AND RECRATION (GTR)	206	107	$14,648,964	51.94%	55.93%	301	67	$9,294,334	22.26%	62.14%
FLOOD MITIGATION	19	4	$655,866	21.05%	2.50%	33	9	$2,338,039	27.27%	15.63%
WATERSHED RESTORATION AND PROTECTION	57	31	$5,105,930	54.39%	19.50%	49	13	$1,256,797	26.53%	8.40%
ABANDONED MINE DRAINAGE ABATEMENT & TREATMENT (AMDAT)	34	12	$5,091,447	35.29%	19.44%	13	4	$1,541,610	30.77%	0.94%
ORPHAN OR ABANDONED WELL PLUGGING	**2**	**2**	**$225,000**	**100.00%**	**0.86%**	**1**	**1**	**$139,999**	**100.00%**	**1.22%**
BASELINE WATER QUALITY DATA (BWQD)	8	2	$463,342	25.00%	1.77%	7	1	$181,895	14.29%	1.22%
SEWAGE FACILITIES PROGRAM	0	0	$0	0.00%	0.00%	57	7	$205,041	12.28%	1.37%
Grand Total	**326**	**158**	**$26,190,549**			**461**	**102**	**$14,957,715**		

Program	2015					2016				
	# Apps	# Appr Apps	Amt of Grant	Percent Approval Rate	Percent of Total $	# Apps	# Appr Apps	Amt of Grant	Percent Approval Rate	Percent of Total $
GREENWAYS, TRAILS AND RECRATION (GTR)	309	89	$11,167,747	28.80%	66.22%	254	66	$8,766,477	25.98%	65.38%
FLOOD MITIGATION	40	12	$2,975,847	30.00%	17.65%	27	8	$1,821,325	29.63%	13.58%
WATERSHED RESTORATION AND PROTECTION	38	8	$1,019,097	21.05%	6.04%	36	11	$1,986,538	30.56%	14.82%
ABANDONED MINE DRAINAGE ABATEMENT & TREATMENT (AMDAT)	13	3	$1,080,491	23.08%	6.41%	8	2	$563,191	25.00%	4.20%
ORPHAN OR ABANDONED WELL PLUGGING	**3**	**0**	**$0**	**0.00%**	**0.00%**	**11**	**1**	**$129,715**	**9.09%**	**0.97%**
BASELINE WATER QUALITY DATA (BWQD)	4	2	$469,912	50.00%	2.79%	0	0	$0	0.00%	0.00%
SEWAGE FACILITIES PROGRAM	22	3	$151,000	13.64%	0.90%	13	4	$141,647	30.77%	1.06%
Grand Total	**429**	**117**	**$16,864,094**			**349**	**92**	**$13,408,893**		

Program	2017					2018				
	# Apps	# Appr Apps	Amt of Grant	Percent Approval Rate	Percent of Total $	# Apps	# Appr Apps	Amt of Grant	Percent Approval Rate	Percent of Total $
GREENWAYS, TRAILS AND RECRATION (GTR)	234	81	$9,862,804	34.62%	63.75%	286	90	$10,586,673	31.47%	65.36%
FLOOD MITIGATION	30	13	$2,994,521	43.33%	19.36%	43	12	$2,866,069	27.91%	17.69%
WATERSHED RESTORATION AND PROTECTION	23	11	$1,830,000	47.83%	11.83%	36	15	$1,993,662	41.67%	12.31%
ABANDONED MINE DRAINAGE ABATEMENT & TREATMENT (AMDAT)	1	0	$0	0.00%	0.00%	3	1	$500,000	33.33%	3.09%
ORPHAN OR ABANDONED WELL PLUGGING	**5**	**3**	**$657,503**	**60.00%**	**4.25%**	**4**	**1**	**$20,624**	**25.00%**	**0.13%**
BASELINE WATER QUALITY DATA (BWQD)	1	0	$0	0.00%	0.00%	8	0	$0	0.00%	0.00%
SEWAGE FACILITIES PROGRAM	10	4	$125,147	40.00%	0.81%	13	4	$231,328	30.77%	1.43%
Grand Total	**304**	**112**	**$15,469,975**			**393**	**123**	**$16,198,356**		

