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CRISIS IN THE OIL AND GAS INDUSTRY: CUSTODY OF ORPHAN WELLS

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I. Introduction

Since the mid-1800s, when operators drilled the first commercially successful oil well in Titusville, Pennsylvania, millions of oil and gas wells have been drilled across the United States, varying in depth and geometry.[1] For nearly a century, these wells predated any regulatory agency.[2] In 1955, almost a century after the first well, Pennsylvania introduced the first regulatory body to police the oil and gas industry.[3] Other states created their own state agencies in the following years.[4] Before the formation of regulation, operators poorly managed records and refused to share field maps, attempting to hide the locations of protentional pockets of oil.[5] As oil and gas companies folded or switched hands, well records disappeared.[6] This regulation delay aided the orphan well crisis in the United States.[7] Now, states recognize millions of orphan wells causing health, safety, environmental, and economic issues.[8] We need to start marking an organized effort to prevent and correctly plug orphan wells.

II. Background

The United States relies on the oil and gas industry for over 60% of its annual energy consumption. On top of that, demand continues to rise, explaining why operators continue drilling new wells.[9] Some newly drilled and completed wells are turned on for production and produce oil or gas for

1. Daniel Raimi et al., *Decommissioning Orphaned and Abandoned Oil and Gas Wells: New Estimates and Cost Drivers*, 55 Envtl. Sci. Tech. 10224 (2021).

2. *Id.*

3. *Id.*

4. *Id.*

5. *Id.*

6. *Id.*

7. Bret Wells & Tracy Hester, *Abandoned but Not Forgotten: Improperly Plugged and Orphaned Wells May Pose Serious Concerns for Shale Development*, 8 Mich. J. Envtl. & Admin. L. 115, 122 (2018).

8. *Id.*

9. Patricia M. B. Saint-Vincent et al., *Identifying Abandoned Well Sites Using Database Records and Aeromagnetic Surveys*, 54 Envtl. Sci. Tech. 8300 (2020).

decades, while others have a shorter lifespan.[10] As production dwindles, oil and gas companies utilize different secondary and tertiary recovery methods to lengthen the life of the well.[11]

Across jurisdictions, definitions surrounding old wells vary, resulting in significant confusion.[12] The Environmental Protection Agency ("EPA") defines abandoned or idle wells as "those with no recent production, injection, or other uses" and remain unplugged.[13] Orphan wells have no solvent owner and are effectively wards of the state.[14] Frequently, people use the terms abandoned and orphaned interchangeably.[15] However, abandoned wells are also wells that have been plugged and have an owner associated with them.[16] In periods of oil and gas market volatility, profit margins get smaller, and operators sell marginal wells to smaller companies with less overhead, which avoid expenses when not required by mandate.[17] Sometimes, well records, including well locations, are lost during this process, especially if the wells predate regulations.[18] Additionally, when operating companies cease to exist or become insolvent, the plugging liability can fall on the state or federal government.[19]

According to Enverus, over 2.6 million of the wells drilled onshore in the United States remain unplugged.[20] The EPA estimates another 1.2 million unplugged, undocumented wells.[21] Of these wells, roughly 50% have not produced oil or gas in the last decade.[22] As of 2020, only 1.6 million of the estimated 4.3 million wells drilled onshore are plugged, many plugged incorrectly.[23] This number equates to only plugging 13,000 wells annually over the oil and gas industry's 120-year history.[24] At the current plugging

10. Interstate Oil & Gas Compact Commission, *Idle and Orphan Oil and Gas Wells: State and Provincial Regulatory Strategies*, 4 (2021).

11. *Id.*

12. Raimi et al., *supra* note 1, at 10225.

13. *Id.*

14. *Id.*

15. *Id.*

16. *Id.*

17. Interstate Oil & Gas Compact Commission, *supra* note 10.

18. *Id.*

19. *Id.*

20. Robert Schuwerk & Greg Rogers, *Billon Dollar Orphans: Why millions of oil and gas wells could become wards the state*, 9 (2020). The Enverus Website can be accessed at Enverus.com.; Enverus is an oil and gas database.

21. *Id.*

22. *Id.*

23. *Id.*

24. *Id.*

rate, even if the United States stopped drilling onshore wells today, it would take over 300 years to plug the nation's estimated 3.8 million unplugged wells.[25] Unfortunately, states have inadvertently, financially incentivized operators to delay permanent well abandonment for as long as possible, often selling the marginal wells to smaller companies with less overhead instead of paying to plug them.[26] Predictably, these sales have led to extensive inventories of largely self-bonded idle or orphan wells.[27]

While many people find orphan wells accidentally, there has been a recent push to locate and correctly plug the old wells, preventing greater issues.[28] Before modern global positioning services ("GPS"), operators recorded well locations on paper maps, often without accuracy and using nonpermanent landmarks as a reference.[29] As a result, many wells remain hidden from sight, often in dense vegetation or rugged terrain.[30] Magnetic surveyors use magnetometers to map magnetic fields and locate ferromagnetic objects, like steel well casings and pipelines, under the ground.[31] While this helps find modern wells, historically, wooden casing was used, making these wells invisible to the magnetometer.[32]

III. Associated Issues

Until recently, orphan wells received little attention, and many were unrecognized.[33] As the population expands, previously undeveloped areas are sold and turned into residential or commercial sites[34] These expansions lead to the discovery of many undocumented orphan wells, often accidentally[35]

As engineering technology improves, oil and gas companies' hydraulicly fracture longer and deeper wells to increase production from previously active oil and gas fields, drilling nearby old wells.[36] If operators correctly

25. *Id.*
26. *Id.*
27. *Id.*
28. *See* Patricia et al., *supra* note 9, at 8300.
29. *Id.*
30. *Id.*
31. *Id*
32. *Id.*
33. Mariya Shappo, *The Long-Term Consequences of Oil and Gas Extraction: Evidence from the Housing Market,* 3 (2020).
34. *Id.*
35. *Id.*
36. Wells & Hester, *supra* note 7, at 121.

