

9-15-2020

Reflection on Shale Gas Fracking Risk Assessment and Management in the United States

Yosra Abid
abid.yosraa@gmail.com

Follow this and additional works at: <https://digitalcommons.law.uw.edu/wjelp>



Part of the [Environmental Law Commons](#), and the [Oil, Gas, and Mineral Law Commons](#)

Recommended Citation

Yosra Abid, *Reflection on Shale Gas Fracking Risk Assessment and Management in the United States*, 11 WASH. J. ENVTL. L. & POL'Y 1 (2020).

Available at: <https://digitalcommons.law.uw.edu/wjelp/vol11/iss1/2>

This Article is brought to you for free and open access by the Law Reviews and Journals at UW Law Digital Commons. It has been accepted for inclusion in Washington Journal of Environmental Law & Policy by an authorized editor of UW Law Digital Commons. For more information, please contact lawref@uw.edu.

WASHINGTON JOURNAL OF ENVIRONMENTAL LAW AND POLICY

SEPTEMBER 2020

Volume 11, Issue 1

© 2020 Washington Journal of Environmental Law and Policy

REFLECTION ON SHALE GAS FRACKING RISK ASSESSMENT AND MANAGEMENT IN THE UNITED STATES

Yosra Abid*

11 WASH. J. ENV'T. L. & POL'Y 1 (2020)

ABSTRACT

Hydraulic fracturing, or fracking, is the current technology of choice for developing most shale gas reserves. This technology allows increased production of natural gas from formerly inaccessible shale formations. One of the primary environmental impacts of concern for fracking is its potential to contaminate water.

This paper focuses on the potential risks affecting the drinking-water resources throughout the complete lifecycle of a drilled and fractured well. Given the significant environmental concerns, fracking risk assessment (what we know about the risk), and fracking risk management (what we wish to do about the risk) appear to be indispensable steps for the enactment of any environmental statute or regulation addressing such high-stake environmental problems and public concerns.

The federal government currently exempts most fracking activities from regulation, and therefore, states remain free to regulate practices as they see fit. This has resulted in a patchwork of state regulations, where

* Yosra Abid is a California-qualified attorney and graduate of New York University (NYU) School of Law, with an LLM in Environmental and Energy Law (2018). Yosra Abid can be contacted at abid.yosraa@gmail.com.

each state enacts various requirements for wastewater disposal, underground injection, water supply acquisition, drilling, casing, and operating wells. The various state fracking regulations fall along a spectrum from outright statewide bans to laissez-faire approaches. This paper includes a comparative analysis of state fracking regulations in three states in the United States: New York, Texas, and Illinois.

Having demonstrated the shortcomings of the current state-centric system regulating the shale gas fracking, the present paper advances forward both structural and substantive changes to enhance fracking risk assessment and management in the U.S.

INTRODUCTION

While the United States' demand for natural gas is rising¹ and its production of conventional natural gas is decreasing,² the temptation of applying a breakthrough technology allowing access to trillions of cubic feet of shale gas³ appears understandably irresistible.⁴ A technological innovation turned the United States from a net importer of natural gas only a decade ago into the world's third largest liquefied natural gas exporter and the world's largest natural gas producer.⁵ This technological innovation consists of a combination of extraction techniques for unconventional natural gas (or shale gas), namely the hydraulic

¹ "US gas demand has been steadily rising from 1980s... in 2009, the EIA Annual Energy outlook predicted that natural gas demand in the United States could reach 24.36 Tcf by the year 2030," Fang-Yu Liang, Marta Ryvak, Sara Sayeed, and Nich Zhao, *The role of natural gas as a primary fuel in the near future, including comparisons acquisition, transmission and waste handling costs of as with competitive alternatives*, NCBI (April 23, 2012), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3332260/>.

² "Conventional natural gas production in the United States has fallen over the past decade by about 14 billion cubic feet per day." *QER Report: Energy Transmission, Storage and Distribution Infrastructure* U.S. DEP'T OF ENERGY, 7 (2015), https://www.energy.gov/sites/prod/files/2015/09/f26/QER_AppendixB_NaturalGas.pdf.

³ There are over 827 tcf of recoverable shale gas reserves in the US. *Shale Gas: Applying to Solve America's Energy Challenges*, U.S. DEP'T OF ENERGY, 4 (2011), <https://www.hsdl.org/?abstract&did=8711>.

⁴ "[...] the shale gas production in the United States has grown more than tenfold from 2.7 Bcf/d in January 2004 to about 35.0 Bcf/d in May 2014 [...] shale gas accounts for about half of overall gas production in the United States," see *QER Report: Energy Transmission, Storage and Distribution Infrastructure*, *supra* note 2, at 7.

⁵ David B. Spence, *Responsible Shale Gas Production: Moral Outrage vs. Cool Analysis*, 25 *FORDHAM ENV'T. L. REV.* 141, 141 (2013).; "Enabled by new technology, especially the combination of horizontal drilling and hydraulic fracturing, in the US natural gas industry has undergone unprecedented changes over the past 8 years," see also *QER Report*, *supra* note 2, at 6; "Less than a decade ago, with natural production on the decline, the United States was expected to become a major importer of liquefied natural gas (LNG) and a last resort market for surplus cargos around the world. But today, thanks to an increase in shale gas output, the United States is poised to become a significant supplier of gas to international markets," Lisa Viscidi, Carlos Sucre & Sean Karst, *Natural Gas Market Outlook: How Latin America and the Caribbean Can Benefit from the US Shale Boom*, *THE DIALOGUE: LEADERSHIP FOR THE AMERICAS*, 1 (2015); The US is the current third largest exporter of LNG. Elizabeth Caldwell, Report: The United States will be The World's Top LNG exporter in the Next Five Years, *Energy in Depth* (2019), <https://www.energyindepth.org/report-the-united-states-will-be-the-worlds-top-lng-exporter-in-the-next-five-years/>; The US is the largest producer of natural gas thanks to shale gas production: "The United States surpassed Russia in 2011 to become the world's largest producer of natural gas [...]." U.S. Energy Info. Admin., *The US Leads Global Petroleum and Natural Gas Production with Record Growth in 2018* (2019), <https://www.eia.gov/todayinenergy/detail.php?id=40973>.

fracturing technique (also commonly known as fracking) and the horizontal drilling technique.⁶

Fracking is currently the most commonly used technology for the development of shale gas reserves.⁷ This technology has allowed the growing output of natural gas from otherwise unreachable shale formations.⁸ To let trapped natural gas out, artificial fractures need to be created. To this end, wells are pumped down with highly pressurized water, tracers, chemical additives, and proppants.⁹

For the purposes of this paper, fracking refers to the whole process allowing the extraction of natural gas from an unconventional formation. This process consists of three-fold stages: 1) exploration, 2) extraction operations, and 3) disposal of the operations-generated wastes.¹⁰ First, at the exploration stage, there should be tests conducted to determine the existence of natural gas in a given site.¹¹ Second, after obtaining requisite drilling permits, if any, the operator starts the construction of the well site and begins drilling.¹² Drilling, in unconventional formations, reaches thousands of feet vertically before it continues horizontally.¹³ This means that fracking drills not only occur beneath the conventional gas reserves, but also, more likely than not, below underground drinking-water supplies.¹⁴ Drilling operations cause natural water, known as “produced water,” in addition to drilling mud to rise in significant quantities from the formation through the well to the surface.¹⁵ Next, the operator injects millions of gallons of water at high pressure along with chemicals and proppants into the well to hydraulically fracture the formation.¹⁶ The use of pressure is essential for the creation of perforations in the well, allowing chemicals and proppants to penetrate the rock.¹⁷ The following stage consists in storing the water and chemicals, which return through the well to the surface, and are referred to as “flow-back water.” Placed

⁶ D. Spence, *supra* note 5, at 147-8.

⁷ James W Adams, Craig D. Stocker & Nicholas R. Lawson, *Emerging Centrifugal Technology in Shale Hydraulic Fracturing Waste Management: A U.S. –France-China Selected Environmental Comparative Analysis*, 34 Hous. J. INT’L L. 561, 562 (2012).

⁸ D. Spence, *supra* note 5, at 141.

⁹ Joanne Hawkins, *Fracking: Minding the Gaps*, 17 ENV’T. L. REV. 8, 9 (2015).

¹⁰ Michael Burger, *The (Re)Federalization of Fracking Regulation*, 2013 MICH. ST. L. REV. 1483, 1492 (2013).

¹¹ *Id.*

¹² *Id.*

¹³ *Id.*

¹⁴ *Id.*; see also Michael N. Mills & Robin B. Seifried, *What is Fracking Wastewater and How Should We Manage it*, 28 NAT. RESOURCES & ENV’T 9, 10–11 (2014).

¹⁵ *Id.*

¹⁶ *Id.*

¹⁷ *Id.* at 1493.

in a pit or tank, flow-back water will then be disposed of or reused.¹⁸ The operator generally opts for one of three methods to dispose of the wastewater resulting from the fracking operations: 1) either through underground injection into a separate disposal well, 2) through discharge into a water treatment plant, or 3) through land application.¹⁹ The final stage of shale gas extraction consists of plugging and abandoning the well at the end of its life.²⁰

The various stages of this process give rise to numerous risks, notably risks for “air pollution,” water contamination, “hazardous waste spills,” toxic chemical leaks, and increasing greenhouse emissions at the site of extraction.²¹ The various stages of the process, notably the transport, storage, and disposal of hazardous waste and toxic chemicals, are likely to cause toxic chemicals to spread to underground water supplies through surface and subsurface channels.²²

The most contentious phase of the shale gas extraction is drilling wastewater management.²³ This concern primarily reflects pollution risks such as methane gas leaks, fluid migration through created fractures into the groundwater, and surface spills from deficiently constructed wells.²⁴

Additionally, it is of particular concern the volume of water used for purposes of fracking.²⁵ For instance, Barnett Shale²⁶ wells use four to

¹⁸ *Id.*

¹⁹ M. Mills & R. Seifried, *supra* note 14, at 9-10.

²⁰ M. Burger, *see supra* note 10, at 1493.

²¹ *Id.*

²² *Id.*

²³ *see generally* M. Mills & R. Seifried, *supra* note 14.

²⁴ J. Hawkins, *see supra* note 9, at 10.

²⁵ The supply of freshwater required is approximately 15,000 m³ during the entire fracturing process into a well, *see* J. Hawkins, *supra* note 9, at 11.

²⁶ “The Barnett shale is a geological formation and rich source of natural gas located in the Fort Worth Basin in Northeast Texas. The shale consists of sedimentary rock made of clay and quartz and spans 5,000 square miles, beneath about 18 North Texas counties. The productive portion of the rock formation is located directly beneath Johnson, Tarrant and western Dallas counties, about a mile and a half underground. The shale contains an estimated 40 trillion cubic feet of natural gas, making it the largest onshore natural gas field in Texas and potentially in the United States.” *What is the Barnett Shale?*, STATE IMPACT: TEXAS (Aug. 24, 2020), <https://stateimpact.npr.org/texas/tag/barnett-shale/>.

five million gallons of fresh water per well, and Eagle Ford²⁷ wells use close to thirteen million gallons per well.²⁸

That said, this paper focuses on the potential risks affecting the drinking-water resources throughout the complete lifecycle of a drilled and fractured well. On-site storage and disposal of fracking wastewater pose contamination risk to both ground water and surface water, the two sources of drinking water.²⁹ Ground water is “water located beneath the earth’s surface, such as an aquifer, and surface water is water exposed to the atmosphere such as lakes, rivers, and ponds.”³⁰ Consequently, this paper identifies the potential threats to water resources, including contamination from chemical spills, improper fracking wastewater storage and disposal, in addition to methane releases during the drilling and fracturing stages.

Given the significant environmental concerns, the fracking risk assessment (what we know about the risk) and the fracking risk management (“what we plan to do about the risk”) appear to be indispensable steps for the enactment of any environmental statute or regulation addressing such scale of environmental problems and public concerns.³¹ The primary objective of risk assessment is “to estimate the likelihood and the severity of harm to human health and the environment occurring from exposure to a risk agent.”³² Risk management is defined as “the process by which the risk assessment is used with other information to make regulatory decisions.”³³

Fracking-related risk assessment has therefore been presented as the underlying driving force for legislative and regulatory actions at the

²⁷ “The Eagle Ford Shale is a hydrocarbon-producing geological of significant importance to its capabilities of producing both natural and also oil than other traditional shale plays. The shale play trends across Texas from the Mexican border into the East Texas, roughly 50 miles wide and 400 miles long with an average thickness of 250 feet with Railroad Commission of Texas Districts 1-6.” *Eagle Ford Shale Information: What is the Eagle Ford Shale?*, LEADING TEXAS ENERGY (Aug. 24, 2020), <https://www.rrc.state.tx.us/oil-gas/major-oil-and-gas-formations/eagle-ford-shale-information/>.

²⁸ Rebecca Jo Reser, *State and Federal Statutory and Regulatory Treatment of Hydraulic Fracturing*, 80 DEF. COUNSEL J. 90, 92 (2013).

²⁹ Kirbie Watson, *The Emperor’s New Clothes: Fracking Legislation in Texas*, 3 LSU J. ENERGY L. & RESOURCES 351, 355 (2014).

³⁰ *Id.*

³¹ See Dorothy E. Patton, *The ABCs of Risk Assessment*, 19 EPA J. 10, 10–11 (1993).

³² John J. Cohnsen & Vincent T. Covello, *Risk Analysis: A Guide to Principles and Methods for Analyzing Health and Environmental Risks* U.S. COUNCIL ON ENV. QUALITY, 55 (1989).

³³ D. Patton, *supra* note 32, at 11.

federal and state levels.³⁴ Risk assessment is, in fact, a vital decision-making and priority-identifying instrument in environmental regulations.³⁵ Policymakers therefore aim to achieve credibility and objectivity for preconceived policy goals by basing legislative and regulatory choices on risk assessment findings and outcomes.³⁶

That said, the present paper will be structured in three main parts: the first part generally addresses (I) fracking risk assessment and management; the second part examines (II) fracking risk assessment and management at the Federal and State levels; while the third part lays down a number of (III) suggestions addressing the current regulatory shortcomings associated with fracking activities.

I. FRACKING RISK ASSESSMENT AND MANAGEMENT

Risk assessment and management are enshrined in legislative and regulatory texts governing fracking operations.

A. *Risk Assessment*

The primary objective of the risk assessment is “to estimate the likelihood and the severity of harm to human health and the environment occurring from exposure to a risk agent.”³⁷ The National Academy of Sciences (NAS) and EPA risk assessment guidelines define risk assessment as “the process by which scientific data are analyzed to describe the form, dimension, and characteristics of risk—that is, the likelihood of harm to humans or the environment.”³⁸ The risk assessment process comprises four main phases: “1) hazard identification, 2) dose-

³⁴ According to H. Wiseman, where there is risk there must be regulation. Thus, regulating depends in large part on the outcome of the risk assessment process. In this respect Wiseman states “The absence of regulation is not of great concern if fracking is a relatively benign practice that can be sufficiently controlled through the general permitting process; but if fracking has significant environmental and public health impacts, the lack of regulation is problematic.” Hannah Wiseman, *Untested Waters: The Rise of Hydraulic Fracturing in Oil and Gas Production and the Need for Revisit Regulation*, 20 *FORDHAM ENV'T. L. REV.* 115, 116 (2009).

³⁵ Bernard D. Goldstein, *If Risk Management is Broke, Why Fix Risk Assessment*, 19 *EPA J.* 37, 37 (1993); see also discussion about the various studies conducted to determine the potential fracking threats on the environment, D. Spence, *supra* note 5.

