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A Unifying Doctrine of Subsurface Property Rights

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A UNIFYING DOCTRINE OF SUBSURFACE PROPERTY RIGHTS

*Joseph A. Schremmer**

This Article advances the “fair opportunity doctrine,” a theory of subsurface property rights that systematizes the case law in this confused area using formal legal reasoning. This theory offers a jurisprudential approach to analyzing private law that can then be applied to the field of subsurface property. This approach emphasizes the law’s role in providing ex ante guidance to members of a community in ordering their affairs and interactions with others and the importance of coherence in that function. On this basis, the “fair opportunity doctrine” improves substantially on the current state of subsurface property law and demonstrates the potential application of this methodological approach in many other areas of private law in general and natural resources property law in particular.

The “fair opportunity doctrine” follows from the basic, unifying principle of subsurface property law: each rights holder within a common subsurface resource is entitled to a co-equal, fair opportunity to use a proportional share of the resource for beneficial purposes. The doctrine holds that a subsurface rights holder is liable for the infringement of another’s rights only when three elements are satisfied: (1) an act by the defendant (2) causes a physical invasion of the plaintiff’s property boundaries and (3) damages the plaintiff either by (a) harming its ongoing subsurface activities or (b) depriving it of a fair opportunity to use the subsurface or produce its contents, unless the defendant has made a fair, reasonable, and nondiscriminatory offer to participate in the activity.

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INTRODUCTION

Suppose a tech entrepreneur wants to dig traffic tunnels deep underground to alleviate surface congestion in urban areas,¹ or a company seeks to capture carbon dioxide emissions and inject them into a deep geologic formation to fight climate change,² or a renewable energy developer wishes to use a geologic formation as a sort of battery to store energy generated from wind turbines on the overlying land.³

In each of these cases, and many similar situations, the general legal questions will arise: What rights do landowners have to conduct or authorize subsurface activity that stretches beyond their own property, and what limits, if any, may neighboring landowners impose? It is surprisingly challenging to find

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1. See Mark Vaughn, *Elon Musk's Boring Company Completes First Mile Long Vegas Tunnel*, AUTOWEEK (Apr. 12, 2021), <https://perma.cc/RM8Q-MVZB>.
 2. See Hannah Grover, *Enchant Energy CEO Says 2021 About Pushing San Juan Generating Station Project over Finish Line*, FARMINGTON DAILY TIMES (Jan. 8, 2021), <https://perma.cc/6MBG-2Q56>.
 3. See Plamena Tisheva, *ESB, dCarbonX to Work on Subsurface Storage of Hydrogen*, RENEWABLES NOW (May 28, 2021), <https://perma.cc/NM5Y-73CY>. See generally Catarina R. Matos et al., *Overview of Large-Scale Underground Energy Storage Techniques for Integration of Renewable Energies and Criteria for Reservoir Identification*, 21 J. ENERGY STORAGE 241 (2019).

answers to these questions in the case law and literature, and this presents an obstacle to the widespread deployment of subsurface projects in the United States. Others have blamed this situation, in part, on a lack of law and scholarship concerning property rights in the earth's subsurface.⁴ But this is not the problem. On the contrary, there is a deep body of relevant case law and literature to be found in a field that property scholars often overlook: oil and gas law.

Oil and gas law has grappled with a number of difficult questions about ownership and use of the deep subsurface. Examples of this include whether an oil and gas developer with a lease prohibiting drilling on the surface of the land may access the underlying minerals by drilling horizontally through an adjacent tract,⁵ whether oil and gas owners can recover damages for the draining of minerals under their land by a neighbor's hydraulically fractured ("fracked") gas well,⁶ or whether a chemical manufacturer is liable for chemical waste injected under its land that migrates to a neighbor's.⁷ This body of law contains the principles necessary to answer the legal questions currently stymieing further development of all manner of mineral and non-mineral subsurface resources.⁸

Thus, it is not for a lack of law that subsurface property rights seem underdeveloped. Rather, the problem is that this body of law is so fragmented and disorganized that its principles, and the system of property rights and liabilities that emanates from them, are obscure. This obscurity prevents the development of useable norms to guide decision-making by all participants in the legal system. Lacking doctrinal guidance, lawyers and judges often eschew traditional doctrinal reasoning altogether in favor of a functional approach in which they seek ad hoc policy reasons for resolving novel and difficult cases. In so doing, courts render judgment on the basis of vague, subjective notions, like the public interest, and thereby render the law even more difficult to predict and rely on. Doctrinal fragmentation, functionalism, and disorganization therefore feed a vicious cycle in which incoherence begets more incoherence.