plug the old wells, the risk of environmental pollution decreases, but sadly, proper plugging is not always the case.[37]

A. Environmental Issues

Most orphan wells are left "shut in," with all the valves closed. However, over time, degradation of the wellbore cement and steel can lead to a migration of hydrocarbons to the surface, creating unwanted environmental contamination, even if the wells were properly shut in.[38] Modern well completion processes can exacerbate this wellbore failure.[39] High pressure from the hydraulic fracturing operations can move hydrocarbons through the newly created and existing fractures and up through the old orphan well to the surface.[40] The old wellhead equipment may not withstand the high pressure of modern hydraulic fracturing operations, resulting in rapid pressure releases or, at the very least, air and water pollution.[41]

The sudden expulsion of contaminants is not the only concern.[42] In some places, wells have been slowly seeping contaminants for years, if not decades.[43] Unfortunately, methane emissions from orphan wells are a significant source of methane emissions to the atmosphere.[44]

B. Health and Safety Concerns

Emissions from unplugged or damaged wells pose more than just environmental problems.[45] Air pollutants, such as benzene, hydrogen sulfide, and volatile organic compounds, endanger human health.[46] In addition, continuous seeping can result in asphyxiation hazards for humans and animals.[47] If orphan wells seep hydrocarbons and toxic chemicals into water supplies, humans and animals who drink the water can be at risk.[48]

Additionally, unplugged and unmarked wells pose tripping and falling hazards to individuals walking near the surface.[49] Before the beginning of

37. *Id.* at 122.
38. Raimi et al., *supra* note 1, at 10225.
39. *Id.*
40. *Id.*
41. *See* Wells & Hester, *supra* note 7, at 122.
42. Raimi et al., *supra* note 1, at 10225.
43. *Id.*
44. *Id.*
45. *Id.*
46. *Id.*
47. *Id.*
48. *Id.*
49. *Id.*

strict regulation, companies would sometimes end the life of an old well by merely cutting the wellhead off at the surface and occasionally shoving something like a tree down the well bore. This ineffective plugging method can be a tripping hazard hidden by vegetation for those hiking.

C. Economic Problems

Abandoned wells also have economic impacts on average citizens.[50] Depending on various factors, including the number of wells and their proximity, unplugged wells can decrease the sale prices of neighboring houses by 2%-24%.[51] Unfortunately, at the point of abandonment, royalties have gone to zero, so production is not providing an upside.[52] Fortunately, once operators plug the neighboring wells, the housing prices are restored almost entirely.[53] Unfortunately, with this expansion into previously undeveloped areas, people buy land and discover undocumented orphan wells.[54] These decreases in property values can lower funding for local schools, police departments and other public services. Orphan wells affected by hydraulic fracturing operations can cause significant damage to not only the land where the well sits but also the adjacent properties.[55] Sadly, it is difficult to track down the person or company liable for the orphan well, so claims are difficult to pursue.[56] However, when landowners and regulatory agencies locate the operator liable for the injury, claims of breach of contract, nuisance, trespass, strict liability, and various torts have been raised.[57]

IV. Steps and Associated Costs

Plugging a well is not a simple process and takes a decent amount of capital and time, depending on various factors.[58] The longer oil and gas wells sit idle, the more expensive plugging usually becomes.[59] Additionally, questions arise over who pays for the plugging operations.[60]

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50. Shappo, *supra* note 33, at 2.
51. *Id.*
52. *Id.*
53. *Id.*
54. *Id.*
55. Wells & Hester, *supra* note 7, at 136.
56. *Id.* at 131.
57. *Id.* 131-41.
58. Raimi et al., *supra* note 1, at 10225.
59. *Id.*
60. *Id.*

A. Required Steps for Plugging

Plugging and abandoning oil and gas wells requires multiple steps and may take a few weeks to complete.[61] The first step is to evaluate the well's physical condition, including the underground steel and cement, and to identify any potential hazards or leaks.[62] Next, the operators clean the wellbore to prepare for the plugging.[63] Cement and other plugging materials, such as gravel and fibers, are used to seal the wellbore.[64] Wellbore conditions and regulations dictate how much of the wellbore needs sealing, but the best practice is to seal more than the required amount.[65] Finally, workers weld a steel cap, remove the production equipment, and complete various amounts of site restoration.[66] This process can take days or weeks.[67]

B. Associated Costs

With the variation in well plugging operations, it makes logical sense that the operating costs would also vary.[68] Seven main factors affect the cost of plugging a well.[69] First, well depth plays a significant part in cost analysis.[70] Deeper wells require more material for plugging, but this, like many other factors, also depends on the regulations in the jurisdiction.[71] Well age must be considered.[72] As a well ages and the integrity of the cement and steel decreases, the cost to plug the well increases substantially.[73] Site topography and location can also increase the costs of decommissioning a well.[74] Oil and gas fields across the country have different minerals in the soil and water, affecting the degradation rate.[75] Some locations also require more transportation costs.[76] Wells located in

61. *Id.* at 10224.
62. *Id.*
63. *Id.*
64. *Id.*
65. *Id.*
66. *Id.*
67. *Id.* at 10226.
68. *Id.* at 10225.
69. *Id.*
70. *Id.* at 10226.
71. *Id.*
72. *Id.*
73. *Id.* at 10226-27.
74. *Id.* at 10226.
75. *Id.*
76. *Id.* at 10227.

rough terrain or miles from infrastructure increase fuel costs and complicate operations. Moving the equipment required to plug a well can be difficult if there is no longer a road to the location. Labor and equipment costs vary from basin to basin.[77] Areas with booming oil and gas activity have greater competition and traditionally offer lower prices from vendors. Whether the well produces oil or gas can also affect plugging costs.[78] Natural gas naturally flows to the surface and requires stricter plugging requirements to prevent the natural gas from flowing through micro-annuli in at the cement. Finally, as with many transactions, a bulk contract may provide a discount.[79] Many service companies will provide a discount if you will contract to use them for multiple plugging jobs.