³⁶ *Id.*

³⁷ Cohrssen, see *supra* note 32, at 55.

³⁸ Dorothy E. Patton see *supra* note 32, at 11.

response relationship, 3) exposure analysis, and 4) risk characterization.”³⁹

After examining (1) fracking risk assessment shortcomings, it seems relevant to identify a wide range of (2) assessed risks associated with fracking operations.

1. *Fracking risk assessment shortcomings*

Risk assessment relating to fracking activities can be (a) uncertain and controversial, (b) manipulated to serve narrow policy goals, and (c) conducted in an environment of scarce data.

a. *Risk assessment inherent limitations: uncertainty and controversy*

It is rare that there is only one answer to an environmental risk assessment question.⁴⁰ This can be illustrated by the controversial risk assessment studies undertaken in connection with the shale gas development.⁴¹

A 2004 EPA study reached the conclusion that fracking “pose[s] little or no threat” to drinking resources.⁴² This study was not only criticized (as it will be further detailed below) for potential political interference, but also for being inconsistent with previously and subsequently conducted studies by the EPA.⁴³ In fact, the 2004 EPA study contradicted a 1987 EPA report which revealed the contamination of an underground drinking water source in West Virginia’s shale gas

³⁹ Donald W. Stever, *The Use of Risk Assessment in Environmental Law*, 14 COLUM. J. ENV’T. L. 329, 329 (1989).

⁴⁰ “[...] risk assessment means different things to different people – a point that comes across in subsequent articles in this issue of EPA Journal – and is thus a source of misunderstanding and controversy. Some points of controversy involve the interpretation of scientific studies. Others have to do with science policy issues. [...]” see D. Patton, *supra* note 32, at 11.

⁴¹ D. Spence *see supra* note 5, at 160–62.

⁴² See EPA, EVALUATION OF IMPACTS TO UNDERGROUND SOURCES OF DRINKING WATER BY HYDRAULIC FRACTURING OF COALBED METHANE RESERVOIRS (2004); see also *EPA Finding on Hydraulic Fracturing Deemed ‘Unsupportable’*, UNION OF CONCERNED SCIENTISTS, (Aug. 24, 2020, 4:01 PM), <https://www.ucsusa.org/resources/epa-findings-hydraulic-fracturing-deemed-unsupportable>.

⁴³ *Id.*; “...in 2011, the EPA concluded that fracturing fluids had contaminated a drinking water aquifer near the town of Pavilion, Wyoming, though the industry disputes that conclusion,” see D. Spence, *supra* note 5, at 160–61.

formation.⁴⁴ Another EPA study, concluded in 2016, found that fracking can contaminate underground drinking water.⁴⁵

A 2011 study, conducted at Cornell University, “found a higher incidence of methane contamination in drinking-water wells located close to natural gas wells.”⁴⁶ In 2012, with the goal of quantifying the risks relating to groundwater contamination, researchers at the State University of New York enumerated a variety of accidents that “could result in a spill, and extrapolat[ed] from those probabilities to produce projected volumes of fracking wastewater that might find their way into groundwater or surface waters in the Marcellus Shale.”⁴⁷ The results of the study show that risks are substantial.⁴⁸

Notwithstanding the aforementioned studies, a 2011 study conducted at Pennsylvania State University showed “no significant increase in well contamination from either methane or fracking fluid constituents” after gathering samples of drinking water wells “before and after nearby fracking operations.”⁴⁹ On the other hand, in a study known as the “Duke Study,” MIT researchers have come to more nuanced conclusions. After sampling well water before and after fracking, MIT researchers found “no evidence of groundwater contamination by fracking fluids or wastewater,” but highlighted that “levels of thermogenic methane were higher in shallow groundwater aquifers near natural gas production wells than elsewhere in the same aquifers.”⁵⁰ It is worth mentioning that the researchers did not come up with an explanation as to the presence of gas drilling in said aquifers.⁵¹ Additionally, after comparing “concentrations of methane and other constituents in 127 water wells in the Fayetteville shale gas production region before and after shale gas production operations,” the US Geological Survey, similarly to the above-mentioned MIT Study and Pennsylvania State University study, reached the

⁴⁴ M. Burger, *see supra* note 10, at 1519.

⁴⁵ EPA, HYDRAULIC FRACKING FOR OIL AND GAS: IMPACTS FROM THE HYDRAULIC FRACTURING WATER CYCLE ON DRINKING WATER RESOURCES IN THE UNITED STATES. EXECUTIVE SUMMARY (2016), available at https://www.epa.gov/sites/production/files/2016-12/documents/hfdwa_executive_summary.pdf; *see also* U.S. EPA. HYDRAULIC FRACTURING FOR OIL AND GAS: IMPACTS FROM THE HYDRAULIC FRACTURING WATER CYCLE ON DRINKING WATER RESOURCES IN THE UNITED STATES (FINAL REPORT). U.S. ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC, EPA/600/R-16/236F, 2016, available at <https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=332990>.

⁴⁶ D. Spence *see supra* note 5, at 161.

⁴⁷ *Id.* at 162.

⁴⁸ *Id.*

⁴⁹ *Id.* at 161.

⁵⁰ *Id.* at 161–162.

⁵¹ *Id.* at 162.

conclusion that there was “no evidence of contamination of either methane or fracking fluid constituents [in] wells.”⁵²

b. Risk assessment neutrality can be compromised

Should the risk assessment be considered distinctly from risk management? Put differently, should we allow politics to influence risk assessment?

The 1983 Red Book report by the National Academy of Science’s (NAS) recommended distinguishing risk assessment and risk management.⁵³

The NAS report further stressed that both the scientific and political domains significantly influence the risk management process.⁵⁴ This exemplifies how risk assessment “operates in the ambiguous borderland between systematic observations of the physical world (“science”) and politically accountable decisions about public health and welfare (“policy”).”⁵⁵

Criticisms addressed to related risk assessment studies illustrate the alarming undue influence of politics and industry on these studies’ findings. By way of illustration, authors of an earlier published study, refuting fracking operations’ impact on methane level in drinking water, had financial ties to Chesapeake Energy, a company which owns unconventional oil and natural gas assets in top US onshore plays.⁵⁶

Furthermore, the accuracy of the EPA’s conclusions was challenged in 2015 by its independent scientific advisory panel which asserted that the study minimized the risks posed to drinking water by fracking.⁵⁷ The 2004 EPA’s report, which reached the conclusion that fracking “posed little or no threat” to drinking water resources, was deemed flawed after establishing conflicts of interest among the majority of the seven-member Peer Review Panel.⁵⁸ As a result, an investigation into the

⁵² *Id.*

⁵³ Sheila Jasanoff, *Relating Risk Assessment and Risk Management*, 19 EPA J. 35, 35 (1993).

⁵⁴ *Id.*

⁵⁵ *Id.*

⁵⁶ Curtis Morrison, *Fracker in the Rye: The Necessity of Federal Fracking Waste Regulation and a Fracking Waste Regulatory Commission*, 37 WHITTIER L. REV. 87, 102 (2015); see also *About*, CHESAPEAKE ENERGY, (Aug. 24, 2020, 4:08 PM) <http://www.chk.com/about>.

⁵⁷ *Id.*

⁵⁸ M. Burger *see supra* note 10, at 1519.

impact of political influence on the study was commenced by the EPA Inspector General.⁵⁹

In 2010 an EPA study on the potential for fracking to contaminate the drinking-water supplies began.⁶⁰ Although completion of the study was intended for 2014, it was not concluded until 2016.⁶¹ Great attention was placed on this EPA study because it was aimed to confirm or refute the 2004 EPA's conclusions, which found "no conclusive evidence" showing that fracking has impacts on drinking-water.⁶² During that time, President Obama openly praised fracking, considering it the reason behind achieving the US energy independence, the growth of the economy, and bringing down the levels of greenhouse gases.⁶³ It is noteworthy that in 2013, the US became the world's largest oil and gas producer, thereby reducing imports to levels unseen in over a decade.⁶⁴ Within the same context, the president of the US Chamber of Commerce expressly warned that the EPA study on drinking water "could short-circuit America's absolute explosion in energy opportunity that is creating millions of jobs."⁶⁵ Such excessive attention to the 2014 EPA study raised an enormous amount of criticism.⁶⁶ Such focus on the study was deemed as "enormous political pressure," interfering with the risk assessment neutrality, and undermining future credibility in risk assessment.⁶⁷

c. Risk assessment conducted in an environment of scarce data

Lax fracking regulations are at the origin of fracking-data gaps and absence of reporting requirements. Risk assessment tools (e.g. predictive models) have purposefully been omitted in statutes and regulations governing fracking activities.⁶⁸ Predictive models are one of the risk-

⁵⁹ *Id.*

⁶⁰ *The politics of fracking*, THIS WEEK (Aug. 24, 2020), <https://theweek.com/articles/451472/politics-fracking>;

⁶¹ *Id.*; see also U.S. EPA. HYDRAULIC FRACTURING FOR OIL AND GAS: IMPACTS FROM THE HYDRAULIC FRACTURING WATER CYCLE ON DRINKING WATER RESOURCES IN THE UNITED STATES (FINAL REPORT). U.S. EPA, *supra* note 46.

⁶² See *supra* section II. A "The Federal Oversight."

⁶³ See *The politics of fracking*, *supra* note 61.

⁶⁴ *Id.*

⁶⁵ *Id.*

⁶⁶ M. Burger *supra* note 10, at 1533.

⁶⁷ *Id.*

⁶⁸ "Rather than using their statutory authority to evaluate potential environmental impacts from shale gas extraction proposals, most states' permitting of oil and gas development have stuck to a traditional role: require minimum well construction standards setbacks, and a process from groundwater supply replacement. This approach differs dramatically from

assessment tools used to measure any potential harm that might be caused by the fracking operations.⁶⁹ Predictive models also allow permitting authorities (risk management authorities) to play a risk assessment role at an early stage of the fracking process, i.e. as early as the permitting stage.⁷⁰ Simply put, the predictive model-based approach ensures that a scientific assessment of potential risks and the operation outcomes be predicted at the early stage of permitting, before the inception of the operations.⁷¹ As a result, the predictive models are deemed to be the best analytical devices available for regulatory agencies to evaluate potential impacts of a proposed activity during the permitting process.⁷²

Additionally, collection of baseline data gathered before drilling can provide evidence about whether methane in nearby groundwater originates from drilling or is already present beforehand.⁷³ In this context, under the Illinois' Hydraulic Fracking Regulatory Act, fracking operators are bound to undertake baseline water sampling before engaging in any fracking activities.⁷⁴ Consequently, in light of collected data, permitting authorities would make well-informed decisions as to whether and under what conditions to issue fracking-related permits.⁷⁵

The EPA's Progress Report and the 2016 final report on its Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources confirm that these models are available for use in shale gas development permitting.⁷⁶

Last but not least, by absolving fracking operators of disclosure obligation, trade secrets laws impede access to important fracking data such as fracking fluids' chemical composition.⁷⁷

the predictive model -based approach of permitting underground injection control wells," see Emily A. Collins, *Permitting Shale Gas Development*, 29 J. LAND USE & ENV'T. L. 117, 118 (2013).

⁶⁹ *Id.* at 119.

⁷⁰ *Id.* at 126.

⁷¹ *Id.*

⁷² "[...] the state agencies have not incorporated necessary information gathering into their permitting rules and processes to use predictive modeling, which is the best evidence, in deciding whether, and under what conditions, to issue a gas development permit," *Id.* at 143.

⁷³ K. Watson, *supra* note 30, at 357.

⁷⁴ *Id.*

⁷⁵ *Id.* at 142.

⁷⁶ See 2016 EPA Study, *supra* note 46.

⁷⁷ "Currently, there is no federal law regulating fracking. Instead, fracking is only regulated under state law. Public disclosure requirements vary widely from state-to-state. Some states have no disclosure requirements at all. Of the states that do, most have included trade secret exception provisions allowing oil and gas companies to refuse to disclose the chemicals

d. Assessed fracking risks

There are environmental risks associated with any oil and gas production sites. However, there are some additional risks specifically associated with shale gas fracking operations. This paper focuses essentially on fracking operations' impacts on water resources.

One of the unique features of fracking operations is the transportation, storage, and use of significant quantities of water.⁷⁸ Risk assessment studies revealed the potential risk of groundwater contamination due to fracking fluids' underground injection throughout the hydraulic fracturing process.⁷⁹ To store the fracking fluids, operators generally use "the purpose-built ponds or 'frack tanks' set at the drilling location."⁸⁰ The natural formation pressure causes a large quantity of the fracking fluids injected into the wells to return to the surface, which is known as "flow-back water."⁸¹ Said flow-back water is also stored in frack tanks or purpose-built ponds at the drilling site.⁸² These ponds pose risks of environmental damage both at short and long terms.⁸³ For instance, a storm may cause the contamination of nearby land and water sources if the concentration of additives is sufficiently high in the stored flow-back waters.⁸⁴ Shallow aquifers, soils, and shallow groundwater are also at the danger of slow releases emanating from the ponds.⁸⁵ Another risk consists in the likelihood of releases from the vertical casings⁸⁶ of these wells, impacting shallow aquifers with either fracking fluid or recovered methane.⁸⁷

they use in fracking. More importantly, very few state laws that have trade secret exceptions also require that the company provide any substantiation that the trade secret is legitimate. Without some kind of uniform factual substantiation requirement, what is to keep oil and gas companies from abusing trade secret exceptions?" See Melanie McCormick, *Conflicting Theories at Play: Chemical Disclosure and Trade Secrets in the New Federal Fracking Regulation*, 9 GOLDEN GATE U. ENV'T. L. J. 217, 218 (2016).

⁷⁸ Thomas Swartz, *Hydraulic Fracturing: Risks and Risk Management*, 26 NAT. RESOURCES & ENV'T 30, 30 (2011).

⁷⁹ See H. Wiseman, *supra* note 34, at 137-38, 184.

⁸⁰ T. Swartz *see supra* note 79, at 31.

⁸¹ *Id.* at 30

⁸² *Id.*

⁸³ *Id.* at 31.

⁸⁴ *Id.*

⁸⁵ *Id.*

⁸⁶ "Typical well construction includes the use of numerous casings, starting with the largest "conductor casing" used to stabilize the shallow soils while drilling the well. The next casing is the surface casing used to establish a seal between the borehole and the shallow formations, which may include shallow and freshwater aquifers," *Id.*

⁸⁷ *Id.*

One additional risk to the shallow aquifers occurs during the completion of the wells.⁸⁸ This is when the fracking process opens up new fractures that would communicate with existing fractures in the overburden, allowing the communication between the deep gas-bearing zone and the shallow drinking-water aquifers.⁸⁹

Another significant risk consists of the loss of “flow-back” water from the production site.⁹⁰ Said flow-back water includes fracking chemicals of undetermined and unknown toxicity.⁹¹ Surrounding farmlands, homesteads, and waterways are particularly vulnerable to this risk.⁹² Similarly, a blowout of a drilling pad would dangerously impact the life of a community particularly if the drilling operations are occurring in the outskirts of an urban area.⁹³

The significance of the above-listed risks stresses the need for appropriate risk management tools.

2. Risk Management

Risk management is defined as the process by which the risk assessment “is used with other information to make regulatory decisions.”⁹⁴ In general, risk management is premised upon studies of technological feasibility costs, and on the economic and social consequences (e.g. employment impacts) of possible regulatory decisions.⁹⁵ The outcome of the risk assessment coupled with other relevant information to risk management are looked at together for purposes of making risk management options and environmental decisions.⁹⁶

Before critically appraising fracking-related risk management in the US, there is a need to determine how risk management and risk assessment relate.