Program	Total # Apps	Total # Appr Apps	Total Amt of Grants	Percent Approval Rate	Percent of Total $
GREENWAYS, TRAILS AND RECRATION (GTR)	1,590	500	$64,326,999	31.45%	62.40%
FLOOD MITIGATION	192	58	$13,651,667	30.21%	13.24%
WATERSHED RESTORATION AND PROTECTION	239	89	$13,192,024	37.24%	12.80%
ABANDONED MINE DRAINAGE ABATEMENT & TREATMENT (AMDAT)	72	22	$8,776,739	30.56%	8.51%
ORPHAN OR ABANDONED WELL PLUGGING	**26**	**8**	**$1,172,841**	**30.77%**	**1.14%**
BASELINE WATER QUALITY DATA (BWQD)	28	5	$1,115,149	17.86%	1.08%
SEWAGE FACILITIES PROGRAM	115	22	$854,163	19.13%	0.83%
Grand Total	**2,262**	**704**	**$103,089,582**		

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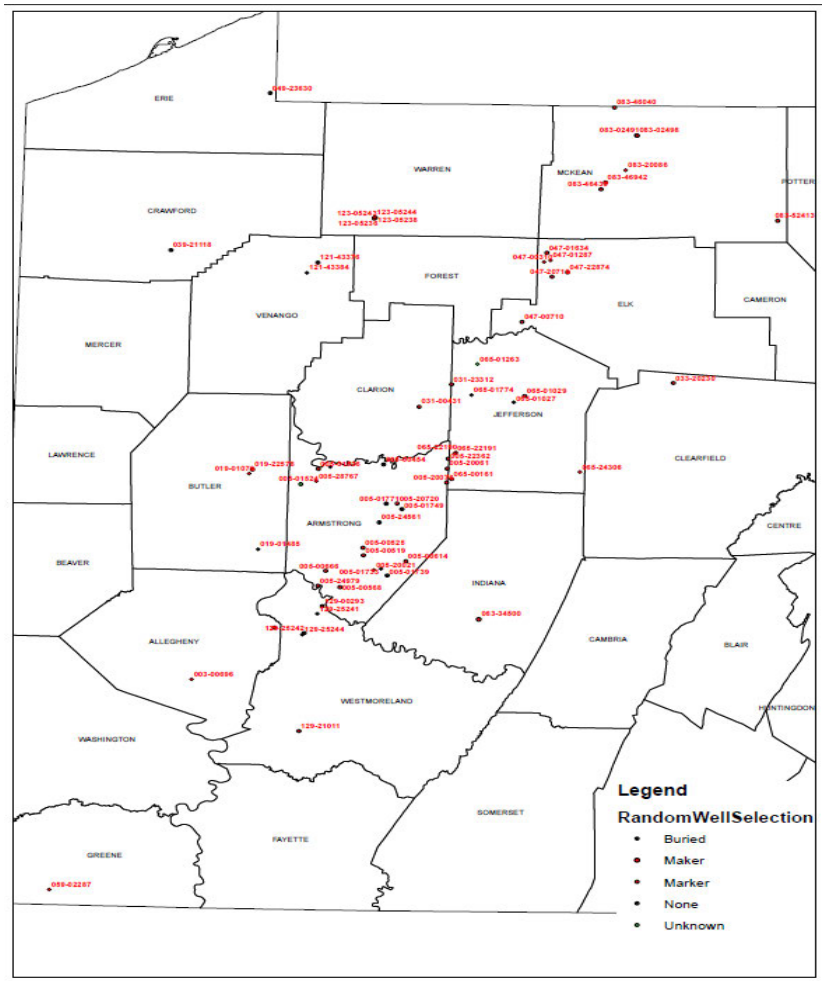
Ongoing Work