Plugging an oil or gas well can be as cheap as $1,000 but may exceed $1,000,000 per well.[80] In addition, modern wells are typically deep, horizontally drilled wells, which can be more expensive to plug than the original vertical, shallow wells, mostly because of the increase in plugging materials required.[81] Using the factors to predict average plugging costs in each state, Carbon Tracker estimates it would take $280 billion to plug roughly 2.6 million documented onshore wells spread across at least 33 states.[82] This number does not include the cost required to plug the estimated 1.2 million undocumented wells.[83]

C. Who Foots the Bill

The need for a plan to address the orphan well crisis is widely accepted, but nobody wants to pay the bill.[84] Current data suggests that states, on average, have secured less than 1% of the cost to plug all the wells in surety bonds, and that assumes every insurer can and will pay.[85] States exacerbate this issue by basing bonding requirements on very-low estimates.[86] Many states allow "blanket bonds" that provide a fixed amount of coverage to secure plugging operations for, unfortunately, an unlimited number of wells under one operator.[87] These bonds lead to a large majority of well liability

77. *Id.*
78. *Id.* at 10226-27.
79. *Id.* at 10226.
80. *Id.*
81. *Id.* at 10225.
82. Schuwerk & Rogers, *supra* note 20, at 8.
83. *Id.*
84. *Id.*
85. *Id.*
86. *Id.*
87. *Id.*

risk concentrated on the state's largest operators.[88] Some states require operators to pay idle-well fees and develop plans to plug wells to prevent newly completed wells from further adding to the crisis.[89] Unfortunately, taxpayer money fills the monetary gap.[90]

During the COVID-19 pandemic, the federal government started offering grants under the REGROW Act to plug orphan wells as part of the 2021 Infrastructure Investment and Jobs Act.[91] This legislation allocated $4.7 billion to the proper plugging of orphan wells across the United States.[92] These grants provide a way to reduce the environmental risk of orphan wells and support unemployed oil and gas workers.[93] These programs are still ongoing, but unfortunately, $4.7 billion pales in comparison to the estimated $280 billion needed to plug the millions of orphan wells across the United States.[94]

V. State and Federal Regulations

Across the United States, regulatory agencies handle the orphan well crisis differently.[95] In some states, the issue is yet to be addressed.[96] States with large quantities of orphan wells include drilling and hydraulic fracturing regulations to ensure minimized communication with other wells, especially orphans. Many states added regulation around injection wells to prevent issues related to offset wells, particularly orphans. Until recently, the federal government avoided the subject, leaving the problem to the states to fix.[97]

A. Federal

On a federal level, a unified stance on handling the orphan well crisis is needed.[98] The American Petroleum Institute ("API") and the Environmental Defense Fund ("EDF") have both provided frameworks to prevent issues

88. *Id.*
89. *Id.*
90. *Id.*
91. Environmental Defense Fund, *Plugging Orphan Wells Across the United States*, (2021), https://www.edf.org/orphanwellmap.
92. *Id.*
93. Raimi et al., *supra* note 1, at 10225.
94. *Id.*
95. Wells & Hester, *supra* note 7, at 124.
96. *Id.*
97. *Id*.
98. *Id.*

associated with hydraulic fracturing and old wells, but neither of these frameworks' have been widely accepted.[99]

The API acknowledges the issues surrounding the orphan well crisis in the United States, explaining their recommended practice in their report.[100] Their stance is summarized as follows:

> Wells that are operating or abandoned (including orphaned wells) that are near current drilling and hydraulic fracturing operations pose a potential risk to containment of fracturing and well fluids . . . . Operators should establish an area of investigation (AOI) around each well being drilled and hydraulically fractured to assess and mitigate potential risks.[101]

According to the API, the operator should determine a proper area of investigation (commonly called the area of review), which should be the area that will contain the hydraulic fracturing fluids.[102] Additionally, the operator should identify all existing well penetrations and non-sealing faults, using a wide variety of available sources, including but not limited to company records, public databases, air or satellite photographs, magnetometer surveys, and maps.[103]

The API framework also states a need for a risk assessment to address the following questions regarding the wells in the area of investigation: (1) what is the location of each well?; (2) where is each well in relation to the proposed well?; (3) where is each well in relation to proposed fracture growth?; (4) what is the condition of each well?; and (5) what faults and other geologic heterogeneities potentially intersect the wellbore and fractures?[104] For each portion of the risk assessment, the operator should develop risk mitigation steps, which might involve redesigning the well, monitoring adjacent wells, intervening in adjacent wells, or potentially not drilling that well.[105] In addition, the API framework emphasizes understanding the petrophysical and geophysical qualities of the formations, including strength and thickness.[106] However, the API framework does not require notices to offset owners before hydraulic

99. *Id.* at 125-30.
100. *Id.* at 125.
101. *Id.*
102. *Id.*
103. *Id.*
104. *Id.* at 125-26.
105. *Id.* at 126.
106. *Id.*

fracturing, an unfortunate blind spot.[107] In summary, the API report places a duty of thorough due diligence on the operators but does not elaborate on the roles of the regulatory agencies.[108] Instead, it relies heavily upon communication within the industry, blindly hoping notifications will be sent to offset operators.[109]