⁸⁸ *Id.*

⁸⁹ *Id.*; see also D. Spence, *supra* note 5, at 151.

⁹⁰ See T. Swartz, *supra* note 79, at 31.

⁹¹ *Id.*

⁹² *Id.*

⁹³ *Id.*

⁹⁴ See D. Patton, *supra* note 32, at 11.

⁹⁵ *Id.* at 12.

⁹⁶ *Id.*

a. Relating risk management to risk assessment

Risk assessors base their judgment on facts that are believed most approximate to the “reality.”⁹⁷ The question that arises here is whether the facts of the risk should be assumed independently from the risk management considerations or have to derive somehow from the concerns of the risk management. The answer to this question depends on how conservatively the policy makers are inclined to draw up their policies to protect public health and the environment.⁹⁸ For instance, do the policy makers want to eliminate the risks that are unacceptably high for some subpopulations or only to reduce those that occur at too high frequency for the entire population? Should risk assessment default assumptions be set to protect individuals that are the utmost exposed, highly vulnerable, or most normal?

As a result of such complexity in making risk management decisions, US states’ policies have varied drastically. For instance, within the fracking regulation context, states such as New York⁹⁹ and Vermont¹⁰⁰ have adopted a statewide outright ban on fracking, while other states like Texas¹⁰¹ and Pennsylvania¹⁰² opted for more flexible fracking regulations and enforcement.

The ultimate objective of any risk manager, with respect to shale gas fracking, is striking a balance between regulating in a way that allows all stakeholders (i.e. industry, states, and communities) to reap the benefits of shale gas, on one hand, and minimizing the potential for environmental degradation on the other.¹⁰³

⁹⁷ S. Jasanoff, *see supra* note 54, at 36.

⁹⁸ *Id.*

⁹⁹ *See* D. Spence, *supra* note 5, at 159.

¹⁰⁰ *Id.* at 143.

¹⁰¹ “In no instance in its [Texas’] rules or application to drill does Texas require information that would allow the Rail Commission to model the potential for substance migration of fluids or methane from gas development operations,” *see* E. Collins, *supra* note 69, at 132; Texas, like Pennsylvania provides no formal predrilling water testing requirement. Nathan Richardson, Madeline Gottlieb, Alan Krupnick & Hannah Wiseman, *The State of State Shale Gas Regulation*, RESOURCES FOR THE FUTURE (2013), https://media.rff.org/documents/RFF-Rpt-StateofStateRegs_Report.pdf.

¹⁰² “Pennsylvania’s gas development permitting process does not actively provide room for reviewing agency to evaluate and address subsurface migration of gas and contaminants prior to development,” *see* E. Collins, *supra* note 69, at 137; For instance, RFF survey cites Pennsylvania among states that do not formally require predrilling water testing before drilling or hydraulic fracturing, *see* RFF report, *Id.* at 30.

¹⁰³ Hannah J. Wiseman, *Risk and Response in Fracturing Policy*, 84 U. COLO. L. REV. 729, 738 (2013).

b. Critical appraisal of fracking risk management solutions

As fracking industry-derived political and economic benefits are undeniable, risk management responses tend in large to (i) accommodate these non-environmental competing policy goals. Due to the inherent uncertainty attached to risk assessment, risk managers are stepping in to overcome such (ii) lack of certainty.

i. Accommodation of non-environmental competing policy goals

There is a tough balance to be struck between handling suspected adverse effects of fracking on the environment and its spillover benefits with respect to the economy and society. Fracking has been praised for contributing to the US energy independence, creating new jobs, and reducing greenhouse gas emissions.¹⁰⁴

Shale gas, extracted in the US, using fracking technology, has been presented as a viable economic alternative source of energy toward achieving a degree of energy independence.¹⁰⁵ Interestingly, thanks to shale gas, the US has been leading the global production of natural gas after bypassing Russia in 2009.¹⁰⁶ President Obama reportedly called Pennsylvania the “Saudi Arabia of natural gas” because of the state’s shale resource and its potential to enhance US energy independence.¹⁰⁷ At a national level, the extraction of shale gas has been perceived as a means to pursue the US paramount interest of energy security and independence, putting an end to a longstanding US dependence on the Middle East’s energy supplies.¹⁰⁸

Additionally, while as of 2012, the shale gas industry has reportedly been the source of 2.1 million jobs, the number is likely to attain 3.3 million by 2020.¹⁰⁹ An \$85 billion reduction in the US annual trade deficit is attributable to shrinking oil and gas imports.¹¹⁰

¹⁰⁴ See *The politics of fracking*, *supra* note 61.

¹⁰⁵ *Id.*

¹⁰⁶ R. Reser, *see supra* note 29, at 91.

¹⁰⁷ “We are the Saudi Arabia of natural gas,” the president said Tuesday,” Eric Schwartzel, *Obama’s Backing of Shale Gas Aimed at Voters in Marcellus Region*, PITTSBURGH POST-GAZETTE (Jan. 29, 2012), <https://www.post-gazette.com/home/2012/01/29/Obama-s-backing-of-shale-gas-aimed-at-voters-in-Marcellus-region/stories/201201290240>.

¹⁰⁸ *Id.*; See also Clarissa Bierstedt, *What’s the Fracking Problem? Hydraulic Fracturing, Silica Sand, and Issues of Regulation*, 63 DRAKE L. 639, 643 (2015).

¹⁰⁹ *Id.* at 644.

¹¹⁰ *Id.*

At a state level, in Texas, for instance, “oil and gas is big business”, as the state’s production of natural gas amounts to “one-fourth of the nation’s natural gas.”¹¹¹ “The oil and gas industry alone accounts for 14.9% of the state’s gross product, and nearly 312,000 people have jobs in the oil and gas industry.”¹¹²

Such remarkable political and economic benefits derived from the fracking industry have further complicated the mission of risk managers, striving to strike a balance between environmental and public health concerns, as well as other competing interests. Risk managers must account for concerns that legislative and regulatory developments may fall behind the increasingly important economic role of shale gas.¹¹³

From another perspective, risk management responses to the fracking potential risks should also be perceived through the lens of industrial interests. Governments do not engage in direct investment in, or production of, energy; rather, governments try to induce private capital to make such investment through regulations (including subsidies) that would raise or lower the profitability of the production of given fuels.¹¹⁴ Therefore, industrial interests tend to lobby policymakers to relax energy-related regulations for economic reasons.¹¹⁵

The decision whether to permit or prohibit shale gas production must overcome the temptation of focusing exclusively on the most immediate impacts drawn from a cost-benefit analysis. Equal importance should rather be accorded to broader impacts of the shale production so that all costs and benefits are weighed, and more widely distributed, in the longer run.¹¹⁶

That said, it bears noting that a cost-benefit analysis is a prevalent technique, almost systematically used by policymakers, in crafting risk management decisions. Proponents of the cost-benefit analysis hold that the analysis presents numerous advantages.¹¹⁷ First, it offers economic justifications for preconceived regulations, promotes economic efficiency, and eliminates “unnecessary and wasteful public and private expenditures.”¹¹⁸ Second, cost-benefit analysis contributes to diminishing

¹¹¹ K. Watson *see supra* note 30, at 358.

¹¹² *Id.*

¹¹³ *Id.*

¹¹⁴ D. Spence *see supra* note 5, at 169.

¹¹⁵ “States also could be inefficiently captured by industry, which benefits from revolving door connections to state regulatory bodies and has lobbied heavily against federal fracturing regulation.” *see* H. Wiseman, *supra* note 104, at 814.

¹¹⁶ D. Spence *see supra* note 5, at 169.

¹¹⁷ Jeremy D. Frailberg & Michael J. Trebilcock, *Risk Regulation: Technocratic and Democratic Tools for Regulatory Reform*, 43 MCGILL, L. J. 835, 858 (1998).

¹¹⁸ *Id.*

interest-group pressures on regulation by ensuring that the regulations are not shrouded in mystery, but are instead made accessible to the lay public.¹¹⁹ Nonetheless, cost-benefit analysis presents a number of limits. The efficiency of this analysis is contingent on its ability to accurately value both costs and benefits of regulating or not regulating involved potential risks.¹²⁰ A fundamental objection to this approach is its attempt to place a dollar value on morally and intellectually invaluable things, such as human life or harms to the environment (as it does not seem moral to place a value judgment on preserving endangered species or natural history).¹²¹

Within the context of shale gas development, potential water resource contamination and threats to drinking water depletion due to fracking's excessive use of water pose sheer valuation problems. For instance, no one can put a price on the availability of clean drinking water at home. People rely on clean and plentiful water resources to meet their basic needs, including drinking, bathing, and cooking. The 2010 documentary "Gasland" eloquently illustrated the magnitude of fracking impacts on drinking waters.¹²² In a particularly notable scene, a husband and wife were able to ignite the water running from their kitchen faucet because of water methane contamination resulting from the alleged fracking chemicals leaking into drinking water aquifers.¹²³ Discussing the cost-benefit analysis role in shaping fracking related risk management decisions is beyond the scope of this paper, however, it seems fair in light of the foregoing to say that the analysis raises serious criticisms with respect to its valuation techniques and strategies.¹²⁴

This paper also argues that the regulatory process should be safeguarded from undesirable interference by granting risk assessment analysis a priority over interest groups' pressure. Environmentalists express concerns as to the risk management process's vulnerability and susceptibility to overlook risk assessment determinations falling for involved industry's pressure.¹²⁵ For instance, in the 1980's, the EPA's Office of Pesticides and Toxic Substances "exempted formaldehyde from designations as a priority chemical under section 4(f) of the Toxic Substances Control Act, even though risk assessors' conclusions

¹¹⁹ *Id.*

¹²⁰ *Id.*

¹²¹ *Id.* at 865.

¹²² C. Bierstedt, *see supra* note 110, at 650.

¹²³ *Id.*

¹²⁴ J. Fraiberg & M. Trebilcock, *see supra* note 119, at 864.

¹²⁵ S. Jasanoff, *see supra* note 54, at 35.

definitively proved that this substance causes cancer in rats.”¹²⁶ The risk management measures seemed to have been unduly influenced by the concerns of the formaldehyde industry.¹²⁷ Within the shale gas context, this instance resembles the US Vice President Dick Cheney’s leadership of a taskforce which exempted Halliburton Company, of which he was the former CEO, from fracking wastewater disposal under the Safe Drinking Water Act. Such regulatory moves are now known as the “Halliburton Loophole.”¹²⁸ The resulting regulatory vacuum at the federal level has generated inconsistent state regulatory regimes, in which only a fraction of states endeavor to resolve fracking fluid disposal issues. As a result, “a variable regulatory terrain” has been created with “many significant gaps unfilled.”¹²⁹

ii. *Fracking risk management uncertainty*

There is a difference between risk and uncertainty. Risk indicates that the likelihood of possible future events is known and defined. Uncertainty, on the other hand, signifies that the likelihood of a future event has not been or cannot be measured.¹³⁰

As previously discussed, fracking impacts on water resources fall within those situations where risk assessment is inconsistent and uncertain. Where risk assessment uncertainty exists, policy judgments are necessary to fill in the gaps.¹³¹ Therefore, risk managers are called to adopt the best policies to deal optimally with uncertainty. When addressing uncertainty, regulators not only have to determine its parameters, but also the impacts of any assumption adopted to deal with the uncertainty on the society, economy, and the environment.¹³²

When uncertainty is inevitable, certain risk managers tend to adopt conservative risk assessment assumptions thereby leading to conservative risk-management decisions.¹³³ It is noteworthy that the choice to be conservative in risk assessment is ultimately a risk management judgement.¹³⁴

¹²⁶ *Id.*

¹²⁷ *Id.*

¹²⁸ C. Morrison *see supra* note 57, at 100.

¹²⁹ M. Burger *see supra* note 10, at 1494.

¹³⁰ J. Fraigberg & M. Trebilcock, *see supra* note 119, at 879-880.

¹³¹ Ellen J. Case, *The Public’s Role in Scientific Risk Assessment*, 5 GEO. INT’L ENV’T. L. REV. 479, 499 (1993).

¹³² *Id.*

¹³³ J. Fraigberg & M. Trebilcock, *see supra* note 119, at 856.

¹³⁴ *Id.*

Additionally, risk managers may resort to conservative positions irrespective of any risk assessment assumptions. This can be exemplified in the fracking risk management context, by the statewide outright fracking bans adopted by a number of states, such as New York and Vermont, as they were faced with insufficient knowledge about fracking impacts on the environment.

Risk assessment conclusions as to whether or not fracking is safe are neither conclusive, nor provide us with facts about the probability of occurrence of certain accidents under certain conditions. The decision that determines the level of acceptable risk – the probability of water contamination – is still beyond the scope of risk assessment and belongs more properly to the domain of risk management.¹³⁵

The subsequent section explores the level of conservatism for which the regulatory authorities opted, in crafting fracking risk management policies, taking into account fracking risk assessment uncertainty.

II. FRACKING RISK ASSESSMENT AND MANAGEMENT AT THE FEDERAL AND STATE LEVELS

This section analyzes fracking risk management tools at the federal and state levels. It further addresses the extent to which risk management and risk assessment should optimally interact in furtherance of water resource protection from fracking potential threats. Despite the fact that risk assessment remains inconclusive as to fracking’s potential impacts on water resources, fracking risk management is exempted from most federal laws and regulations. This has led to the emergence of a spectrum of inconsistent state laws and regulations, which range from a *laissez-faire* approach to outright statewide bans on fracking.

A. *The Federal Oversight*

1. *Historical overview of fracking-risk assessment at the federal level*

The 1980 Amendment to the Resource Conservation and Recovery Act (RCRA) exempted several types of solid wastes from regulation as hazardous wastes, including “drilling fluids, produced waters, and other

¹³⁵ See generally H. Wiseman, *see supra* note 34; See also Wiseman alluded to the state of New York stating that New York’s position toward shale gas activities relied on “incomplete set of data,” *see supra* note 104, at 816.

wastes associated with the exploration, development, or production of crude oil or natural gas or geothermal energy.”¹³⁶

Section 8002(m) of the amendment requires EPA to study these wastes and to submit a final report to Congress.¹³⁷ The EPA conducted and submitted a report in December 1987, known as the 1987 report. The report also addressed the “adverse effects of such wastes on humans, water, air, health, welfare, and natural resources [...]”¹³⁸

The report recommendations were not confined to whether Congress ought to continue with the application of RCRA Subtitle C to exempted wastes or uphold the current exemption; rather, the report analyzed the risks posed by the improper management of oil, gas, and geothermal wastes, which may adversely affect and cause damage to public health or the environment.¹³⁹ It bears pointing out that the report was of general scope and not specifically designated to evaluate risks generated by fracking wastes.

Additionally, the EPA acknowledged the limits of the 1987 report conclusions due to a lack of data necessary for risk modeling and risk assumptions.¹⁴⁰ The report recognizes that “the limited amount of waste sampling data and the lack of empirical evidence on the probability of injection well failures have made it impossible to estimate precisely the absolute nationwide or regional risks from current waste management.”¹⁴¹

It is important to note that comprehensive information on the exempted wastes from oil and gas operations is not routinely collected nationwide. Rather, the information relied upon in the report was

¹³⁶ See 42 U.S.C. § 6921(b)(2)(A)—(B) (1982); see also OFF. OF SOLID WASTE AND EMERGENCY RESPONSE, EPA/530-SW-88-003, REPORT CONGRESS: MANAGEMENT OF WASTE FROM THE RCRA, I-1 (1987), available at <https://nepis.epa.gov/Exe/ZyNET.exe/2000ESA8.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1986+Thru+1990&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C86thru90%5CTxt%5C0000002%5C2000ESA8.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL>.