This Article is primarily an effort to unify and organize the law of deep subsurface property. It seeks to reveal the field's inner theoretical coherence and make it easier to understand, remember, and apply in practice. In Oliver Wendell Holmes's words, this Article attempts to "systematize" the law.⁹ Systematizing the law will not only aid the kinds of projects noted above, but will also clarify oil and gas law by unifying the multitude of fragmented doctrines that

4. John G. Sprankling, *Owning the Center of the Earth*, 55 UCLA L. REV. 979, 981 n.1 (2008).

5. See *Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, 520 S.W.3d 39 (Tex. 2017).

6. See *Coastal Oil & Gas Corp. v. Garza Energy Tr.*, 268 S.W.3d 1 (Tex. 2008). On fracking, see *infra* note 51.

7. See *Chance v. BP Chems., Inc.*, 670 N.E.2d 985 (Ohio 1996).

8. See generally Joseph A. Schremmer, *Pore Space Property*, 2021 UTAH L. REV. 1 (2021) (demonstrating how oil and gas property principles apply to pore space).

9. Oliver W. Holmes, *The Path of the Law*, 10 HARV. L. REV. 457, 458 (1897).

comprise the law of oil and gas property.¹⁰ The Article synthesizes an objective, coherent, and intelligible doctrinal framework to guide people in the use and enjoyment of subsurface property and to resolve the growing number of novel and difficult disputes that have tested the bounds of the law in recent years.¹¹

While this project shares Holmes's goal of systematizing the law, it rejects his jurisprudential approach to doing so, in favor of one that is formal. Holmes famously viewed private law as an instrumental means of serving public or social purposes extrinsic to the law itself.¹² He criticized the practice of treating legal rules as authoritative and decisive merely because they are rules¹³ and instead pressed for the reshaping of law "with conscious articulate reference to the end in view."¹⁴ In contrast, this Article seeks to understand and restate the law from an *internal* perspective, one which focuses on the legal doctrine itself rather than its external social consequences.¹⁵ This approach also embraces making decisions and reshaping the law on the basis of legal rules and standards—"formal" reasoning—rather than on the basis of economic, political, institu-

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10. These include the *ad coelum* doctrine, the rule of capture, the negative rule of capture, the doctrine of correlative rights, the doctrine of waste, and subsurface trespass, to name some of the most well-known. See *infra* Part I.B.1.
 11. In its pursuit of this goal and in its general methodology, this Article's approach is similar to that of the New Private Law or New Formalism. See generally Paul B. Miller, *The New Formalism in Private Law*, 66 AM. J. JURIS. 175, 196 (2021) ("The new formalism is a methodology built upon the notion that the law's core function is that of providing practically reasonable guidance to its addressees in authoritative settlement of conflict and/or coordination issues that arise within political communities.").
 12. See Holmes, *supra* note 9, at 466; see also Paul B. Miller & Jeffrey A. Pojanowski, *The Internal Point of View in Private Law*, 67 AM. J. JURIS. (forthcoming 2022) (manuscript at 2), <https://perma.cc/H8NA-BH2X>. Relatedly, in analyzing the law, Holmes took the viewpoint of the "bad man," or the person who only seeks to avoid the law's sanctions or to benefit from another's liability under the law rather than from the point of view of a person who seeks to understand and comply with the law as a matter of moral or legal obligation. See Holmes, *supra* note 9, at 459; Miller & Pojanowski, *supra*, at 2.
 13. Holmes, *supra* note 9, at 469 ("It is revolting to have no better reason for a rule of law than that so it was laid down in the time of Henry IV. It is still more revolting if the grounds upon which it was laid down have vanished long since, and the rule simply persists from blind imitation of the past.").
 14. *Id.*
 15. See *infra* Parts II.A–B (discussing the internal versus external point of view in private law theory). In analyzing the law from an internal point of view, this Article joins something of a scholarly revival of legal formalism within private law theory. See Miller, *supra* note 11, at 175–77; Andrew S. Gold, *Internal and External Perspectives: On the New Private Law Methodology*, in THE OXFORD HANDBOOK OF NEW PRIVATE LAW 1–2 (Andrew S. Gold et al., eds. 2020) (discussing the rise in the 1980s and 1990s of scholars interpreting private law from an internal point of view); Thomas C. Grey, *The New Formalism* 4–5 (Stanford L. Sch. Pub. L. & Legal Theory Working Paper Series, Paper No. 4, 1999), <https://perma.cc/HJ3P-MPZ4> (describing what he calls the "new formalism").