The EDF proposed the Mode Regulatory Framework for Hydraulically Fractured Production Wells to assist state governments in developing regulations.[110] The EDF framework states that an operator must submit the following to regulatory agencies as part of a hydraulic fracturing application: (1) a planned location in compliance with spacing rules; (2) hydraulic fracturing details including the base fluid; (3) the total volume of hydraulic fracturing fluids; (4) the maximum anticipated pumping pressure; (5) the range of anticipated surface treating pressure; (6) the calculated estimated fracture length and height; (7) the anticipated sources of the base fluid; (8) a statement regarding flowback fluid handling, disposal, and recycling; and (9) an analysis of the intervening zone.[111] The EDF framework also outlines the need for the operator to demonstrate a geologic understanding, showing that the confining layers are sufficient to prevent migration.[112]

The EDF Framework also requires operators to identify all other wellbores and naturally occurring faults and fractures in the area of investigation.[113] The operator determines this area of investigation, but the regulatory agency assesses the scientific method used to select the radius.[114] Unlike the API report, the EDF framework envisions the regulatory agency and operator working together and communicating through the permitting and operating of the wells.[115]

Both frameworks have merit but are useless unless they are implemented. Each of the potential plans contain strengths, as outlined above, but would be even stronger if combined and implemented in addition to the regulations of the states.

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107. *Id.* at 127.
108. *Id.*
109. *Id.*
110. *Id.* at 127-28.
111. *Id.* at 128.
112. *Id.* at 128-29.
113. *Id.* at 129.
114. *Id.*
115. *Id.*

B. Alaska

Alaska has a significant amount of orphan wells, with an estimated 5,000 sprinkled across the state.[116] Carbon Tracker estimates the state needs over $1 billion to plug them all.[117]

Alaska requires operators to submit applications for approval to the state before the commencement of fracing operations and to provide notice to all landowners, surface owners, and operators located in a one-half-mile radius of the wellbore's intended trajectory.[118] These regulations allow other operators and landowners to be informed and take precautions.[119] This application to hydraulically fracture a well must include the well location, locations of all the water wells within a one-half-mile radius, penetration and fracturing intervals, and locations of all known or suspected fault lines.[120] Additionally, the operator must identify all freshwater aquifers within a one-half mile and create a testing plan.[121] Operators must submit detailed information before the hydraulic fracturing operations, including evidence of the casing and cement integrity, planned volumes, maximum anticipated pressures, and expected fracture dimensions.[122] Alaska's regulations require a detailed plan for monitoring the hydraulic fracturing operations and set notice requirements for pressures exceeding 500 pounds per square inch (gauge) above the expected pressures.[123] Operators must submit a post-operation report with the chemicals and volumes used during the hydraulic fracturing operations.[124]

Alaska also has heightened requirements for disposal wells and wastewater injection, in addition to the other regulations.[125] Operators must provide detailed maps with all aquifers, wells, and other features that could allow communication of freshwater and wastewater within 5,000 meters of the injection well.[126] Additionally, the operators must show there is a 90 percent probability that the surrounding geological characteristics would

116. Schuwerk & Rogers, *supra* note 20, at 7.
117. *Id.*
118. Alaska Admin. Code tit 20, § 25.280(f) (2017).
119. Wells & Hester, *supra* note 7, at 166.
120. Alaska Admin. Code tit 20, § 25.283(a)(11)-(12) (2017).
121. *Id.* § 25.283(a)(3)-(4).
122. *Id.* § 25.283(a)(6)-(10),(12)-(13).
123. *Id.* § 25.283(g).
124. *Id.* § 25.283(b)-(d),(f),(h).
125. Wells & Hester, *supra* note 7, at 167.
126. Alaska Admin. Code tit 20, § 63.130(c) (2017).

prevent the wastewater from contacting any aquifer or surface water within 1,000 years.[127]

C. Colorado

Colorado has over 60,000 documented orphan wells, which would take an estimated $7 billion to plug correctly.[128] However, until recently, Colorado failed to actively work to prevent interference with offset, old wells.[129]

The Colorado Oil and Gas Conservation Commissions adopted new, stricter rules in 2015 to prevent issuing surrounding abandoned wells.[130] Operators must perform anti-collusion analysis regarding all active wells within 150 feet.[131] Additionally, if the hydraulically induced fractures or wellbores will potentially be within 150 feet of the old well, the operator must make reasonable efforts to obtain written consent from the operator of the offset well.[132]

Colorado's rules on injection are more stringent.[133] For example, operators must provide plats showing all wells, operational and abandoned, within a one-quarter mile from the injection site, along with detailed mapping of all freshwater sources.[134] In addition, applications to drill and operate injection wells must include casing and cement specifications with a statement including all the planned hydraulic fracturing chemicals.[135]

D. North Dakota

North Dakota only has roughly 29,000 orphaned wells, but it would still take an estimated $8 billion to plug them all.[136] However, North Dakota does not have stringent regulations about offset, abandoned wells.[137]

Operators must test the casing and cement of their wells during and after hydraulic fracturing operations.[138] Pressure on the casing cannot exceed

127. *Id.* § 63.130(b).
128. Schuwerk & Rogers, *supra* note 20, at 7.
129. Wells & Hester, *supra* note 7, at 168.
130. Colo. Code Regs. § 404-1-317.r to .s (2018).
131. *Id.* § 404-1-317.r.
132. *Id.* § 404-1-317.s.
133. Wells & Hester, *supra* note 7, at 169.
134. Colo. Code Regs. § 404-1-401.b (2018).
135. *Id.* § 404-1-401.b(4)(D).
136. Schuwerk & Rogers, *supra* note 20, at 7.
137. Wells & Hester, *supra* note 7, at 171.
138. N.D. Admin. Code § 43-02-03-27.1 (2017).