¹³⁷ Report congress: management of waste from the RCRA, see *supra* note 138, at I-7.

¹³⁸ *Id.*

¹³⁹ *Id.* at I-8.

¹⁴⁰ *Id.*

¹⁴¹ *Id.* at V-64.

collected by the American Petroleum Institute (API) and the injection, production, and hauling reports conducted by state agencies.¹⁴²

In the guise of a general conclusion, the report states:

For the vast majority of model scenarios evaluated in this study, only very small to negligible risks would be expected to occur even if the toxic chemical(s) of concern were of relatively high concentration in the wastes and there was a release into ground water as was assumed in this analysis. Nonetheless, the model results also show that there are realistic combinations of measured chemical concentrations . . . and release scenarios that could be of substantial concern. **EPA cautions that there are other release modes not considered in this analysis that could also contribute to risks.** Also there are almost certainly toxic contaminants in the large unsampled population of reserve pits and produced fluids that could exceed concentration levels measured in the relatively small number of waste samples analyzed by EPA.¹⁴³

With respect to risks associated with produced water disposal in injection wells, the report concluded that the prevalent risks for underground injection stem from either grout seal or well casing failures.¹⁴⁴ However, the report recognized that “other possible release pathways such as migration through unplugged boreholes or fractures in confining layers, . . . could be of concern.”¹⁴⁵

The 1987 report recommended that “the imposition of RCRA Subtitle C regulation for all oil and gas exploration, development, and production wastes to be unnecessary” and “impractical.”¹⁴⁶ First, “unnecessary” because damages and risks posed by oil and gas operations result from violations of existing State and Federal regulations. According to the EPA, the enhancement of existing authorities, the improvement of the state programs, and existing Federal initiatives relating to underground injection and surface water risks, are adequately designed to manage oil and gas wastes.¹⁴⁷

¹⁴² *Id.* at I-4.

¹⁴³ *Id.* at V-64.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*

¹⁴⁶ *Id.* at VIII-12.

¹⁴⁷ *Id.*

Second, “impractical” because of the substantial (possibly 22%) reduction in gas and oil production in the US should Subtitle C regulations be enforced.¹⁴⁸ The 1987 report was relied upon to exempt the oil and gas exploration and development wastes from RCRA Subtitle C. This remains applicable to the fracking waste and will be further discussed in the ensuing section.

In the early 2000’s, in response to public concerns about potential impacts on the drinking water from shale gas fracking, Congress directed the EPA to study the relationship between fracking oil and gas and drinking water in the U.S.¹⁴⁹ In 2004, the EPA undertook a study that assessed the potential for contamination of underground sources of drinking waters (USDW)¹⁵⁰ from the injection of hydraulic fracturing fluids into coalbed methane (CBM) wells.¹⁵¹

The 2004 study was limited at least in two respects. First, although the study alluded to steps in the fracking other than fracking wastewater injection that can contaminate the underground drinking water, it fails to fully analyze these stages.¹⁵² Second, the study analysis was limited to CBM wells and did not include other hydraulic fracturing practices, such as those for petroleum oil and gas.¹⁵³

The 2004 study found that there is “no conclusive evidence that water quality degradation in USDWs is a direct result of injection of hydraulic fracturing fluids into CBM wells and subsequent underground movement of these fluids.”¹⁵⁴ Interestingly, the 2004 study was criticized for using existing data and not undertaking further investigations, and hence missing out on the opportunity to conduct an independent risk assessment study rather than merely building its conclusions upon existing literature.¹⁵⁵

The conclusions of the 2004 study underpinned the 2005 Amendment of the Safe Water Drinking Act (SWDA), which exempted

¹⁴⁸ *Id.*

¹⁴⁹ Francis Gradijan, *State Regulations, Litigation, and Hydraulic Fracturing*, 7 ENV’T. & ENERGY L. & POL’Y J. 47, 52 (2012).

¹⁵⁰ A USDW is defined as an aquifer or a portion of an aquifer that:

- A. 1. Supplies any public water system; or
 2. contains sufficient quantity of groundwater to supply a public water system; and
 - i. currently supplies drinking water for human consumption; or
 - ii. contains fewer than 10,000 milligrams per liter total dissolved solids;
- B. Is not exempted aquifer.

¹⁵¹ See 2004 EPA Study, *supra* note 43.

¹⁵² See F. Gradijan, *supra* note 151, at 53.

¹⁵³ *Id.*

¹⁵⁴ See 2004 EPA study, *supra* note 43, at 25.

¹⁵⁵ See F. Gradijan, *supra* note 151, at 54.

the fracking fluids underground injection from the scope of the federal UIC program under SWDA. This point will be further addressed with more details in a subsequent section.

In 2010, due to the controversy that surrounded the 2004 study, the EPA began planning a study of the fracking water cycle to understand how different activities affect the quality or quantity of drinking water resources and to identify factors that affect the frequency or severity of those impacts.¹⁵⁶ The EPA rendered the final report in 2016 (hereinafter “the 2016 report”).¹⁵⁷

The 2016 report concluded that groundwater resources are vulnerable to a combination of activities and factors in the fracking water cycle.¹⁵⁸ These activities and factors include:

- 1) water withdrawals for hydraulic fracturing in times or areas of low water availability, particularly in areas with limited or declining groundwater resources;
- 2) spills during the management of hydraulic fracturing fluids and chemicals or produced water that result in large volumes or high concentrations of chemicals reaching groundwater resources;
- 3) injection of hydraulic fluids into wells with inadequate mechanical integrity, allowing gases or liquids to move to groundwater resources, and;
- 4) injection of hydraulic fracturing fluids directly into groundwater to surface water resources and disposal or storage of hydraulic fracturing wastewater in unlined pits, resulting in contamination of groundwater resources.¹⁵⁹

The report concedes that further conclusions regarding the impacts of fracking on drinking water could not be reached owing to data gaps and uncertainties.¹⁶⁰

Particularly, data gaps existed with regard to the environmental presence and movement of fracking chemicals. The report suggested that such gaps may be bridged by standardizing the currently rare practice of obtaining water quality data both before and after engaging in fracking.¹⁶¹

¹⁵⁶ See 2016 EPA’s Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources, *supra* note 46, at 3.

¹⁵⁷ *Id.*

¹⁵⁸ *Id.* at 42.

¹⁵⁹ *Id.*

¹⁶⁰ *Id.* at 40.

¹⁶¹ *Id.*

These data limitations precluded the EPA from being conclusive in determining whether or not fracking activities adversely affect drinking water resources.¹⁶² It is worth noting that data gaps and lack of relevant monitoring figures are essentially due to regulatory loopholes, which omit to require such pre, post, and during fracking water testing.¹⁶³ Requirements for provisions of fracking data as well as fracking fluid chemicals disclosure will be further discussed in the ensuing sections.

The report called for additional efforts to bridge the data gaps and increase risk assessment certainty with regard to the prevalence and volume of drinking water impacts.¹⁶⁴

Before suggesting a number of solutions to remedy these shortcomings preventing the elaboration of more certain and complete fracking risk assessment, the ensuing sections discuss the current legal and regulatory status quo, both at the federal and state levels, highlighting to a greater extent the origin of fracking-related data gaps to which the report pointed.

2. *Fracking-risk management at the federal level*

Because this paper mainly focuses on threats posed by the fracking operations to water resources (surface and underground), this section examines the major pieces of federal legislation designed to regulate hydraulic fracturing effects on water resources.

Similar to conventional oil and gas, the exploration and production of shale gas is regulated by a complex set of federal, state, and local laws.¹⁶⁵ At the federal level, the EPA takes on the responsibility of administering the federal laws. At the state level one or more regulatory agencies issue well related permits covering various aspects like “design, location, spacing, operation, and abandonment, in addition to environmental activities and discharges, including water management and disposal, waste management and disposal, air emissions, underground injection, wildlife impacts, surface disturbance, and worker health and safety.”¹⁶⁶

The federal legislative arsenal related to shale gas development and water resources protection include 1) the Safe Drinking Water Act

¹⁶² *Id.*

¹⁶³ Theodore IV Bosquez, Daniel Carmeli, Jeremy Esterkin, Mae Kieng Hau, Kenneth Komoroski, Camarin Madigan & Matthew Sepp, *Fracking Debate: The Importance of Pre-Drill Water quality testing*, 26 ENV'T. LITIG. 7, 7, 9–10 (2015).

¹⁶⁴ *Id.* at 41.

¹⁶⁵ See J. Adams, *supra* note 7, at 578.

¹⁶⁶ *Id.*

(SDWA) which addresses the subsurface fluid injections; 2) the Clean Water Act (CWA) which deals with the surface water discharges; 3) the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) which provides for the cleanup of historic contamination by hazardous substances; 4) the Resource Conservation and Recovery Act (RCRA) which sets forth federal standards for the management of hazardous wastes from the stage of generation to the disposal; 5) the National Environmental Policy Act (NEPA) which mandates a comprehensive assessment of the environmental effects of shale gas extraction on federal land, and; 6) The Emergency Planning and Community Right to Know Act (EPCRA) which facilitates and ensures access to information and statistics in order to foster a positive feedback mechanism that allows the exercise of greater pressure on local or central government to enforce existing regulations.¹⁶⁷

a. Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was enacted in 1974, with “its ‘general purpose to assure that water supply systems serving the public meet minimum national standards for protection of public health.’”¹⁶⁸ The SDWA regulates the underground injection activities with the goal of “protect[ing] groundwater resources, including underground drinking-water supplies.”¹⁶⁹

Under the SDWA, the EPA oversees at the federal level the safety of the groundwater resources through the Underground Injection Control (UIC) permit program.¹⁷⁰

As far as the hydraulic fracturing is concerned, in 1997, a Federal Court¹⁷¹ interpreted the SDWA as applicable to “underground injection of fracking fluids.”¹⁷² Under the SDWA, the EPA undertakes a “minimum inspection, monitoring, record keeping and reporting requirements for state Underground Injection Control (UIC)

¹⁶⁷ *Id.* at 579, 582, 585.; “...Congress enacted EPCRA as a comprehensive regime requiring companies to disclose information related to the storage and use of hazardous and toxic chemicals,” *see* Burger, *supra* note 10, at 1521.

¹⁶⁸ M. Burger *see supra* note 10, at 1503.

¹⁶⁹ *Id.*

¹⁷⁰ *Id.* at 1504.

¹⁷¹ *See* Legal Env’t Assistance Foundation v. EPA, 118 F.3d 1467, 1478 (11th Circuit 1997).

¹⁷² D. Callies & C. Stone, *Regulation of Hydraulic Fracturing*, 1 J. INT’L & COMP. L. 1, 11 (2014).

programs.”¹⁷³ All underground injections are prohibited unless exempted or permitted.¹⁷⁴

In the event a state chooses to take control of the enforcement of the UIC programs, it may apply to the EPA to be granted statutory responsibilities.¹⁷⁵ “Once approved, states are primarily responsible for issuing injection permits and monitoring the effect of injections on the quality of” the underground water resources.¹⁷⁶ A state seeking EPA approval must develop a UIC program which safeguards drinking water from any potential dangers due to injections, as well as guarantees of sufficient oversight measures.¹⁷⁷ Failure to secure the approval of a state UIC program or in the event of incompetent management, federal control and management may step in.¹⁷⁸

Consequently, under the ordinary and plain meaning of the SDWA provisions, hydraulic fracturing would have come under the scope of the statute. In other words, there is nothing in the ordinary and plain language of the SDWA that supports the exclusion of hydraulic fracturing. Thus, the state UIC programs would have made the issuance of permits obligatory for the injection of fracking fluids.¹⁷⁹ The “oil and gas injection wells—including the so-called ‘enhanced recovery’ wells like fracking wells—are regulated under the federal UIC program’s Class II requirements.”¹⁸⁰ In *Legal Environmental Assistance Foundation, Inc. v. United States Environmental Protection Agency*, the Eleventh Circuit rejected the EPA’s interpretation, which argued that the “underground injection” did not include hydraulic fracturing operations.¹⁸¹ The Eleventh Circuit held that SDWA required the regulation of hydraulic fracturing alongside the traditional underground injection forms.¹⁸²

In 2005, Congress passed the Energy Policy Act (EPAct), which carved out the operations associated with the shale gas exploration and extraction from the scope of the SDWA.¹⁸³ The EPAct “amended the definition of ‘underground injection’” to “exclude ‘the underground injection of fluids or propping agents’” associated with the hydraulic

¹⁷³ *Id.*

¹⁷⁴ *Id.* at 12.

¹⁷⁵ *Id.*

¹⁷⁶ *Id.*

¹⁷⁷ *Id.* at 11–12.

¹⁷⁸ *Id.* at 12–13.

¹⁷⁹ See M. Burger, *supra* note 10, at 1504.

¹⁸⁰ *Id.*

¹⁸¹ *Legal Env’t. Assistance Found., Inc. v. EPA*, 118 F.3d 1467, 1478 (11th Cir.1997):

¹⁸² *Id.* at 1477–1478.

¹⁸³ M. Burger *see supra* note 10, at 1504.

fracturing operations.¹⁸⁴ Pursuant to the exclusion, only injection of diesel requires a prior UIC permit.¹⁸⁵ The EPAct also indicates that the regulatory framework governing fracking activities would from then on fall within the state permitting and enforcement structures.¹⁸⁶ As a result, unless the gas drillers inject diesel fuel underground, “they are not required to seek a permit, or to disclose any of the chemicals in their fracking fluid under federal law.”¹⁸⁷

The UIC permitting under SDWA relies on predictive models in determining the endangerment standard, which yields a risk-based evaluation of a proposed operation during the permitting process.¹⁸⁸ The outcome of the evaluation would give rise to one of the following decisions: 1) a prohibition of the activity without a permit, or 2) establishment of a standard for permit issuance that requires the applicant to demonstrate that the underground injection will not endanger drinking water sources.¹⁸⁹

The SDWA was envisioned to “foster a ‘cooperative effort in which the Federal government assists, reinforces, and sets standards for the State and local efforts’ in implementing the Act.”¹⁹⁰ Nonetheless, the exemption of injection of the fracking fluids from the scope of the SDWA enabled the individual states to assume the enforcement of their own UIC programs.¹⁹¹ As it will be addressed in further detail in the ensuing section, the states’ UIC programs generally do not restate the SDWA endangerment standard.¹⁹²

The absence of “a federal floor of minimal regulation in permitting shale gas extraction” fueled the debate over whether states should be trusted with the environmental management and control.¹⁹³

State oil and gas development statutes are infused with broad language that leaves sufficient room for state agencies to promulgate necessary rules to prevent any undesired environmental impacts of the shale gas extraction.¹⁹⁴ Yet, more often than not the state agencies fail to

¹⁸⁴ *Id.*

¹⁸⁵ *Id.*

¹⁸⁶ See E. Collins, *supra* note 69, at 117.

¹⁸⁷ Thomas Hooker, *Zoning Out Fracking: Zoning Authority under New York State’s Oil, Gas and Solution Mining Law*, 40 *FORDHAM URB. L. J.* 869, 876 (2012).

¹⁸⁸ See E. Collins, *supra* note 69, at 125-126.

¹⁸⁹ *Id.* at 125; see also 42 U.S.C. §300h(b)(1)(A) (2013) and 42 U.S.C. §300h(b)(1)(B).