tional, or other social ends—“substantive” reasoning.¹⁶ In these ways, Holmes represents a “functional” jurisprudential approach that is distinct from the “formal” approach adopted here.¹⁷

The formal approach rests on the following basic premise: that legal doctrine should provide sound practical guidance to property owners in how to order their affairs and deal with others in securing the use and enjoyment of their property, and that the ultimate source of usable guidance is the law’s internal *coherence*. Excessive functionalism leads to doctrinal *incoherence* by introducing extrinsic substantive considerations that are inherently uncertain. The uncertainty of functional doctrine undermines the law’s ability to provide useable guidance and, in the case of subsurface resources, depresses socially beneficial development of the subsurface.

The Article begins in Part I with a description of the nature of subsurface resources and the current state of subsurface property law, and that Part concludes by discussing the contemporary need for an intelligible doctrine of subsurface property rights. Part II engages with recent private law literature to develop an internal approach and methodology for recasting the law of subsurface property into a formal doctrine. This approach emphasizes the law’s function of providing normative guidance to participants in the legal system.¹⁸ Based on this premise, Part II develops criteria to evaluate the success of a formalist theory and a step-by-step process for applying the formal method to a particular field of law.

Parts III and IV apply the formal method to synthesize a theory of subsurface property rights, which I call the “fair opportunity doctrine.” The analysis focuses on the physical nature of subsurface resources and the case-law treatment of subsurface rights to identify the unifying concept that governs the relationship among owners within a common subsurface resource: each owner has a co-equal, fair opportunity to use or enjoy a proportional amount of a resource. From this unifying principle, the analysis derives a three-element test for determining when a party has injured the legal rights of a subsurface property owner. The elements are: (1) an act by the defendant that (2) causes a physical invasion of the plaintiff’s property boundaries and (3) damages the plaintiff either by (a) harming its ongoing subsurface activities or (b) depriving it of a fair opportunity

16. These definitions of “formal” and “substantive” reasoning are from P.S. ATIYAH & ROBERT SUMMERS, *FORM AND SUBSTANCE IN ANGLO-AMERICAN LAW* 2 (1987). By “rules,” I mean abstract, generally applicable legal norms that are authoritative for decision-making. I include in that definition both hard-and-fast rules and flexible standards, to the extent they do not render judgment primarily on the basis of substantive considerations. *See id.* at 71.

17. My purpose is not to debate Holmes’s jurisprudence itself. Rather, I am only using Holmes as a representative of functional jurisprudence, which I criticize as needed to defend the formal approach I develop and use to systematize subsurface property. *See infra* Part II.C (addressing the functional approach).

18. *See* Miller, *supra* note 11, at 198.

to use the subsurface or produce its contents, unless the defendant has made a fair, reasonable, and nondiscriminatory offer to participate in the activity.

Although these three elements fit most cases, Part IV expands the fair opportunity doctrine to account for a line of cases that are left out: ones involving “waste” of oil and gas resources. In private law, “waste” is an act by the defendant that interferes with the plaintiff’s opportunity to use or produce a proportionate part of a common resource for beneficial purposes, and thereby reduces the total net value of the common resource available to all the owners.¹⁹ Because waste does not require a physical invasion of the plaintiff’s property boundaries, it is left out of the primary test. Together, the fair opportunity principle and the prohibition against waste generate a unified theory of subsurface property that fits the existing case law, coheres around a unifying principle, and excludes external substantive considerations that lead to incoherence.

Moreover, the fair opportunity doctrine effectively coordinates communities of owners of interconnected subsurface resources. It delimits how far an owner can go in using a common subsurface resource without infringing on the rights of other owners. It encourages owners to cooperate and use the resource holistically. By furnishing relatively clear, *ex ante* guidance, the doctrine reduces the legal risks of undertaking subsurface projects and may render economic some (perhaps many) marginal projects that otherwise would have been abandoned or never pursued. The positive social consequences of the fair opportunity doctrine, therefore, are substantial. Consequently, the theory may also be justified on the grounds that it achieves greater social benefit from the use of subsurface resources than a functional approach could.²⁰

Finally, Part V discusses how the formal approach developed here could apply beyond subsurface property law and may provide a starting point for a larger project of systematizing property and natural resources law in general.