85% of the API rating for that casing.[139] Oil and gas companies must notify the regulatory agency if there are indications that the casing may be compromised.[140] In addition, oil and gas companies must publish all chemicals utilized during the hydraulic fracturing operations on the FracFocus website within 60 days of the well's completion.[141]

North Dakota has heightened requirements on injection well operations.[142] Within an application for an injection well, the operator must include all wells within one-quarter mile of the propped injection site and geologic data for the injection and confining zones.[143] Operators must also disclose the estimated fracture pressure of the top confining geologic zone and the maximum planned injection pressure.[144] Additionally, the operators must give notice to all the adjacent landowners and provide a detailed report of corrective actions to be taken for any wells penetrating the injection zone within one-quarter mile of the injection site.[145]

E. Ohio

Ohio would have to spend over $13 billion to plug their over 170,000 documented orphan wells.[146] Throughout the state, advertisements ask people to report the orphan wells on their property in an attempt to gain a more accurate count as property changes hands.

Shockingly, Ohio has no explicit regulations that deal with abandoned wells that could be affected by hydraulic fracturing.[147] However, Ohio's Division of Oil and Gas Resources Management requires operators to include a plat prepared by a registered survey with the locations of all vertical wells within 500 feet of the proposed wellbore path in the horizontal well drilling permit.[148] The Ohio Division of Oil and Gas Resources Management employees compare the permit and the existing records.[149] If there is a potential for communication based on the records from the abandoned wells, the applicant may have to reposition the

139. *Id.* § 43-02-03-27.1(2)(a).
140. *Id.* § 43-02-03-27.1(3).
141. *Id.* § 43-02-03-27.1(2)(i). The FracFocus Website can be accessed at FracFocus.org.
142. Wells & Hester, *supra* note 7, at 172.
143. N.D. Admin. Code § 43-02-05-14(2)(b) (2017).
144. *Id.* § 43-02-05-14(2)(c) to (f)
145. *Id.* § 43-02-05-14(2)(j) to (l).
146. Schuwerk & Rogers, *supra* note 20, at 7.
147. Wells & Hester, *supra* note 7, at 172.
148. Ohio Admin. Code § 1501:9-1-04 (2017).
149. Wells & Hester, *supra* note 7, at 173.

wellbore plan or work with offset operators to plug old wells.[150] Additionally, 14% of the Division of Oil and Gas Resources Management goes toward their orphan well plugging efforts, which is unique amongst the states.[151]

For injection wells, oil and gas companies must investigate and identify all landowners, wells, and well operators within the area of review, which extends to either one-half mile or one-quarter mile from the wellsite, depending on the planned injection rates.[152] Oil and gas companies must plan corrective actions if any wells inside the area of review offer a continuation risk.[153] Additionally, the Ohio regulatory division publishes notices of hearings to consider the injection well permit, and any person can submit comments or objections.[154] The regulatory agency must examine each objection received.[155] The Ohio regulatory rules also explicitly require operators to conduct operations in a way that will not result in surface or water source contamination.[156]

F. Oklahoma

Oklahoma has over 288,000 orphan wells that would require an estimated $31 billion to plug.[157] In 2017, the Oklahoma Corporation Commission added a rule that requires all operators to provide notices to surface owners and offset well operators within one-half mile of the proposed perforation interval, acknowledging the increase in well interreference.[158] Additionally, the operator must give a post-operation report about the hydraulic fracturing operations.[159] However, the rules do not explicitly deal with the risks of hydraulic fracturing on abandoned wells.[160]

Oklahoma has explicit rules about injection and disposal wells.[161] Operators must provide a plat showing the location of the proposed injection well and all other wells, including dry holes, in the area

150. *Id.*
151. *Id.*
152. Ohio Admin. Code § 1501:9-5-05(B) (2017).
153. *Id.* § 1501:9-5-05(C)(11).
154. *Id.* § 1501:9-5-05(E)(1).
155. *Id.* § 1501:9-5-05(E)(2).
156. *Id.* § 1501:9-5-06.
157. Schuwerk & Rogers, *supra* note 20, at 7.
158. Okla. Admin. Code § 165:10-3-10(a) (2017).
159. *Id.* § 165:10-3-10(c).
160. *See generally id.* §§ 165:10-3-10 to -5-15.
161. Wells & Hester, *supra* note 7, at 174.

encompassed by the project.[162] Oil and gas companies must identify all offset well operators.[163] To aid in the orphan well crisis, the operator must plug any unplugged orphan well and remediate any improperly plugged abandoned well within one-quarter mile of the proposed injection site.[164]

G. Pennsylvania

Pennsylvania has over 174,000 orphan wells within its borders, which would take an estimated $15 billion to plug correctly.[165] To avoid issues with the abandoned wells, Pennsylvania has robust due diligence requirements placed upon the operators.[166]

Operators must identify the surface and bottom hole locations of any well, including plugged wells, within 1,000 feet from any part of the proposed wellbore.[167] During this search, operators must review all well databases available, review historical source information, and submit questionnaires provided by the regulatory agency to all landowners within the area of review.[168] Additionally, operators must provide notice of hydraulic fracturing operations to all other operators within 1,500 feet of the planned wellbore perforations.[169] Operators must also submit: proof of sending the questionnaires, a plat with all the wells in the area of review, the monitoring plan for the wells in the area of review, the true vertical depth of all the wells in the area of review, and well integrity data for all wells in the area of review.[170] Based on the submitted information, operators may have to follow more requirements to prevent issues caused by hydraulic fracturing operations.[171] All wells, including those plugged, must be visually monitored during the hydraulic fracturing operations.[172]

In addition, operators must immediately notify the Pennsylvania Department of Environmental Protection about any changes in the wells in the area of review, if there are any unexpected pressure or volume changes during the hydraulic fracturing operations, or if there is any confirmed well