¹⁹⁰ *Id.* at 128.

¹⁹¹ *Id.*

¹⁹² See *infra* section II. 2.

¹⁹³ See Emily A. Collins, *supra* note 69, at 118.

¹⁹⁴ *Id.* at 126.

put in use the discretion they were granted.¹⁹⁵ In fact, unlike the SDWA, with the exception of Illinois’s statute, no state has an oil and gas statute at the permit application phase that “(1) clearly puts the burden on the applicant to show that their proposed operation is safe, or (2) describes the level of acceptable risk of contamination of water supplies.”¹⁹⁶

The fracking fluids’ exemption from the scope of the SDWA has been criticized as “bad environmental policy.”¹⁹⁷ For instance, EarthWorks contented that the exemption makes “oil and gas the only industry allowed to inject toxic fluids directly into good quality groundwater without oversight by the U.S. Environmental Protection Agency.”¹⁹⁸

As mentioned above,¹⁹⁹ this exemption has been referred to as the “Halliburton Loophole” given that it “was pushed through Congress by Vice President Dick Cheney, a former chief executive of [Halliburton, a multinational oil and gas company].”²⁰⁰ Knowing that fracking was invented by Halliburton in 1947, critics insinuate that EPA would have not abdicated the authority of regulating fracking activities to the states “but for inappropriate interference of corporate interests.”²⁰¹

b. Clean Water Act

The Clean Water Act (CWA) governs “unpermitted discharges of soil, chemicals or other materials to wetlands or surface waters.”²⁰² “Since 1987, drilling operations have been exempted from storm water runoff provisions of the CWA.”²⁰³ Additionally, a CWA amendment made fluids generated by the hydraulic fracturing fall outside the scope of the “pollutant” category: “the term ‘pollutant’ . . . does not mean . . . (B) water, gas, or other material which is injected into a well to facilitate production of oil or gas.”²⁰⁴ As a result, the CWA only comes into play

¹⁹⁵ *Id.*

¹⁹⁶ *Id.*

¹⁹⁷ Matt Willie, *Hydraulic Fracturing and Spotty Regulation: Why the Federal Government Should Let States Control Unconventional Onshore Drilling*, 2011 BYU L. REV. 1743, 1761 (2011).

¹⁹⁸ See Wiseman, *supra* note 35, at 145 n.156 (quoting EARTHWORKS, OIL & GAS ACCOUNTABILITY PROJECT, HYDRAULIC FRACTURING, available at <http://www.earthworksaction.org/pubs/Fracking.pdf>).

¹⁹⁹ See discussion *supra* 1.2.b.i.

²⁰⁰ See C. Bierstedt, *supra* note 110, at 659.

²⁰¹ *Id.*

²⁰² See D. Callies & C. Stone, *supra* note 174, at 21.

²⁰³ *Id.*

²⁰⁴ *Id.*; See also 33 U.S.C § 1362(6).

to regulate the disposal of fracking “flowback or fracking wastewater,” other than the underground injection.²⁰⁵

In Texas, similar to many other states, the “fracking wastewater is disposed of primarily by injection into underground storage wells below impermeable rock layers.”²⁰⁶ Consequently, because the CWA essentially regulates “discharge at the surface level, instead of underground injections of fluids, [it] has not historically played a large role in the regulation of oil and gas operations” in some geographical areas.²⁰⁷ Nonetheless, it is noteworthy that certain geological formations, including the Marcellus Shale region, are not appropriate for underground disposal, which may explain the existence of fewer injection wells in that region.²⁰⁸ As a result, treatment of fracking operation flow-back water in publicly owned treatment works (POTW) is “more common.”²⁰⁹ This makes the provisions of the CWA of greater relevance within certain geographical areas when compared with others. Put differently, the CWA’s applicability to fracking fluids disposal depends on the geological characteristics of the shale gas formations at issue, which in turn vary widely across states and jurisdictions.

The CWA endows the EPA with the power to set wastewater standards for industries as part of pollution control programs.²¹⁰ “They have also set water quality standards for a variety of contaminants in surface waters.”²¹¹ The CWA provides that the discharge of a pollutant into the water of the U.S. requires a permit from either the EPA or the authorized state agency, and that the discharge is in compliance with the CWA-based National Pollutant Discharge Elimination System (NPDES).²¹²

“Shale gas production sites or commercial facilities [taking on the responsibility of handling the] ‘disposal or treatment of shale gas produced water must obtain permits if they intend to discharge directly into the surface waters.’”²¹³ Also, the CWA provides that indirect disposal of fracking wastewater through POTW by discharging directly into waters in the US falls within the jurisdiction of the EPA.²¹⁴

²⁰⁵ See D. Callies & C. Stone, *supra* note 174, at 21.

²⁰⁶ R. Reser, *supra* note 29, at n. 18.

²⁰⁷ D. Callies & C. Stone, *supra* note 174, at 21.

²⁰⁸ R. Reser, *supra* note 29, at n. 18.

²⁰⁹ *Id.*

²¹⁰ Adams et al., *supra* note 7, at 580 (citing 33 U.S.C. §1251).

²¹¹ *Id.*

²¹² R. Reser, *supra* note 29, at 98.

²¹³ Adams et al., *supra* note 7, at 580.

²¹⁴ R. Reser, *supra* note 29, at 98-99.

Granting a NPDES permit, either by the EPA or an authorized state agency, requires the consideration of technology-based effluent limits and the water quality-based effluent limits.²¹⁵ In sum, “states are generally delegated primary enforcement authority with regards to the CWA, following the EPA’s approval of the state program.”²¹⁶

c. Comprehensive Environmental Response Compensation and Liability Act

CERCLA “is a retrospective law designed to provide for the cleanup of historic contamination by hazardous substances.”²¹⁷ CERCLA provides for the creation of a ‘Superfund’ with the goal of financing “government remedial actions.”²¹⁸

Under CERCLA, contaminated sites can be cleaned up either by state or federal government authorities, or responsible private parties (either voluntarily or under a government order).²¹⁹ Under CERCLA, federal and state governments and certain private parties can bring claims against “potentially responsible parties” (PRPs) on the grounds of their release of hazardous substances.²²⁰ Section 104 (e) of the statute empowers the EPA “to investigate the site and any alleged PRP” in the event of identification of a contamination site.²²¹ Subsequent to the investigation, the EPA is authorized under section 106 to order PRPs to undertake certain remedial actions.²²² However, CERCLA turns to be of little relevance to fracking waste management since in defining “hazardous substance” for establishing a potential PRP’s liability, CERCLA excludes “petroleum, including crude oil, . . . natural gas,

²¹⁵ R. Reser, *supra* note 29, at 98-99; *see also* Adams et al., *supra* note 7, at 580-81 (“Effluent limitations serve as the primary mechanism under NPDES permits for controlling discharges of pollutants to receiving water. When developing effluent limitations for an NPDES permit, a permit writer must consider limits based on both the technology available to control the pollutants (i.e. technology-based effluent standards) and the regulations that protect the water quality standards of the receiving water (i.e. water quality-based effluent standards). The intent of technology-based effluent limits in NPDES permits is to require treatment of effluent concentrations to less than a maximum allowable standard for point source discharge to the specific surface water body. This is based on available treatment technologies, while allowing the discharger to use any available control technique to meet the limits.”).

²¹⁶ R. Reser, *supra* note 29, at 98.

²¹⁷ *Id.* at 99.

²¹⁸ *Id.*

²¹⁹ *Id.*

²²⁰ *Id.*

²²¹ *Id.*

²²² *Id.*

[and] natural gas liquids.”²²³ This exemption is of particular importance to the oil and gas industry.²²⁴

From another vantage point, because the hydraulic fracturing fluids may include other substances than the ones exempted, CERCLA empowers the EPA to issue remedial orders, instructing operators to redress contamination associated with the fracking fluids.²²⁵

d. Resource Conservation and Recovery Act

The provisions of subtitle C of RCRA sets forth “the federal standards for the management of hazardous [solid] wastes” from the stage of generation to disposal.²²⁶ The RCRA establishes stringent safeguards and waste management procedures in regulating hazardous solid wastes.²²⁷

Under the RCRA, the EPA may entrust the execution and enforcement of hazardous solid waste regulations with the states only when the state programs meet the federal regulations level of stringency.²²⁸ The stated overarching goals driving the enactment of the RCRA were essentially to ensure that:

- (1) It provides uniformity among the states as to how hazardous wastes are regulated.
- (2) It provides industry and commercial establishments that generate such wastes uniformity among states,
- (3) by providing such uniformity a state with environmentally sound laws does not drive business out of the state to a state which, for economic reasons, decides to be a dumping ground for hazardous programs equivalent to the federal program, the police power of the states that are [sic] utilized rather than the creation of another federal bureaucracy to implement this act.²²⁹

²²³ *Id.*

²²⁴ *Id.*

²²⁵ *Id.* (“Following an investigation, CERCLA section 106 authorizes the EPA to order a PRP to undertake certain remedial actions.”).

²²⁶ M. Burger *supra* note 10, at 1521.

²²⁷ R. Reser, *supra* note 29, at 99.

²²⁸ M. Burger *supra* note 10, at 1522–23.

²²⁹ H.R. REP. NO. 94-1491, at 30, *reprinted in* 1 ENV'T &

NAT. RES. POL'Y DIV., CONG. RSCH. SERV., A LEGISLATIVE HISTORY OF THE SOLID WASTE DISPOSAL ACT, AS AMENDED, TOGETHER WITH A SECTION-BY-SECTION INDEX 585, 558, 591 (COMM. PRINT 1991).

In 1980, Congress temporarily exempted wastes from the oil and gas exploration and production from the RCRA's federal hazardous waste regulation until the EPA determined later whether to include said wastes.²³⁰ Such a decision was justified by the fact that allegedly some of the EPA regulations governing drilling fluids, produced waters, and other oil and gas exploration and production wastes "could have a significant economic impact" on the industry, and further information on the degree of risk and the efficiency of existing state and federal programs was required.²³¹

In 1988, based on the EPA 1987 report,²³² the agency recommended that the federal regulation of oil and gas exploration and production wastes under the RCRA was unnecessary.²³³ Therefore, the EPA has never listed fracking waste as "hazardous waste."²³⁴ The position taken by the EPA "was premised on its finding that alternative regulations were infeasible, state regulations were adequate, and the economic harm suffered by the oil and gas industry would be severe."²³⁵

As a result, even though the fracking fluids include toxic chemicals, which would normally be regulated by the RCRA, the fracking operation wastes fall outside the scope of the statute.²³⁶

In 2010, several environmental groups represented by the Natural Resource Defense Council requested the EPA regulate hazardous waste created by exploring and producing oil and gas.²³⁷ Additionally, the petition demonstrated that fracking produces hazardous waste and that there are significant gaps in existing state regulatory regimes that necessitate federal intervention to fulfill the statute's purposes²³⁸

e. National Environmental Policy Act

NEPA's general purpose is to set forth national goals for the protection, maintenance, and enhancement of the environment.²³⁹ Within

²³⁰ M. Burger *supra* note 10, at 1523.

²³¹ *Id.*

²³² *Id.*

²³³ *Id.*

²³⁴ C. Morrison, *supra* note 57, at 100.

²³⁵ M. Burger *supra* note 10, at 1523.

²³⁶ R. Reser, *supra* note 29, at 99.

²³⁷ M. Burger *supra* note 10, at 1525.

²³⁸ *Id.* (RCRA's overarching concerns—providing nationwide protection from hazardous wastes and promoting uniformity among the states—would best be served by rescinding the regulatory exemption).

²³⁹ "The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environmental; to promote efforts which will prevent or eliminate damage to the environment and biosphere and

the context of shale gas operations, NEPA imposes “a thorough environmental impact analysis” for activities taking place on federal land.²⁴⁰

NEPA provides for three levels of environmental risk assessment requirements: 1) activities that fit within a categorical exclusion enjoy a low level of review or risk assessment requirements due to these activities’ insignificant impact on the environment; 2) an environmental assessment is required when there is a need to determine whether an activity necessitates an environmental impact statement; and, 3) an environmental impact statement, which is a comprehensive risk assessment tool that provides alternative actions, addresses unavoidable effects, and suggests other stringent requirements.²⁴¹

Strikingly, the EAct (2005) exempted certain oil and gas activities from stringent environmental review under NEPA.²⁴² Also the EAct specified that the oil and gas related activities, including fracking, fall within the categorical exclusion standard, which is the lowest level of scrutiny required by NEPA and does not allow public comment.²⁴³ In line with EAct policy, the US Bureau of Land Management exempted oil and gas companies who lease federal lands from the environmental impact statement.²⁴⁴

f. The Emergency Planning and Community Right to Know Act

The public’s access to information and statistics leading to rising, informed, public awareness and greater pressure on relevant authorities may play a major role in improving the enforcement of environmental laws and existing regulations.²⁴⁵

These transparency measures can contribute to filling data gaps in connection with the oil and gas industry in general and with respect fracking activities specifically.²⁴⁶

stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.” National Environmental Policy Act of 1969, Pub. L. No. 91-190, § 2, 83 Stat. 852 (1970).

²⁴⁰ Adams et al., *supra* note 7, at 579.

²⁴¹ *Id.*

²⁴² *Id.*

²⁴³ *Id.*

²⁴⁴ *Id.*

²⁴⁵ Paolo D. Farah & Riccardo Tremolada, *A comparison between Shale Gas in China and Unconventional Fuel Development in the United States: Water, Environmental Protection, and Sustainable Development*, 41 BROOK. J. INT’L L. 579, 622 (2016).

²⁴⁶ *Id.* at 623.

Passed in 1986, the EPCRA was intended to urge information disclosure with the goal of facilitating both decision makers and the public's access to relevant data, in addition to motivating fracking operators to diminish or stop hazardous or toxic chemicals' release.²⁴⁷

Under this statute, companies are under the obligation to file annual reports on the amounts of toxics released into the environment, or else recycled, treated, or disposed of in landfills.²⁴⁸ The reports are accessible online through the database called the Toxic Releases Inventory (TRI).²⁴⁹ The TRI is a searchable database maintained by the EPA, to inform and guide policy decisions of local communities and federal government about the toxic releases and waste-management activities.²⁵⁰

The statute only provides for the facilities in the manufacturing sector to file the reports with TRI; however, the EPA has the authority to add additional industry sectors at its discretion to the statutory list.²⁵¹ Similar to chemicals utilized in other oil and gas activities, the chemical composition of fracking fluids is carved out from the scope of EPCRA.²⁵² Hence, U.S. Shale gas companies are not required by federal law to disclose the chemicals being used for hydraulic fracturing.²⁵³

In 2012, a number of environmental groups led an initiative, known as the "Environmental Integrity Project" calling the EPA to place the oil and gas extraction industry on the list of those entities obligated to disclose toxic releases under the TRI.²⁵⁴ Among the elements that the EPA should weigh is whether disclosure by facilities within the oil and gas industry will increase the amount of information available or "otherwise further the purposes of [the] EPCRA."²⁵⁵ In examining this factor, the EPA's TRI analysis asks whether existing state and voluntary information disclosure rules provide adequate information to satisfy the EPCRA's purpose.²⁵⁶

Interestingly, eleven states where fracking operations are occurring have not adopted disclosure requirements, while the other half require drilling companies to reveal some, but not all chemicals used for

²⁴⁷ M. Burger *supra* note 10, at 1526.

²⁴⁸ Sheldon Leigh Jeter, *The Role of Risk Assessment, Risk Management, and Risk Communication in Environmental Law*, 4 S.C. ENVTL. L. J. 25, 46 (1995).