I. SUBSURFACE PROPERTY: BACKGROUND

A. Defining the “Subsurface”

This Article is concerned with property rights in the earth’s deep subsurface. “Subsurface,” as I use it in this Article, encompasses the various structures, void spaces, and substances that comprise those portions of the earth’s crust that are below the immediate reaches of the surface. Much as “airspace” is often

19. Tara K. Righetti & Joseph A. Schremmer, *Waste and Governance of Public and Private Property*, 93 U. COLO. L. REV. 609, 611–12 (2022).

20. I do not mean to concede by this statement that the theory *must* be defended on functionalist or empirical grounds, but only that it *can* be. *But see* Cass R. Sunstein, *Must Formalism Be Defended Empirically?*, 66 U. CHI. L. REV. 636, 641 (1999) (asserting that formal theories can and must be justified, if at all, empirically).

used in legal contexts to reference the area above the “immediate reaches of the enveloping atmosphere” where a landowner may have exclusive control,²¹ the term “subsurface” references the area below the immediate reaches of the surface where an ordinary landowner may have exclusive control.²²

The earth’s subsurface consists of layered and pressurized geologic formations (sometimes called “strata” or “zones”) of sedimentary and metamorphic rock.²³ Sedimentary formations contain microscopic void pore spaces that trap natural gas and fluids such as saltwater and oil. Within any given formation, these pore spaces are interconnected so as to make the formation permeable. Permeability allows the trapped fluids to migrate throughout the formation in response to changes in formation pressure.²⁴ The extent of the porosity and permeability of formations varies significantly. The most porous and permeable formations are aquifers, which contain water, and reservoirs, which contain oil or natural gas.²⁵ Oil and natural gas may also be found in formations that are porous but relatively impermeable. Oil and gas production from these “tight” formations relies on “unconventional” development techniques, i.e., horizontal drilling and large-volume hydraulic fracturing.²⁶

Numerous natural resources are found within these formations. In addition to oil and gas reservoirs, these formations also contain naturally occurring geothermic heat, which can be mined for energy.²⁷ And porosity (the volume of

21. *United States v. Causby*, 328 U.S. 256, 264 (1946); *see also* RESTATEMENT (SECOND) OF TORTS § 159 cmts. j–m (AM. L. INST. 1969) (discussing *Causby* and defining airspace trespass with reference to intrusions into the “immediate reaches” of the atmosphere).

22. Not unlike the precise point where the immediate reaches of the atmosphere end and “airspace” begins, the precise point where the deep subsurface begins is murky, and efforts to define the point with specificity are problematic. *See, e.g.*, Sprankling, *supra* note 4, at 1033–38 (attempting to define models of ownership within the crust). It is not essential to define the precise depth at which the deep subsurface begins, as the same general principles apply to the use of the shallow subsurface. Consider the doctrine of lateral support, which holds that the owner of land is entitled to have its soil supported by the soil of adjoining lands, such that “if A’s neighbor excavates on his land so near to the line and in such way that the soil of A’s land in its natural state sinks as a result thereof, the neighbor thereby commits an act of trespass against A’s land.” Elmer M. Leesman, *The Significance of the Doctrine of Lateral Support as a Real Property Right*, 16 ILL. L. REV. 108, 108–09 (1921). That doctrine, which applies to the immediate reaches of the subsurface, imposes mutual, or correlative, rights and duties on the relationship between neighboring landowners in how they excavate below their land. Thus, the rights of landowners in the shallow subsurface are interdependent just as they are at deeper depths. *See infra* Part III.A.

23. Joseph A. Schremmer, *Getting Past Possession: Subsurface Property Disputes as Nuisances*, 95 WASH. L. REV. 315, 320 (2020).

24. *Id.*

25. Schremmer, *supra* note 8, at 7–8, 7 n.22. Shales are a common type of tight formation.

26. PATRICK H. MARTIN ET AL., *THE LAW OF OIL AND GAS: CASES AND MATERIALS* 15–16 (11th ed. 2022).

27. *See generally* GEOTHERMAL ENERGY: UTILIZATION AND TECHNOLOGY (Mary H. Dickson & Mario Fanelli eds., 2005).

pore spaces within a rock) itself is increasingly useful for the sequestration of oilfield and industrial wastes and human-generated carbon dioxide, as well as the storage of natural gas and renewably generated energy.²⁸ Each of these subsurface resources shares a distinctive physical nature (described below) and is subject to the principles of subsurface property delineated below.