162. Okla. Admin. Code § 165:10-5-4(b) (2017).
163. *Id.*
164. *Id.* § 165:10-5-15(b)(1)(D).
165. Schuwerk & Rogers, *supra* note 20, at 7.
166. Wells & Hester, *supra* note 7, at 174.
167. 25 Pa. Code § 78a.52a(a) (2016).
168. *Id.* § 78a.52a(b).
169. *Id.* § 78a.73(c).
170. *Id.* § 78a.52(c)-(d).
171. *Id.* § 78a.73(e).
172. *Id.* § 78a.73(c).

communication.[173] In the event of an incident, the operator must immediately stop stimulation and take measures to prevent pollution.[174] Additionally, if the hydraulic fracturing operations alter an abandoned or orphaned well, the operator must plug the altered well or place the well into production.[175] Finally, the Pennsylvania rules state that the operator "shall construct and operate the well . . . to ensure that the integrity of the well is maintained and health, safety, and environment and property are protected" and prevent migration of pollutants into freshwater.[176]

Unlike other states, Pennsylvania does not require baseline water samples.[177] However, a pre-drilling water survey must be taken if an operator wants to preserve its defenses and claims water pollution before hydraulic fracturing operations.[178] Moreover, if a person wants to document water quality for a potential future claim of water contamination from hydraulic fracturing operations, they are entitled to have a survey conducted by an independent Pennsylvania accredited laboratory before the hydraulic fracturing.[179] Oil and gas companies assume these rules apply to injection operations as well.[180]

H. Texas

Texas's Railroad Commission regulates the oil and gas industry within the state.[181] In 2013, the Railroad Commission amended the regulations, acknowledging the issues arising from hydraulic fracturing operations and orphan wells.[182] Texas has over 783,000 orphan wells, more than any other state.[183] This staggeringly large number of wells would require over an estimated $117 billion to plug correctly.[184]

Texas's amended rules require securely anchored casing for effective well control, isolation of all usable water zones, and prevention of fluid migration out of the production zone.[185] To achieve this, the Texas Railroad

173. Wells & Hester, *supra* note 7, at 176.
174. *Id.*
175. 25 Pa. Code § 78a.73(d) (2016).
176. *Id.* § 78a.73(a).
177. Wells & Hester, *supra* note 7, at 176.
178. 25 Pa. Code § 78a.52(a),(c) (2016).
179. *Id.* § 78a.52(b).
180. Wells & Hester, *supra* note 7, at 176.
181. *See generally* Tex. Nat. Res. Code Ann. § 86.042 (West 1977).
182. Wells & Hester, *supra* note 7, at 176.
183. Schuwerk & Rogers, *supra* note 20, at 7.
184. *Id.*
185. 16 Tex. Admin. Code § 3.13(a) (2016).

Commission set forth detailed specifications about casing and cement.[186] If a well will be hydraulically fractured, which most are, then the operator must pressure test the casing up to the maximum pressure planned to be used during the hydraulic fracturing treatment and notify the Texas Railroad Commission within twenty-four hours if the test fails.[187] In addition, during hydraulic fracturing, the operator must monitor all annuli for deviations from expected readings.[188]

The rules also set heightened minimum separation requirements.[189] A well that will be hydraulically fractured must have at least 1,000 feet of vertical separation between the producing zone and any useable water supply.[190] More rigorous testing and cementing requirements may be imposed on the operator if the well is close to only 1,000 feet of separation.[191]

Surprisingly, the rules do not require the operators to investigate the existence of orphan wells.[192] Additionally, operators are not required to notify landowners, offset well operators, or water source owners before hydraulic fracturing operations.[193]

The Texas Railroad Commission has different rules for injection and disposal wells.[194] Before any injection, operators must use public records to identify all wells within a one-quarter mile of the new well.[195] The operator must also view plugging records and determine if other oil and gas companies correctly plugged wells in the area of review.[196] Additionally, operators must notify all parties within one-half mile of the proposed injection or disposal well.[197] The Texas Railroad Commission provides all those potentially affected the opportunity to attend a hearing before issuing the permit for disposal or injection.[198] To obtain a permit for disposal or injection, the operator must also provide geologic evidence of the

186. *Id.* § 3.13(4).
187. *Id.* § 3.13(7).
188. *Id.* § 3.13(7)(C).
189. *Id.* § 3.13(1)(L).
190. *Id.*
191. *Id.* § 3.13(7)(D).
192. Wells & Hester, *supra* note 7, at 178.
193. *Id.*
194. *See generally* 16 Tex. Admin. Code §§ 1.1-20.605 (2017).
195. 16 Tex. Admin. Code § 3.46(e)(1) (2016).
196. *Id.* § 3.9(7)(A).
197. Wells & Hester, *supra* note 7, at 178.
198. *Id.*

separation between the freshwater and production formations by impervious geologic beds that provide adequate protection.[199]

I. West Virginia

West Virginia has over 102,000 orphan wells, which would require over $8 billion to plug.[200] West Virginia has strict regulations to combat water, air, and land contamination, especially related to old wells and communication with hydraulic fracturing operations.[201]

Horizontal well applicants must provide notice to the surface owner, owners of any water source within 1,500 feet of the wellsite, and the owners of any coal seams in the path of the proposed wellbore.[202] Additionally, the operator must publish a notice in the local newspaper and have an official website with the well location.[203] Finally, the application to drill must include proof of service to all parties.[204] West Virginia then provides thirty days for all noticed parties to provide written comments and objections to the application, and the regulatory agency must review each writing.[205]

Wellsites must be over 1,000 feet from any public water supply and at least 100 feet from any perennial stream, lake, pond, or reservoir.[206] Horizontal wells cannot be within 250 feet of any known water well or spring used for human or domestic animal consumption.[207] While there is no baseline water testing requirement, operators can test before drilling to prove any condition predated oil and gas operations.[208] The operator's application must include the basis for concluding that the well integrity will remain through hydraulic fracturing, preventing water contamination.