²⁴⁹ *Id.*

²⁵⁰ P. Farah & R. Tremolada, *supra* note 247, at 623.

²⁵¹ Jeter, *supra* note 250, at 46.

²⁵² 42 U.S.C. § 11004(a)(2)(B) (2006 & Supp. 2012); M. Burger, *supra* note 10, at 1527.

²⁵³ P. Farah & R. Tremolada, *supra* note 247, at 624.

²⁵⁴ M. Burger *supra* note 10, at 1527.

²⁵⁵ *Id.* at 1528.

²⁵⁶ *Id.* at 1526.

fracking.²⁵⁷ However, it is worth stressing that, Congress did not expressly exclude fracking from the scope of the EPCRA. In fact, it is a matter of proper implementation of the EPCRA. Simply put, it is up to the EPA to add the fracking industry to the TRI.²⁵⁸

Within the same context, it bears pointing out that there is no federal law or regulation that governs the disclosure of the chemical ingredients added to the fracturing fluids.²⁵⁹ The composition of fracturing fluids differs according to the characteristics and nature of the formation at issue; in general, the fluid contains mostly water, proppants (e.g. sand - to keep the fractures open), and a small percentage of chemical additives.²⁶⁰

Some of these additives have been characterized as “hazardous to health and the environment.”²⁶¹ For instance, the Shale Gas Production Subcommittee of the Secretary of Energy Advisory Board “has recommended public disclosure of all of the chemical ingredients added to the fracturing fluids,” while according a certain degree of protection to trade secrets.²⁶²

However, there are 15 states that enacted chemical disclosure laws, half of which require direct public disclosure of chemical information on the FracFocus chemical disclosure website.²⁶³ Few states give the disclosing parties a choice of either submitting the information to a publicly-accessible website comparable to FracFocus or to a state agency.²⁶⁴ Additionally, the disclosure’s timing and level of the detail vary from state to state. While a number of states impose the submission of material safety data sheets (MSDSs) for certain chemicals, the level of

²⁵⁷ P. Farah & R. Tremolada, *supra* note 247, at 623.

²⁵⁸ M. Burger *supra* note 10, at 1529.

²⁵⁹ R. Reser, *supra* note 29, at 99.

²⁶⁰ *Id.* at 93, 101.

²⁶¹ *Id.* at 101–02.

²⁶² *Id.* at 102.

²⁶³ R. Reser, *supra* note 29, at 102 (State regulations which require disclosure of chemical information on the FracFocus chemical disclosure website include: The Code of Colorado Regulations (Colo. Code Regs. §404-1:205A(b)(2)), North Dakota Administrative Code (N.D. Admin. Code 43-02-03-27.1(1)(g), (2)(h)), Texas Administrative Code (Texas Admin. Code §3.29(c)(2)(A)); *see also* BRANDON J. MURRILL, CONG. RES. SERV., HYDRAULIC FRACTURING: CHEMICAL DISCLOSURE REQUIREMENTS 5 (2012), <https://fas.org/sgp/crs/misc/R42461.pdf>.

²⁶⁴ Louisiana Administrative Code provides that the operator must make disclosures to the state agency or “furnish a statement signifying that the required information has been submitted” to the FracFocus site or a comparable registry, so long as “all information is accessible to the public free of charge.” *see* LA. ADMIN. CODE tit. 43, § 118(C)(1), (C)(4); *see also* B. MURRILL, *supra* note 263, at 5.

disclosure remains low.²⁶⁵ A number of state laws provide that “at least some disclosure of information about fracturing fluid chemical composition be disclosed” before fracturing takes place.²⁶⁶ It is worth noting that such requirements of disclosure of fluid chemical composition before fracturing rather than afterward turns out to be of limited usefulness.²⁶⁷ This is because the chemical mixtures of the fracturing fluids are adjusted as the process progresses.²⁶⁸ As a result, the disclosures provided before the fracturing stage “may not accurately reflect the actual chemicals that will be used.”²⁶⁹

The disclosure of the chemicals’ identities before and after the fracturing operations helps establish the chemicals baseline present in the water prior and after the gas extraction activities.²⁷⁰ By comparing the “baseline testing results” before the start of the operations with the results from post-fracking operations, an eventual “groundwater contamination” as well as its potential source will undoubtedly be detected with greater certainty.²⁷¹ From another perspective, in case of a spill or release, the prior knowledge of the fracking fluids chemicals would facilitate the mission of responding to and containing the emergency.²⁷²

B. *A Spectrum of Inconsistent State Fracking Approaches: From “Laissez Faire” to Outright Statewide Bans*

It follows from the above section that the federal government currently exempts most fracking activity from regulation and thus states are free to regulate practices as they see fit.²⁷³ For this reason the bulk of fracking regulation has been crafted at the state level. There currently exists a patchwork of state regulations, where each state enacts various

²⁶⁵ R. Reser, *supra* note 29, at 102.

²⁶⁶ *Id.*; Kentucky requires some disclosure at the permitting phase (805 KY. ADMIN. REGS.1:110 (2008)); see also Jeremy. I. Maynard, *Fracking the Oil and Gas Trade Secrets of the Marcellus Shale Natural Gas Play*, 6 KY. J. EQUINE AGRIC. & NAT. RESOURCES L. 161, 174 (2013).

²⁶⁷ R. Reser, *supra* note 29, at 104.

²⁶⁸ *Id.* at 104.

²⁶⁹ *Id.*

²⁷⁰ *Id.* at 103.

²⁷¹ *Id.* at 104 (citing AM. PETROLEUM INST., HYDRAULIC FRACTURING OPERATIONS WELL CONSTRUCTION AND INTEGRITY GUIDELINES §10.2 (2009), <http://www.api.org/-/media/Files/Policy/Exploration/APIHFI.ashx>). For more information on this issue, see MARY TIEMANN & ADAM VANN, CONG. RES. SERV., NO. R41760, HYDRAULIC FRACTURING AND SAFE DRINKING WATER ACT ISSUES (2015).

²⁷² *Id.* at 103–04.

²⁷³ See *supra* II. 1.

requirements for wastewater disposal, underground injection, water supply acquisition, drilling, casing and operating wells.²⁷⁴ The various state fracking regulations fall along a spectrum from outright statewide bans to a *laissez-faire* approach.²⁷⁵ This panoply is best exemplified by New York, Illinois, and Texas' fracking-related regulations. While New York is currently enforcing a statewide fracking ban, Texas has a long-standing fracking-friendly regulation, and Illinois stands in the middle of these two extremes by having enacted one of the most comprehensive regulatory frameworks governing almost all aspects of fracking.²⁷⁶

This section explores first (1) arguments advanced for trusting the states with regulating shale fracking operations, then turns to a (2) detailed analysis of the fracking regulations in the three chosen states.

1. *Arguments for trusting states with undertaking fracking risk assessment and management*

Proponents of “spotty” fracking regulation at the state level advance a number of arguments in support of such a stance.²⁷⁷ First, commentators on this side of the debate argue that more local and specialized regulation is better. This is primarily because the fracking technology is almost always geologic and region specific.²⁷⁸ Thus, additional federal regulation becomes unnecessary and potentially problematic if it conflicts with state controls.²⁷⁹ Opponents of re-establishment of a federal oversight on fracking activities argue that the states already provide for extensive environmental protections. They further consider that establishing a uniform system at a federal level would not only paralyze the state-centric system (which, they claim, has been working for decades without remarkable issues), but also creates overlapping controls, slowing down domestic oil and gas production in addition to generating a one-size-fits-all technological solution to fields of diversified geological characteristics.²⁸⁰ Additionally, it has been argued that the state officials are generally better equipped and more informed about local and regional production techniques than federal regulators.²⁸¹

²⁷⁴ See *infra* II. b.

²⁷⁵ *Id.*

²⁷⁶ *Id.*

²⁷⁷ See generally M. Willie, *supra* note 199.

²⁷⁸ *Id.* at 1772.

²⁷⁹ *Id.*

²⁷⁹ *Id.* at 1775–78.

²⁸¹ *Id.* at 1772.

Many also give the example that Congress struggled to craft effective mining legislation, despite the widespread expansion of national environmental protections throughout the last century because the geological and regional differences encouraged a state-centric regulatory scheme.²⁸² Such argument is advocated to be equally pertinent to the oil and gas industry.²⁸³ Decentralization adopts risk-management tools that are tailored more narrowly to specific local risk assessment data and more responsive to particular geographical environmental conditions.²⁸⁴

In line with these thoughts, commentators argue that fracking operations are either benign or hazardous depending on the shale formation.²⁸⁵ Thus, the stringency of fracking regulation should vary according to the shale location and characteristics.²⁸⁶ Therefore, it is argued that the fracking risk management decisions ought to be left to state policymakers and state regulatory agencies, who are better placed to take into account the importance of the geological dissimilarities between shale formations.²⁸⁷

Furthermore, as a result of the wide variety of geologic and regional specificities, the fracking fluids vary by field and formation.²⁸⁸ For instance, fracking operators in Montana have been reportedly using “mostly gel water sand frac[k], with the gel consisting of a drilling mud or polymer.”²⁸⁹ However, reports show that the fracking wastewater generated at the Pennsylvania’s Marcellus Shale is unexpectedly highly rich in radiation.²⁹⁰

Political accountability is another reason to favor state regulation because federal regulators are presumably less sensitive to local concerns mainly because bureaucrats reside far away from the shale gas formations subject of their federal directives.²⁹¹ It is strongly argued that decentralization generates decisions that are more democratic and more responsive to local preferences.²⁹²

²⁸² *Id.* at 1773.

²⁸³ *Id.* at 1774–75.

²⁸⁴ *Id.*

²⁸⁵ *Id.* at 1775.

²⁸⁶ *Id.*

²⁸⁷ *Id.* at 1775.

²⁸⁸ *Id.* at 1774.

²⁸⁹ H. Wiseman, *supra* note 35, at 141.

²⁹⁰ Don Hopey & Daniel Malloy, *Radiation in Fracking Fluid is a New Concern*, PITTSBURGH POST-GAZETTE (Feb. 28, 2011), <https://www.post-gazette.com/local/region/2011/03/01/Radiation-in-fracking-fluid-is-a-new-concern/stories/201103010626>.

²⁹¹ M. Willie, *supra* note 199, at 1773.

²⁹² M. Burger *supra* note 10, at 1491–92 (arguments supporting decentralization).

Additional rationales may corroborate the rhetoric opting for decentralization of fracking regulations. Numerous states may act as “laboratories of democracy” or experimentation to enhance innovation and creativity in resolving fracking-related issues.²⁹³ Decentralization might encourage inter-jurisdictional competition, which can lead to economically efficient regulation or even “a race to the top.”²⁹⁴

In the section below, the analysis of fracking regulations in three different jurisdictions demonstrates that the current state-centric system is replete with shortcomings. State approaches towards fracking varied dramatically from an outright statewide ban to a relaxed regulatory framework.²⁹⁵ These approaches range from unnecessarily stringent regulations to regulations replete with regulatory gaps. Additionally, the various state approaches fail to promote the collection of fracking related data needed for more certain fracking risk assessment studies, and thus more informed risk management decisions.²⁹⁶

2. *Comparative analysis of state fracking regulations*

This section explores fracking legal and regulatory frameworks in three states in the US, namely (a) New York, (b) Texas, and (c) Illinois. Each of these three states falls at a different position of the aforementioned spectrum, ranging from “laissez faire” (Texas) to outright statewide ban of fracking activities (New York).

a. *New York*

The Marcellus Shale in the State of New York is deemed as “one the largest shale formations in the country.”²⁹⁷ The type of natural gas found in this formation is thermogenic gas.²⁹⁸ It was determined that drilling vertical wells (i.e. conventional drilling method) into these formations was not an economically viable choice.²⁹⁹ Thus, advanced technology (i.e. horizontal drilling) was needed to render the development of shale gas cost-effective.³⁰⁰

²⁹³ *Id.*

²⁹⁴ *Id.* at 1492.

²⁹⁵ *See infra* II. b.

²⁹⁶ M. Burger *supra* note 10, at 1528–29.

²⁹⁷ D. Callies & C. Stone, *supra* note 174, at 28.

²⁹⁸ T. Hooker, *supra* note 189, at 872.

²⁹⁹ *Id.* at 873.

³⁰⁰ *Id.*

In 2009, the US Geological Survey assessed the Marcellus Shale at 84 trillion cubic feet of undiscovered, technically recoverable natural gas.³⁰¹ Other estimations consider the Marcellus Shale as the second largest volume of captured natural gas in the world and that it holds 489 trillion cubic feet of natural gas.³⁰² It is noteworthy that “the total annual rate of gas consumption in the US is only 25.5 trillion cubic feet.”³⁰³

New York Governor David Peterson imposed a statewide moratorium on fracking in December 2010.³⁰⁴ At the outset, it is worth précising the difference in meaning among the terms used such as moratorium, ban, and legal or executive moratorium or ban. A moratorium refers to a temporary suspension of a specific activity, whereas a ban imposes a general prohibition by legal means.³⁰⁵ A moratorium by law, or ban by law, is ban or moratorium that is approved by the legislature, whereas political ban or political moratorium is established by the executive branch.³⁰⁶

Fracking activities became one of the hottest political, legal, environmental, and commercial debates throughout New York State due to rising public concerns about the immense amount of water needed which must be disposed of, the little knowledge available about chemicals used for fracking, and the impacts of these factors on water resources.³⁰⁷ The proximity of the Marcellus Shale to the New York City and Syracuse Watersheds ignited public concerns that the fracking fluids injected into wells would contaminate drinking water.³⁰⁸

In July 2008, Governor Paterson directed the NY Department of Environmental Conservation (DEC) to update its 1992 Generic Environmental Impact Statement (GEIS) which governs oil and gas drilling in New York State (known as the supplemental GEIS, or SGEIS).³⁰⁹ In September 2009, a draft of the SGEIS was released for

³⁰¹ See U.S. GEOLOGICAL SURV., USGS RELEASES NEW ASSESSMENT OF GAS RESOURCES IN THE MARCELLUS SHALE, APPALACHIAN BASIN (August 23, 2011), <https://archive.usgs.gov/archive/sites/www.usgs.gov/newsroom/article.asp-ID=2893.html>.

³⁰² C. Bierstdt, *supra* note 110, at 645; see also Kelsey L. Hanson, *Hey New York. You Can Frack: An Examination of How Liquefied Petroleum Gas Sidesteps New York’s Fracking Ban to Provide a Legal and Practical Approach for Horizontal Drilling in New York’s Marcellus Shale*, 65 BUFF. L. REV. 375, 378 (2017).

³⁰³ K. Hanson, *supra* note 304, at 378.

³⁰⁴ D. Callies, & C. Stone, *supra* note 174, at 28.

³⁰⁵ RUVEN FLEMING, SHALE GAS, THE ENVIRONMENT AND ENERGY SECURITY 112 (Edward Elgar Publishing, 2017).

³⁰⁶ *Id.*

³⁰⁷ K. Hanson, *supra* note 304, at 378–380.

³⁰⁸ *Id.* at 379.