Not all subsurface natural resources are subject to the principles synthesized in this Article. Solid, non-migratory minerals like coal or uranium, despite being located underground, are subject to different doctrinal and statutory provisions, owing to their different physical characteristics. Unlike the subsurface resources treated here, which are generally fluid, interconnected, and nonexcludable, solid minerals do not migrate and are fully excludable, even when buried in the deep subsurface.²⁹ Groundwater is also excluded from the fair opportunity doctrine. Although it shares the basic physical nature of the other subsurface resources the doctrine describes—being fluid, interconnected, and nonexcludable—groundwater is essential to human life and, to a degree, capable of regeneration. These traits arguably distinguish groundwater from the kinds of property subject to the fair opportunity doctrine.³⁰ More importantly, groundwater is subject to specialized common law doctrines and statutory regimes that vary widely across jurisdictions and differ from the doctrines developed in oil and gas law.³¹

The physical attributes of subsurface geologic formations, and of the substances contained within them, influence the structure of property rights in these resources. Formations are interconnected by their porosity and permeabil-

28. See *infra* Part I.C.

29. Cf. *Gerhard v. Stephens*, 442 P.2d 692, 704 (Cal. 1968) (noting the “practical difference between oil and gas and solid minerals: the latter remain in place beneath the surface of land, but the former, fugacious and vagrant may be drawn from beneath the surface of other lands”).

30. See *Coyote Lake Ranch, LLC v. City of Lubbock*, 498 S.W.3d 53, 63–64 (Tex. 2016) (“We acknowledged the important difference between water and hydrocarbons: water is an ‘often . . . renewable,’ ‘life-sustaining’ resource used for ‘drinking[,] recreation, agriculture, and the environment,’ while oil and gas are ‘essentially non-renewable . . . commodit[ies] for energy and in manufacturing.” (quoting *Edwards Aquifer Auth. v. Day*, 369 S.W.3d 814, 831 (Tex. 2012))).

31. For a survey of these various groundwater laws, see generally Joseph W. Dellapenna, *A Primer on Groundwater Law*, 49 IDAHO L. REV. 265 (2013). If we were to ignore the specialized groundwater doctrines and statutes and apply the traditional common law principles that are more or less retained within oil and gas law, groundwater certainly could be synthesized with oil and gas and pore space in the fair opportunity doctrine. Indeed, I drew the connections among these resources in Schremmer, *supra* note 8, at 22–27. Only Texas, however, still applies the traditional common law doctrines of *ad coelum* and the rule of capture to groundwater. See Dellapenna, *supra*, at 274; see also *Edwards Aquifer Auth.*, 369 S.W.3d at 831 (holding that principles of oil and gas reservoirs apply to groundwater in Texas). As a consequence, the fair opportunity doctrine synthesized here can fairly be said to apply to Texas groundwater law.

ity, such that penetration of a formation by a wellbore affects the pressures and fluids in the wellbore's vicinity.³² Thus, when a landowner drills a well to extract oil or gas from a common reservoir, the wellbore decreases the surrounding pressure and allows fluids to drain into the wellbore, possibly even from beneath the land of others. Likewise, when an owner drills a well to inject fluids into the pore space of a common formation, the injection increases the surrounding pressure and pushes the fluid out into the reservoir, possibly even beneath others' land.³³ The ability of one landowner's activities within a common formation to influence conditions under other owners' land and interfere with others' subsurface activities means that no owner can claim exclusive control over the formation. In short, subsurface resources are nonexcludable.

By virtue of this nonexcludability, subsurface resources are best described as a "semicommons."³⁴ Semicommons are resources held in common by a limited group of owners.³⁵ Membership within the community of a given subsurface semicommons is determined based on the ownership of the surface of the overlying land.³⁶ Reflecting the physical attributes of subsurface resources themselves, property rights in a subsurface semicommons are nonexclusive. Owners may use a common formation or its contents—even parts of it that extend beyond the boundaries of their surface land—but cannot exclusively possess any portion of it—even the portions within the boundaries of their land.³⁷ One owner's use of a subsurface semicommons can easily interfere with the corresponding (correlative) rights of another common owner to also use the resource.

Accordingly, competing uses of a semicommons, such as the subsurface, must be coordinated in some fashion to avoid a "tragedy of the commons."³⁸ This task entails great difficulty, as the vast academic literature on the subject reflects.³⁹ Coordinating norms in any given semicommons may be found in cus-

32. Schremmer, *supra* note 8, at 7–11.

33. *Id.*

34. *Id.* So, too, are groundwater resources. *Id.*

35. *Id.* at 10; see also generally ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 3–28 (Canto Classics 2015) (1990) (discussing "common pool resources" and the various approaches to governing the cooperation and coordination of owners with interests in them).