Operators must investigate the area within 500 feet of the surface location and 500 feet of the lateral section of the wellbore to identify and evaluate any potential conduits for unintended fracture propagation.[209] In the application, the operator must include a written report of those findings

199. 16 Tex. Admin. Code § 3.9(2) (2017).
200. Schuwerk & Rogers, *supra* note 20, at 7.
201. Wells & Hester, *supra* note 7, at 181.
202. W. Va. Code R. § 22-6A-10 (2017).
203. *Id.*
204. *Id.* § 22-6A-11(b).
205. *Id.* § 22-6A-11(a).
206. *Id.* § 22-6A-11(b).
207. *Id.* § 22-6A-12(a).
208. *Id.* § 22-6A-18(b).
209. *Id.* § 35-8-5.11.

and any reasonably expected impact on any wells.[210] In addition, West Virginia's regulations set specific requirements for the casing and cement used in wellbore design.[211]

The operator must identify all wells, including plugged wells, and all known and suspected geological faults when planning injection and disposal wells.[212] Then, operators must conduct, test, and monitor the injection well to maintain the wellbore integrity through the well's operations, following the detailed regulations outlined in the rules.[213] Operators must also demonstrate that the injection zone's geologic strata has a confining bed above it, free of known faults and fractures.[214]

J. Wyoming

Wyoming is home to over 64,000 orphan wells, requiring over $10 billion in plugging costs.[215] Wyoming has developed regulations regarding interference from abandoned wells center on water protection and prevention of hydrocarbon migration into water sources.[216]

As part of a drilling permit, operators must submit groundwater baseline sampling data and a water monitoring plan, including subsequent sampling and testing to be gathered after setting the casing and cement.[217] If there are four or fewer water sources within a one-half mile of the proposed wellbore, then the operator must collect water samples from each water source.[218] If over four water sources are within the area, the operator must submit a baseline sampling plan and identify any aquifers.[219] The baseline sampling must occur within twelve months before spudding the well.[220] Additionally, the operator must conduct subsequent sampling within twelve to twenty-four months after setting the production casing.[221] A subsequent secondary sampling occurs after twelve to twenty-four months.[222] Oil and gas companies must send copies of all tests to the Wyoming Oil and Gas

210. *Id.*
211. *Id.* § 22-6A-24.
212. *Id.* § 47-13-8.5.a.2.
213. *Id.* § 47-13-8.2.a.
214. *Id*.
215. Schuwerk & Rogers, *supra* note 20, at 7.
216. Wells & Hester, *supra* note 7, at 182.
217. 55-3 Wyo. Code R. § 46(a) (LexisNexis 2017).
218. *Id.* § 46(b).
219. *Id.* § 46(c).
220. *Id.* § 46(e).
221. *Id.*
222. *Id.*

Conservation Commission and owners of all adjacent water sources within three months of the sample collection.[223] If there is any sign of water contamination, the operator must notify the water source owner and the Wyoming Department of Environmental Quality within twenty-four hours of discovery.[224]

Wyoming's disposal and injection well regulations require a similar process.[225] However, in addition to the other rules, the oil and gas companies must locate any potential faults within one-half mile of the proposed well.[226]

K. All Other States and Federal Land

While the states above have the most orphan wells, several others suffer from the crisis.[227] Thirty-three states acknowledge having orphan wells.[228] The other states, combined, have over 637,000 orphan wells that will require over $39 billion to plug.[229] Sadly, many of these states have yet to develop regulations to help prevent issues when new oil and gas activity begins near orphan wells.[230]

VI. Suggestions For the Future

There is no arguing that there is an orphan well crisis in the United States. Many states are taking steps to work on the issue and prevent more wells from joining the problem; however, at the current rate it will take over a century to fix. Unfortunately, the approach necessary to make a significant impact combines multiple states' policies and the EDF and API Frameworks. Regulatory agencies and operators need to work together, communicate, and pool resources to drill and complete new wells while working toward eliminating the orphan well crisis. Offset operators should be notified to prevent protentional issues. Mitigation plans should be required prior to the beginning of operations. Risk assessments need to be completed for the area surrounding each well. Thankfully, the increase in technology, mapping technologies, and efforts of regulatory agencies have decreased the opportunity for wells to become true orphans. However, the

223. *Id.* § 46(g).
224. *Id.* § 46(j).
225. *See generally* 55-4 Wyo. Code R. § 5 (LexisNexis 2017).
226. *Id.*
227. Schuwerk & Rogers, *supra* note 20, at 7.
228. Interstate Oil & Gas Compact Commission, *supra* note 10, at 8.
229. Schuwerk & Rogers, *supra* note 20, at 7.
230. *See* Wells & Hester, *supra* note 7, at 162.

issues still arise when companies dissolve and cannot pay to plug their wells.

Currently, all the states that have regulations to aid in the oil well crisis have different rules. Creating a unified set of rules would help the states that do not currently have a plan to address orphan well issues. Operators would have one unified set of rules to follow no matter what state their wells were located in. Having federal guidelines would force the states to align and add regulations to the states that have yet to address the orphan well crisis.

When oil and gas operators apply to drill a well, they should be required to submit a surety bond equal to the amount it would cost to plug an average well of that type in that area based on historical data, or at least a large percentage of the cost. Some of the wells will take less than the average, but others require additional resources. While many states already have this requirement, updates need to be made to the antiquated guidelines and required amounts need to be increased. Currently, surety bonds, especially blanket bonds, cover far less than the average cost to plug an average well, so do little to provide assurance of plugging capability. Blanket bonds currently create a huge discount for operators with multiple wells, but this leads to a higher chance of creating risk of not insuring the plugging of wells. States need to change blanket bond policies and change the cost of the blanket bond to a closer aggregate of average costs for plugging the desired number of wells.