³⁰⁹ *Id.*

public comments.³¹⁰ The draft included that the “DEC found no substantive basis to believe that water quality [would] be degraded in the New York City watershed or any other watershed or aquifer.”³¹¹

Before the DEC issued its final SGEIS, the New York legislature passed a bill in November 2010 placing a moratorium on all vertical and horizontal hydro-fracking until 2011.³¹² Governor Paterson vetoed this bill for being “too broad” and for its potential to “halt hundreds of existing, productive vertical fracturing operations that were supporting many hundreds of jobs in New York.”³¹³ Notwithstanding his previous position, the Governor later signed Executive Order No. 41, which instructed further environmental investigation on the issue of fracking and “prohibited the DEC from issuing permits for hydraulic fracking activities until completion of the SGEIS and the elaboration of a regulatory regime specifically designed for such projects.”³¹⁴

Importantly even when Governor Cuomo took office in January 2011, his predecessor’s executive order remained in effect.³¹⁵ In June 2012, the DEC was considering permitting fracking activities only in five counties in the Southern Tier of New York. Confining fracking activities to these areas would have limited fracking operations to the deepest areas of the Marcellus Shale rock formation.³¹⁶ This would have been undertaken in an effort to reduce potential risks of groundwater contamination.

The final GEIS of June 2015 eventually provided for a statewide ban on high volume hydraulic fracturing (HVHF) across New York state.³¹⁷ It was revealed later on that keeping fracking operations out of specifically mapped environmentally sensitive areas would reportedly have effectively prevented fracking above 63% of the Marcellus Shale (the number of wells would be limited to fifty statewide).³¹⁸ Accordingly, a partial ban was deemed justifiable from a cost-benefit perspective. The limitation would result in “limited economic and social benefits that would be derived from High Volume Hydraulic Fracturing” and hence,

³¹⁰ *Id.* at 380.

³¹¹ *Id.*

³¹² *Id.*

³¹³ *Id.*

³¹⁴ *Id.* at 381 (quoting Peter J. Kiernan, *An Analysis of Hydrofracturing Gubernatorial Decision Making*, 5 ALB. GOV’T L. REV. 769, 780–81 (2012)).

³¹⁵ *Id.*

³¹⁶ *Id.*

³¹⁷ K. Hanson, *supra* note 304, at 381.

³¹⁸ R. Roddewig & W. Hughes, *Underbalanced Drilling: Can it Solve the Economic, Environmental and Regulatory Taking Problems Associated with Fracking*, 49 J. MARSHALL L. REV. 511, 530 (2015); *see also* K. Hanson, *supra* note 304, at 381.

“the No-Action alternative [was] the only reasonable alternative consistent with social, economic and other essential considerations.”³¹⁹ Interestingly, the New York DEC relied on a cost-benefit analysis, rather than risk assessment analysis, to depart from geographically-limited fracking operations.³²⁰

It is also worth highlighting that the final Supplemental GEIS banned only High-Volume Hydraulic Fracturing, which uses “300,000 or more gallons of water as the base fluid for hydraulic fracturing for all stages in a well completion,” not any other type of fracking that uses less quantity of water.³²¹

b. Texas

As shale gas fracking is booming in Texas, fracking-related “regulation and enforcement appear to be lagging behind.”³²² Texas’ fracking laws and regulations illustrate the shortcomings of allocating primary regulatory authority to the states, without a federal regulatory floor.³²³ In Texas, this has resulted in an alarming legislative and regulatory void with respect to water resources protection.³²⁴

i. Texas’ deficient UIC program

In the UIC context, Texas Natural Resources Code provides that the well construction standards and practices allow the evaluation of harms threatening water supplies.³²⁵ The state agency (Texas Railroad Commission) is also empowered to impose other requirements to curtail adverse environmental impacts on ground and surface water.³²⁶

In this context, Texas’ statute provides:

To prevent pollution of surface water or subsurface water in the state, the commission shall adopt and enforce rules

³¹⁹ K. Hanson, *supra* note 304, at 382 (quoting N.Y. STATE DEP’T OF ENVTL. CONSERVATION, FINAL SUPPL. GENERIC ENVTL. IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REG. PROGRAM: FINDINGS STATEMENT 1, 5 (2015)).

³²⁰ *Id.* (quoting N.Y. STATE DEP’T OF ENVTL. CONSERVATION, FINAL SUPPL. GENERIC ENVTL. IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REG. PROGRAM: FINDINGS STATEMENT 1, 2 n. 1 (2015)).

³²¹ *Id.*

³²² R. Reser, *supra* note 29, at 107.

³²³ *Id.* at 106–7.

³²⁴ *Id.*

³²⁵ E. Collins, *supra* note 69, at 132.

³²⁶ *Id.*

and orders and **may** issue permits relating to: 1) the drilling of exploratory wells and oil and gas wells or any purpose in connection with them, 2) the production of oil and gas . . . The commission shall adopt rules to establish groundwater protection requirements for operations that are within the jurisdiction of the commission, *including requirements relating to the depth of surface casing for wells.*³²⁷

At the outset, the statute uses a permissive language, suggesting that the agency “may issue permits,” hence it is not obliged to undertake any risk analysis to protect groundwater. The statute also merely requires uniform rules for every gas drilling and production, overlooking the specificity of fracking operations.³²⁸

Furthermore, the statute fails to provide minimum standards for ensuring the protection of groundwater. In this sense, Texas’ statute does not provide for specific conditions related to protection of groundwater which would result in the denial of a permit in the event of non-compliance.³²⁹ Texas’ rules and drilling applications do not require any additional information that allows the agency to restrict drilling and operations if a predictive model shows that water contamination may occur at a specific location.³³⁰

Moreover, the drilling application fails to include a clause that allows the Railroad Commission to obtain information necessary to model the potential for subsurface migration of fluids or methane from gas development operations.³³¹ This casts real doubts as to whether the current regulations assure the conduction of adequate risk assessment associated with the drilling operations.

Texas’ statute focuses more on well construction rules to ensure protection of groundwater. Nonetheless, the statute fails to expressly and clearly require the state to evaluate risks associated with the contemplated fracking operations prior to issuing a permit.

Texas agency’s regulations and drilling application do not require the provision of any additional fracturing data, despite the breadth of the role attributed to the agency on protecting groundwater under Texas statute’s language. This data is extremely important for the agency to deny

³²⁷ Tex. Nat. Res. Code Ann. §§ 91.101 (a)(1)-(2), 1015 (West 2013) (emphasis added).

³²⁸ E. Collins, *supra* note 69, at 132.

³²⁹ *Id.*

³³⁰ *Id.* at 133.

³³¹ *Id.*

drilling and operations if a predictive model shows that adverse environmental impacts are imminent.³³²

ii. *Failure to regulate the use of potable groundwater for shale gas fracking activities*

Chapter 36 of the Texas Water Code exempts the use of potable groundwater for an oil and gas exploration permit.³³³ This exemption means that fracking operators are allowed “to drill as many water wells as they want and use as much fresh groundwater as they need with few restrictions or guidelines.”³³⁴ No permit is required for pumping fresh groundwater so long as this water is used for oil and gas activities.³³⁵ Strangely enough, a permit is only required when fracking operators use brackish water.³³⁶ The Railroad Commission issued only 33 of such permits in 2012.³³⁷

iii. *Shortcomings of Texas’ chemical disclosure law: Texas House Bill 33228*

In 2011, Texas enacted the House Bill 3328, which required operators of fracking activities to disclose the chemical composition of their fracking fluids.³³⁸ Nonetheless, the statute includes an exception for chemicals classified as trade secrets.³³⁹ Therefore, the Texas Railroad Commission must determine a process for fracking operators to “withhold and declare certain information as a trade secret.”³⁴⁰

Additionally, the chemical disclosure requirement provision does not apply retroactively, hence, the fracking operations that commenced before February 1, 2012, are not subject to the disclosure requirement.³⁴¹ Therefore, “hundreds of thousands of pre-existing drilling operations are

³³² *Id.* at 132.

³³³ R. Reser, *supra* note 29, at 105–06.

³³⁴ *Id.* at 106.

³³⁵ *Id.*

³³⁶ R. Reser, *supra* note 29, at 106. Brackish water (less commonly brack water) is saltwater and fresh water mixed together. It is saltier than fresh water, but not as salty as seawater. It may result from mixing of seawater with fresh water, as in estuaries, or it may occur in brackish fossil aquifers. *See Brackish Water*, EUROPEAN ENV’T AGENCY, <https://www.eea.europa.eu/archived/archived-content-water-topic/wise-help-centre/glossary-definitions/brackish-water> (last visited Aug. 27, 2020).

³³⁷ R. Reser, *supra* note 28, at 106.

³³⁸ K. Watson, *supra* note 30, at 352.

³³⁹ *See* Tex. Nat. Res. Code Ann. § 91.851(a)(3) (West 2011 & Supp. 2012).

³⁴⁰ K. Watson, *supra* note 30, at 352.

³⁴¹ *Id.* at 365.

not required to disclose the components of the fracking fluid used in their well” regardless of whether or not the chemicals are trade secrets.³⁴²

Texas HB 3328 presents a number of deficiencies. The Bill initially required the approval of the Railroad Commission in order for an operator to obtain trade secret exemption from the disclosure requirement.³⁴³ However, the final enacted version omitted the upfront requirement for the Commission’s approval of the trade secret claim.³⁴⁴ Rather, the enacted statute directed the Commission to prescribe a process whereby an operator can claim the components are a trade secret.³⁴⁵ The Commission did not prescribe a process that scrutinizes the credibility of an operator’s claim for trade secret protection; rather, the Commission prescribed a process that lists limitations applicable to potential challengers of an operator’s trade secret claim.³⁴⁶ In other words, an operator does not need the approval of the commission to take advantage of the trade secret exemption from the disclosure requirement under HB 3328, whereas a challenger to the trade secret protection must comply with a number of conditions, including: 1) a 2-year statute of limitations, and 2) the challenger must be the landowner, an adjacent landowner, or a government agency.³⁴⁷ No authority is tasked with overseeing operators in respect of the requirements for trade secret claims, while restrictions are imposed on the challengers.³⁴⁸

Additionally, the Commission would request an operator “to substantiate its trade secret protection claim only *after* a challenge to the claim has been asserted.”³⁴⁹ Simply put, the fracking operators are not required to proffer evidence in order to claim trade secret protection; rather, evidence is only requested when the claim is challenged.³⁵⁰ Hence, Texas HB 3328 offers fracking operators the opportunity to easily circumvent the disclosure requirements.³⁵¹ Such regulatory relaxation is concerning as it encourages a significant number of exemptions to be claimed (in 2012, one year from the enactment of the disclosure law, fracking operators claimed 10,000 exemptions).³⁵²

³⁴² *Id.* at 365–366.

³⁴³ *Id.* at 364; *see also* H.B. 3328, 82d Leg., Reg. Sess. § 91.856 (Tex. 2011).

³⁴⁴ K. Watson, *supra* note 30, at 364.

³⁴⁵ *Id.* at 363; *see also* H.B. 3328, 82d Leg., Reg. Sess. § 91.853 (Tex. 2011).

³⁴⁶ K. Watson, *supra* note 30, at 364.

³⁴⁷ *Id.*

³⁴⁸ *Id.*

³⁴⁹ *Id.*

³⁵⁰ *Id.* at 365; *see also* H.B. 3328, 82d Leg., Reg. Sess. § 91.853 (Tex. 2011).

³⁵¹ K. Watson, *supra* note 30, at 365.

³⁵² *Id.*

Furthermore, even the operations that are subject to the disclosure requirement must comply with such obligation after the completion of the fracking.³⁵³ As a result, the fracking chemicals are disclosed only after having been used. Environmentalists and the public may understandably question the purpose of such a disclosure requirement, as the supposed damage may have already been done.³⁵⁴

c. Illinois

Commentators who are in favor of allocating fracking regulatory authority to the states often advance the state of Illinois as illustrative of the ability of states to adopt fracking regulations that make better sense and suit the needs of its citizens.³⁵⁵ This is because, in 2013, Illinois passed “a major comprehensive statute to regulate fracking,” the Hydraulic Fracturing Regulatory Act (HFRA).³⁵⁶ The HFRA has been deemed so far “the nation’s strictest regulations for natural gas drilling.”³⁵⁷

In fact, the HFRA imposes a number of restrictive requirements on fracking operators, notably: a high volume horizontal hydraulic fracturing permit is required for each fracking well developed,³⁵⁸ all chemicals anticipated to be added to or used as hydraulic fracturing fluid must be disclosed in the permit application as well as its concentration and “mass;”³⁵⁹ each application for a permit requires a plan for the handling, storage, transportation, disposal, or reuse of the fluids, together with a traffic management, containment, and plugging and restoration plan;³⁶⁰ and water quality monitoring of all water sources likely to be affected by the process of fracking.³⁶¹ In addition to the drilling permit required by the Oil and Gas Act, a specific permit for horizontal hydraulic fracturing is also required,³⁶² “fracking operations will be

³⁵³ *Id.* at 366

³⁵⁴ *Id.*

³⁵⁵ D. Callies & C. Stone, *supra* note 174, at 26; *see also* E. Collins, *supra* note 69, at 119, 142–144.

³⁵⁶ D. Callies & C. Stone, *supra* note 174, at 26.

³⁵⁷ *Id.*

³⁵⁸ Ill. Hydraulic Fracturing Regulatory Act, 2013 Ill. Legis. Serv. P.A. 98-22 (West) (codified in 225 ILL. COMP. STAT. 732 (2013)), §1-30 (a).

³⁵⁹ *Id.* at §1-35 (8), § 1-35 (8) (c), § 1-35 (8) (d).

³⁶⁰ *Id.* at § 1-35 (b) (11), § 1-35 (b) (13), § 1-35 (b) (14), § 1-35 (b) (18).

³⁶¹ *Id.* at §1-80.

³⁶² *Id.* at §1-30 (a); *see also* Illinois Oil and Gas Act, 225 ILL. COMP. STAT. ANN. 725/6(1) (2013), 725/6(2), 725/6.1 (setting forth requirements for drilling permit).

conducted in a manner that will protect the public health and safety and prevent pollution or diminution of any water source.”³⁶³

It is worth stressing that, under the HFRA, the burden falls upon the permit applicant to show the safety of the shale gas development operations to the state agency.³⁶⁴ Thus, the high volume horizontal hydraulic fracturing operations must at no time pose a threat to public health, safety, or the environment.³⁶⁵ This requirement is “completely unique to Illinois.”³⁶⁶

In the UIC context, the Illinois Oil and Gas Act charged Illinois’ Natural Resources Department with requiring:

The drilling casing and plugging of wells to be done in such a manner as to prevent the migration of oil or gas from one stratum to another; to prevent the intrusion of water into oil, gas or coal strata; [and] to prevent the pollution of fresh water supplies by oil, gas or salt water.³⁶⁷

Illinois’ Oil and Gas Act requires developers to obtain a drilling permit.³⁶⁸ It further requires that the application for permit provide for the well location, the depth, and other information required by the Department of Natural Resources.³⁶⁹

The HFRA added another layer of sophistication to Illinois’ UIC program. Not only did the HFRA replicate many of the federal UIC regulatory requirements, it added further provisions, notably in relation

³⁶³ Ill. Hydraulic Fracturing Regulatory Act, 2013 Ill. Legis. Serv. P.A. 98-22, § 1-53 (a) (4), § 1-75(a)(2); *see also* E. Collins, *supra* note 69, at 142.

³⁶⁴ Applicants must submit along with the permit application plans and proofs of compliance with conditions included in section 1-35 of HFRA. *See* Ill. Hydraulic Fracturing Regulatory Act, 2013 Ill. Legis. Serv. P.A. 98-22, § 1- 35; *see also* §§ 1-53 (a) (3) and (4) (providing that a permit shall only be issued “if the record of decision demonstrates that... the plans required to be submitted with the application under section 1-35 of this Act are adequate and effective” and “the proposed hydraulic fracturing operations will be conducted in a manner that will protect the public health and safety and prevent pollution or pollution or diminution of any water source”).