Plugging Program Initiatives

- BOGPPM Plugging Program modernization and enhanced outreach
  - Website
  - Social media
  - DCNR partnership
- Cross-program work
  - GHG emissions factors and estimates (EPO and Air Quality)
- Academia
  - GHG emissions factors and estimates (Kang at McGill)
  - Integrity concerns (Brantley at PSU)
  - Property values (Weber at Pitt)

Attainable Bottom Field Study

Investigate plug effectiveness in wells not plugged to total depth



Cornplanter State Forest Emissions

Quantify emissions to be reduced through area-wide plugging project

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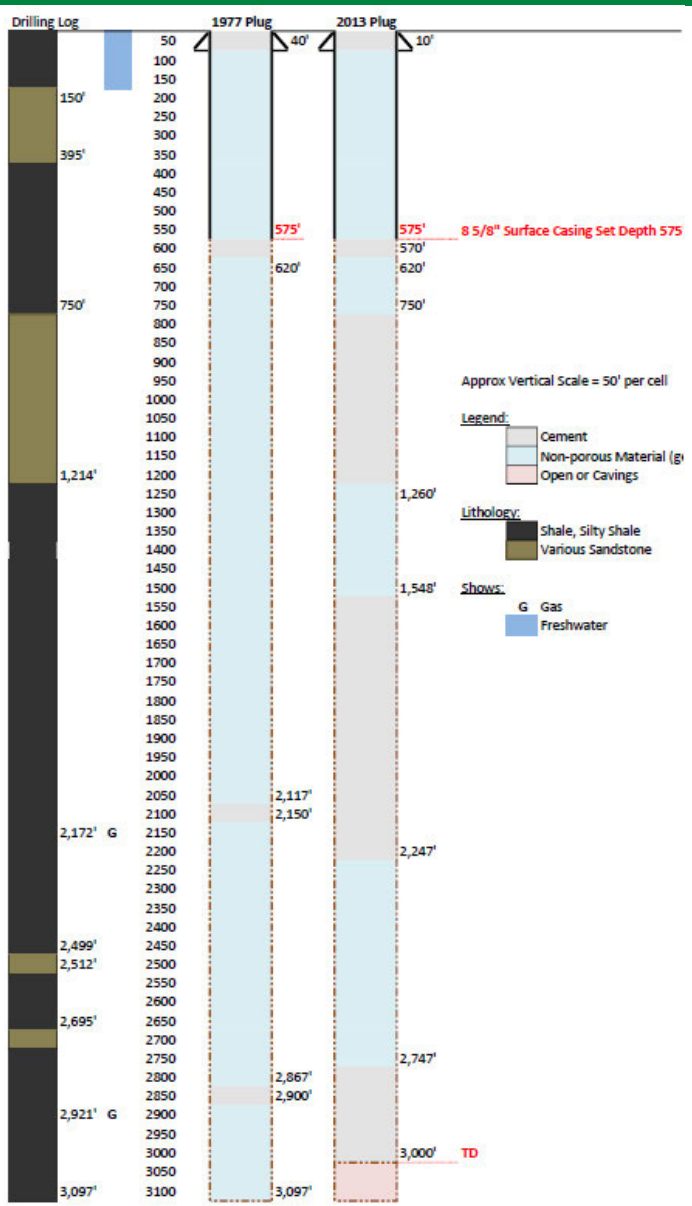
Leaking Plug Study



Analyze well and plug characteristics to identify potential contributing factors of known leaking plugs

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Research Partnerships

- McGill University (Kang)
  - Utilized highly sensitive meters to determine a high occurrence of leaking abandoned and plugged wells
  - Isotopic signatures support deep, oil-associated origin
  - In some cases, gas was found outside of the outermost well casing
  - DEP is currently working to understand the construction and/or plugging details at the identified leaking wells

Moving Forward

Summary

- Historic legacy challenge must be met
- Overall liability has been defined
- Economic opportunity
- Focused responses
- Delivering protection

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Oil and Gas Management

Thank You!

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Acknowledgments

M. Seth Pelepko, Harry Wise, Serena Oldhouser, Kevin Bogdan, Crystal Magon, Doug Catalano, Rick Swank, Lindsay Byron, and Stew Beattie