Unfortunately, placing a larger surety bond requirement might deter smaller oil and gas companies, particularly startup companies, from being able to drill. One solution to this can already be found in many states.[231] Different depth wells are assigned different surety amounts and single well surety bonds are available for smaller companies who cannot afford blanket bonds. States need a streamline process for registering new owners of oil and gas wells, ensuring that as wells change hands, records are kept, and information is updated. All new owners of oil and gas wells need to comply with bonding requirements, ensuring that the plugging liability is still covered after the sale.

Additionally, operators should be required to plug all orphan wells within one-half mile of the proposed location for a new well, from surface to total depth. Oklahoma is currently the only state with this requirement,

231. https://www.ncsl.org/energy/state-oil-and-gas-bonding-requirements; Alaska, Arizona, California, Colorado, Florida, Idaho, Illinois, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Montana, New Mexico, New York, North Carolina, Oregon, Pennsylvania, South Dakota, Tennessee, Texas, Utah, and Wyoming.

but the required radius is smaller. Adding this requirement helps ensure a decrease in orphan wells when operators are adding to the new well count in each state. Smaller operators might have issues finding the capital to satisfy this requirement, but these plugging efforts would be a great use of federal or state grant money set aside for plugging operations.

While the REGROW Act is certainly a step in the right direction, the total amount of grant funding pales in comparison to the total cost required to plug all the orphan wells across the United States. There is a need for more allocation of funds toward the plugging of orphan wells, as the issue addresses economic, health and safety, and environmental concerns. The REGROW act signals the increased awareness of the issue, but it simply is not enough.

The burden should not solely rest on the federal side. State agencies need to follow Ohio's lead and allocate a percentage of the state's oil and gas agency's revenue to a plugging program. Providing funding for these programs not only helps with the orphan well crisis, but also provides jobs for oil and gas workers, especially during the cyclical downturns within the industry. These programs could be utilized in two different ways. The state programs could help provide funding for operators, particularly smaller companies, to plug offset orphan wells when preparing to drill and hydraulically fracture new wells. Application systems should be developed to strategically divide the funding, ensuring aid went to operators that show need or aid with plugging extremely financially burdensome wells. These programs could also be used to hire unemployed oil and gas workers directly to commence plugging operations for orphan wells across the state. Either method would help address the orphan well crisis.

In drilling new wells, operators and regulatory agencies should work together and pool resources to ensure the most negligible impact from the hydraulic fracturing operations. Agencies and operators have access to different records and can cooperate to paint the most complete picture of the situation. Before drilling and hydraulic fracturing, notifications and pertinent well information should be sent to all landowners, water source owners, mineral owners, and operators within a half mile to ensure open communication and more thorough monitoring. The well information, information including location and a contact, should be posted in local papers and on a website. Additionally, a standard application should be used to drill and hydraulically fracture across every state. This application should include information regarding every well, including plugged wells, within a one-mile radius; mitigation plans for well interference; geological data regarding the formations to be drilled through; any known fracture or

natural fault; water sources; hydraulic fracturing and drilling plans; and basic well information.

Before drilling new wells, state regulatory agencies should require baseline water samples from the same radius to be taken and compared to water samples taken periodically after the well's completion. Thankfully, many states already have water testing regulations. Additionally, operators should be required to monitor offset orphan wells during hydraulic fracturing operations to minimize any environmental issues if there is communication between the new well and the surrounding orphan wells. These operators should also be required to notify regulatory agencies if pressures unexpectedly increase by more than 500 psi during hydraulic fracturing operations. These unexpected pressures can indicate communication between the well currently being hydraulically fractured and another well. If the operators and regulatory agencies work together, resources can be pooled to figure out which older well is being affected and prevent further damage if any occurred. Even if no damage or communication is evident, the documentation of the potential communication may raise awareness and be used to prevent future issues with future operations in the area.

VII. Conclusion

The orphan well crisis in the United States needs to be addressed on a federal level and a state level. As operators continue to drill, they need to work on dwindling the orphan well population. Solving the orphan well crisis can be done, but it is going to take cooperation between the operators, regulatory agencies, governments, and locals.

While the orphan well crisis is becoming more prevalent, most people are completely unaware of the large number of orphan wells across the United States. Other states need to follow Ohio's lead and post advertisements providing guidance on steps to take if an orphan well is located on a person's property. Orphan wells can often be local or family knowledge but remain unknown to regulatory agencies and operators in the area. These wells become known only after incidents when new wells being hydraulically fractured, but the environmental issues that result could have been prevented. Individuals need to know how and where to report orphan wells. The identification of orphan wells is the first step to solving the orphan well crisis.

Millions of oil and gas wells sit abandoned across the United States, and the plans to handle them vary significantly from state to state. The amount

of orphan wells peppering the country is a mystery, thanks to historical data in lost paper files, wooden casing, and dissolved companies. However, with new technology leading to current development in areas with historical production and new land developments, environmental, health, and impact from orphan wells have increased significantly.

The cost to plug orphan wells varies from state to state and even across basins, making it difficult to allocate the appropriate resources to the plugging effort. States have taken different approaches to pay for plugging plans, but sadly the bonds collected cover only a tiny percentage of the orphan wells. States also handle regulations on preventing interference with orphan wells differently, sometimes ignoring the issue altogether.

Operators should pay the average cost to plug the proposed well in surety bonds, ensuring there are funds to plug the well. Additionally, with the help of government grants and state funding, operators should be required to plug orphan wells within one-half mile of the proposed wells.

The orphan well crisis in the United States continues to worsen, but there are steps states can take, with the help of federal grants, to prevent further problems and address the issue at hand. If we continue to drill without plugging the orphan wells, there will be a significant rise in economic, health and safety, and environmental issues. It will take years to correctly plug the millions of orphan wells in the United States, but the process needs to begin.