³⁶⁵ *Id.* at § 1-75 (a) (2) (providing “[a]ll phased of high volume horizontal hydraulic fracturing operations shall be conducted in a manner that shall not pose a significant risk to public health, life, property, aquatic life, or wildlife”).

³⁶⁶ E. Collins, *supra* note 69, at 142.

³⁶⁷ 255 ILL. COMP. STAT. ANN. 725/6(1) (2013).

³⁶⁸ *Id.* at 725/6(2), 725/6.1.

³⁶⁹ E. Collins, *supra* note 69, at 142.

to “planning and evaluation . . . of proper use and management of water supply quantities.”³⁷⁰

The HFRA sets forth with great specificity what an application for UIC permit must include.³⁷¹ Importantly, the state may deny an application for a permit, if the applicant fails to submit satisfactory information.³⁷² The HFRA is clearly “an *environmental* permitting and enforcement statute for shale gas development instead of a traditional well location and construction statute.”³⁷³ This feature of the HFRA is lacking in most oil and gas development statutes in the rest of the states.

III. SUGGESTIONS AND RECOMMENDATIONS

This section suggests and explores solutions at both the structural level and substantive level with the goal of enhancing fracking risk assessment and management in the US.

A. *Structural Solutions to Enhance Fracking Risk Assessment and Management*

The structural solutions addressed in this section are three-fold: (1) shared regulatory authority between federal and state level, (2) creation of a national commission for fracking wastewater disposal, and (3) establishment of one spot-shop for fracking permits.

1. *Shared regulatory authority governing fracking activities*

This subsection argues that a shared regulatory authority between the federal government and the states would ensure a minimum federal regulatory floor that would serve like a safety valve to protect water resources from potential threats posed by hydraulic fracturing.

The controversy surrounding the risks posed by fracking operations has been exacerbated because fracking has been exempt, as analyzed above, in important ways from several federal environmental laws including but not limited to the SDWA, the CWA, the RCRA, the CERCLA, and the EPCRA.

³⁷⁰ *Id.*; see also Ill. Hydraulic Fracturing Regulatory Act, 2013 Ill. Legis. Serv. P.A. 98-22, §§ 1-35 (b) (10), 1-75 (e).

³⁷¹ *Id.*; see also Ill. Hydraulic Fracturing Regulatory Act, 2013 Ill. Legis. Serv. P.A. 98-22, §§ 1-35 (b) (6) (C), (E).

³⁷² *Id.*

³⁷³ *Id.* at 142–43.

This analysis addresses the question of whether the assessment and management of fracking risks should flow from a national or state level and seeks to discern which level of governance is most appropriate by considering the number of factors. This paper argues that the status quo (the state-centric system) does not adequately deal with fracking's potential impacts on underground drinking-water supplies.

Many analysts advocate that fracking-related risk assessments and risk management would be most effective if it came from the Congress and the EPA rather than from a patchwork of state regulations.³⁷⁴ This would arguably yield a certain consistency and visibility for the fracking industry.³⁷⁵ Additionally, regulation at the federal level would “ensure that the residents of every state are equally protected from any harmful fracking effects.”³⁷⁶

There are essentially two conceptions of what represents an appropriate sharing/division of regulatory authority, namely dual federalism, and cooperative federalism.³⁷⁷

Dual federalism emphasizes the centrality of state autonomy. It reflects relation of conflict between federal and state governments.³⁷⁸ It views the federal government as one with limited purposes and powers.³⁷⁹ Additionally, it maintains that the federal and the states “are sovereign within their separate spheres.”³⁸⁰

Unlike dual federalism, which seeks to divide the US into exclusive power domains, cooperative federalism, emphasizes partnership between federal and state governments.³⁸¹

The advocates of federal minimum oversight call for cooperative federalism in dealing with fracking regulations. The cooperative federalism emphasizes partnership between the federal government and the states, rather than calling for dividing governance into exclusive power domains between federal and state authorities.³⁸² Cooperative federalism maintains that states and the federal government often operate in areas of overlapping authority and jurisdiction.³⁸³

Various arguments in favor of a minimum federal oversight are noteworthy. First, fracking's generation of “interstate externalities”

³⁷⁴ C. Bierstedt, *supra* note 110, at 659.

³⁷⁵ *Id.* at 659–60.

³⁷⁶ *Id.* at 660.

³⁷⁷ M. Burger *supra* note 10, at 1489–90.

³⁷⁸ *Id.* at 1489.

³⁷⁹ *Id.*

³⁸⁰ *Id.*

³⁸¹ *Id.*

³⁸² *Id.* at 1498.

³⁸³ *Id.*

makes a federal response crucial.³⁸⁴ Second, federalization is likely to solve “the problem of the ‘race to the bottom’” in which state and local governments compete to give more concessions in order to attract fracking companies.³⁸⁵ The federal uniformity in the regulation of fracking activities provides economic efficiencies to the regulated entities.³⁸⁶ Centralization can pool resources for gathering technical information, generating reliable scientific knowledge, creating durable rules, and enhancing enforcement.³⁸⁷ Centralization may also enable a “different balance of interest group influence.”³⁸⁸ Lastly, federalization can attenuate the “not in my backyard” attitude often evident in the conflicts surrounding the siting of hazardous waste disposal sites and other locally undesirable land uses.³⁸⁹

States should not be left as free riders in regulating fracking’s impacts on water resources. For instance, states that are sensitive to fracking waste risks may choose to ban fracking wastewater disposal within their states, rather than banning fracking altogether. This policy may lead to states lacking strong environmental regulations and pro-environment politicians in office being the dumping location of fracking wastes, including wastewater transported from states with more stringent fracking wastewater disposal regulations.³⁹⁰ This is illustrative of the situations where the states become vulnerable to political influences of the gas industry and economic forces, and compete among themselves to adopt lax environmental regulations resulting in the “race to the bottom” phenomenon.³⁹¹ Additionally, the oil and gas industry lobby has significant sway, especially in smaller state and local areas, making these locations particularly susceptible to its relentless search for lower fracking wastes disposal costs.³⁹²

In sum, with the proliferation of fracking activities across the US, the risks of interstate pollution increase the need for a federal response.

³⁸⁴ *Id.* at 1490.

³⁸⁵ *Id.*

³⁸⁶ *Id.*

³⁸⁷ *Id.* at 1491.

³⁸⁸ *Id.*

³⁸⁹ *Id.*

³⁹⁰ C. Morrison *supra* note 56, at 107–08.

³⁹¹ M. Burger *supra* note 10, at 1490.

³⁹² C. Morrison *supra* note 56, at 108–09.

2. *Creation of federal commission for fracking wastewater disposal*

Fracking lacks regulation in three main areas: 1) “oversight of and accountability for onsite fracking processes,”³⁹³ 2) oversight of fracking fluid chemicals, which are often insulated from disclosure under trademarks claims, and 3) monitoring fracking fluids storage and disposal, including the underground injection of fracking wastewater in underground wells.³⁹⁴

Therefore, the need seems crucial for the creation of a national commission to regulate and enforce the laws governing fracking wastewater disposal in the US. Observers propose that the commission be named “Fracking Waste Disposal Regulatory Commission” (FWDRC).³⁹⁵

To guarantee effective monitoring, it is recommended that the Commission have regional headquarters with short distances from the fracking sites.³⁹⁶

Another factor for the commission to attain its objectives is to guarantee its neutrality. In fact, observers deem that the “most crucial component of creating any new authority would be minimizing the risk of agency capture, whereby those charged with regulating an industry actually serve the interests of the industry.”³⁹⁷ The concept of agency neutrality is of paramount importance because it deters manipulation of the risk assessment and management processes.³⁹⁸

Scholarship deemed that agency capture stands behind the fact that the “federal government’s leadership in fracking regulation has been paralyzed.”³⁹⁹ Therefore, in order to efficiently address the fracking-related risk assessment and management challenges, measures should be taken to minimize agency capture. For instance, candidates for the position of commissioner who previously worked for the oil and gas industry, or owned interest in an oil and gas entity, should be restrained from being appointed.⁴⁰⁰ Another less stringent proposal would suggest a “cooling period” where the candidates for the position of commissioner should not have worked for an oil or gas entity or have had oil and gas

³⁹³ *Id.* at 111.

³⁹⁴ *Id.*

³⁹⁵ *Id.*

³⁹⁶ *Id.* at 111–12.

³⁹⁷ *Id.*

³⁹⁸ *Id.* at 113.

³⁹⁹ Michael Burger, *Fracking and Federalism Choice*, 161 U. PA. L. REV. 150, 157 (2012).

⁴⁰⁰ C. Morrison, *supra* note 57, at 112–13.

interests for the last ten years.⁴⁰¹ Another measure consists of including a non-compete clause in employment contracts, which would impede the commissioner of seeking jobs in the oil and gas industry at the end of their mandates with the commission.⁴⁰²

3. *One-stop shop for fracking permits*

One of the solutions to achieve more efficient risk analysis with respect to authorizing fracking operations is “to create a ‘one-stop shop’ for federal fracking permits within the EPA or a state agency that has been delegated to implement federal environmental statutes.”⁴⁰³ The creation of such a body would help coordinate the permitting process under the various applicable federal statutes and deriving regulatory requirements, such as the CWA (for surface-level wastewater disposal), SDWA (for underground injection of wastewater and underground injection of fracking fluid that includes diesel fuel), and the TSCA (for disclosure of chemical content), and any probable subsequent requirement under RCRA, EPCRA, or CERCLA.⁴⁰⁴ The same body may also grant permits necessary for underground injection of fracking fluids in states that require a permit under their UIC programs, similar to UIC programs under SDWA.⁴⁰⁵ Additionally, Congress may revoke the 2005 EPA Act’s exemption and bring UIC permitting into the same consolidated process.⁴⁰⁶

B. *Substantive Solutions to Enhance Fracking Risk Assessment and Management*

The substantive solutions suggested in this subsection are three-fold: (1) repealing fracking exemptions from most of federal environmental statutes, (2) setting a federal floor of requisite fracking data at the fracking permitting stage, and (3) imposing federal requirements for fracking fluid chemical disclosures along the different process stages.

⁴⁰¹ *Id.* at 113.

⁴⁰² *Id.*

⁴⁰³ M. Burger *supra* note 10, at 1536.

⁴⁰⁴ *Id.*

⁴⁰⁵ *Id.*

⁴⁰⁶ *Id.*

1. *Repealing fracking exemptions from federal environmental statutes and regulations: SDWA, CWA, EPCRA, NEPA, RCRA, CERCLA, EPCRA*

Crafting a fracking regulatory framework that strikes a balance between the various competing interests appears to be the most adequate solution. As analyzed above, a minimum federal oversight of fracking activities is indispensable, and thus, the federal statutes should not be exempting fracking activities from their scope. To the contrary, the existing exemptions should be repealed and replaced with adequate provisions that would efficiently govern the fracking activities.

For instance, Congress should repeal the exemption for fracking in the SDWA by crafting a language that makes “underground injection of fluids used for fracking” fall within the scope of “underground injection” concept.⁴⁰⁷ Thus, fracking operators injecting fracking fluids in underground wells, no matter where their operations are located, would be subject the federal UIC’s Class II well requirements.

2. *Federal requirement for provision of fracking-related data*

At the outset, it is worth stressing that permitting schemes that do not require needed information for informative risk assessment do more to license harm than prevent it. Therefore, it is recommended that Congress imposes the use of predictive models of underground contamination to be incorporated into all states’ UIC permitting processes, to ensure fracking operations’ compliance with these minimal federal standards.⁴⁰⁸

Furthermore, the imposition of baseline water testing and continual water testing at regular intervals both during and after drilling is recommended. Such practices would provide invaluable empirical data to achieve an objective and more certain fracking risk assessment. Water testing is not new and has been done in fracking studies, but the testing requirement must be imposed by federal law, not left to state legislatures’ discretion. In fact, except for Illinois’ HAFRA where water testing is required before and during fracking operations, water baseline and interval testing is not required by any other state fracking regulation.⁴⁰⁹

Additionally, an independent third party must be conducting the water testing to ensure the integrity of the results. Federal fracking regulations can take a further step by imposing testing of the soil prior to, during, and immediately after the fracking operations.

⁴⁰⁷ C. Bierstedt, *supra* note 110, at 661.

⁴⁰⁸ E. Collins, *supra* note 69, at 144.

⁴⁰⁹ *Id.* at 142–44.

If such federal fracking regulatory requirements are followed nationwide, this would help monitor levels of contamination, if any occurs, over the entire life cycle of the process. Additionally, it would achieve greater credibility and certainty with respect to any conclusion drawn.

3. Federal requirement for fracking fluid chemicals disclosure

In order to enhance transparency within shale gas exploration and extraction operations, we propose that fracking operators be under the obligation to timely and effectively disclose the composition of fracking fluids used, including any chemicals mixed therein. The proposed solution is two-fold. First, fracking operators will be under the obligation to disclose the complete composition of the chemicals used in the exploration and extraction operations. The disclosure must occur prior to conducting any fracking operation and post completing the operations. The level of detail of the disclosure and the timing are of paramount importance to ensure that chemical disclosure obligation achieve its goals. Therefore, this recommendation emphasizes the need for public disclosure of all of the chemical ingredients added to fracking fluids, on a well-by-well basis. Also, it is worth emphasizing that the disclosure must take place prior to conducting any fracking operations and post-completion of the fracking within a predetermined time frame, such as within 30 days.

Second, trade secret protections must not strip the fracking chemical disclosure obligation of its efficiency. The requirement for detailed chemical disclosures may conflict with proprietary rights pertaining to the chemicals used. Therefore, the trade secret protections should be crafted and interpreted restrictively. Additionally, the Commission in charge must prescribe a process to determine whether a fracking operator's claim for trade secret protections should be upheld. Additionally, the process must make sure that any withheld information associated with the chemical composition of fracking wastewater should be conveyed to a third party (e.g. recyclers) acquiring the fracking wastewater for purposes of disposal or treatment. The owner of the fracking wastewater and the acquiring party, to whom the waste is transferred, may enter into a non-disclosure agreement, confidentiality agreement, or any other equivalent agreement. The agreement may provide for a damages recovery remedy in the event of a breach of the terms of confidentiality.

CONCLUSION

Hydraulic fracturing will remain a hot button issue, and debates in relation to this topic will continue to play out in federal and state legislatures, agencies, courtrooms, and the front pages of newspapers.

The analysis of the current state-centric system regulating the shale gas fracking reveals critical shortcomings and serious regulatory gaps, which justify the rising calls for federal governmental intervention to ensure, at a minimum, a federal fracking regulation floor.

A federal regulatory floor does not necessarily require preemption of current state oil and gas statutes; rather, states will continue to enjoy primacy over the environmental permitting and the various fracking regulatory aspects. This paper simply advocates for a “cooperative effort” in which the federal legal and regulatory arsenals assist, reinforce, set minimum standards, and step in whenever state and local efforts seem to be inadequate.

At a structural level, this paper recommends that fracking regulatory authority ought to be shared by both the federal government and states; a national commission for fracking waste disposal should be created; and a one-stop shop to be established for the issuance of fracking operations permits.

At a substantive level, this paper suggests that the exemption of fracking activities from most of the federal statutes and regulations dealing with water resources protection should be repealed. Additionally, minimum federal obligations requiring fracking operators to provide indispensable fracking data should be established, regardless of whether or not they were required to do so under state and local regulations. This solution brings a remedy to the fracking data gaps. The availability of adequate fracking-related information contributes to greater certainty in fracking risk assessment, which leads to more informed fracking risk management policies.