36. See *infra* Part III.A. The concept of membership within a subsurface or "reservoir" community is David Pierce's. David E. Pierce, *Employing a Reservoir Community Analysis to Define and Marshall Correlative Rights in the Oil and Gas Reservoir*, 76 LA. L. REV. 787, 803–04 (2016).

37. Schremmer, *supra* note 23, at 375–76.

38. *Id.*

39. *Id.* The need for coordination and the various means of achieving it within a semicommons is the topic of Elinor Ostrom's Nobel Prize-winning work as well as much of Carol Rose's work. See OSTROM, *supra* note 35; see, e.g., Carol M. Rose, *Expanding the Choices for the Global Commons: Comparing Newfangled Tradable Allowance Schemes to Old-Fashioned Common Property Regimes*, 10 DUKE ENV'T L. & POL'Y F. 45 (1999).

tom, contract, or law.⁴⁰ Legal norms for commons governance often take one of two competing approaches: extensive privatization or “illiberal communitarian solutions,” although intermediate approaches that combine elements of both are possible.⁴¹ I have previously contended that effective coordination of semicommon subsurface resources requires relatively flexible and context-sensitive standards of governance that are more like nuisance than trespass.⁴² Ultimately, the theory of subsurface property rights synthesized in this Article coordinates competing uses of semicommon subsurface resources through standards that regulate the outer limits of permissible activity and enable cooperation among competing owners within those limits.

B. *The Present State of the Law*

As presently constituted, the law fails to generate a coherent doctrine for coordinating the correlative rights of members in subsurface semicommons. There are two aspects to this failure. First, the law has fragmented into numerous individual doctrines that do not easily coalesce into a unified system of rights and liabilities. Second, courts have adopted functionalist standards to determine liability for subsurface property invasions, which often turn on policy considerations and courts’ notions of the interests of the oil and gas industry and society at large. Together, fragmentation and functionalism have rendered the case law of subsurface property rights incoherent and unable to guide the coordination of subsurface semicommons.

1. *Fragmentation*

There currently is no single doctrine of subsurface property rights. Instead, several individual doctrines have developed to govern different aspects of the use of common subsurface reservoirs. It is not obvious how these different doctrines fit together into a unified system. Lacking a systematic view of these disparate rules and standards, courts often struggle in novel and difficult cases to determine which to apply. Moreover, the fragmentation of this area has obscured what doctrines rightly fit under the general heading of subsurface rights,

40. See Carol M. Rose, *Given-ness and Gift: Property and the Quest for Environmental Ethics*, 24 ENV'T L. 1, 26–27 (1994).

41. See also Hanoch Dagan & Michael A. Heller, *The Liberal Commons*, 110 YALE L.J. 549, 551–52 (2001). Much of Dagan and Heller’s work on “liberal commons” seeks to combine elements of privatization and regulation to coordinate the use of semicommons property. The fair opportunity and waste doctrines that I synthesize here and in other work essentially function as a “liberal commons” in that they regulate certain aspects of the use of subsurface resources while enabling cooperation among owners to coordinate their uses in private. See Righetti & Schremmer, *supra* note 19, at 662–64 (discussing the principle underpinning waste doctrine as a form of “liberal commons”).

42. Schremmer, *supra* note 23, at 333–42.

perhaps even contributing to the belief that there is little law governing the subsurface.⁴³

The leading oil and gas treatises reveal the fragmentation. Rather than speaking of a unified field of subsurface rights, treatises disaggregate the topic into numerous individual subjects and organize them into practical categories of activity rather than on the basis of the underlying legal concepts. These categories include the *ad coelum* doctrine, the rule of capture, injection for disposal, injection for secondary recovery (sometimes called the “negative rule of capture”), the doctrine of waste, negligent or intentional injury to reservoirs, the doctrine of correlative rights, subsurface trespass, and subsurface trespass by fluid injection or gas storage.⁴⁴ Within the doctrine of correlative rights alone, treatise writers distinguish numerous individual rights and duties, which carries the fragmentation even further.⁴⁵

Parts III and IV give a detailed account of these various doctrines while relocating each of them within the unified fair opportunity doctrine. For present purposes, however, a brief description of some of the foundational doctrines suffices to illustrate the fragmentation in this field.

Under the *ad coelum* doctrine, the owner of land owns all of the rock and substances underlying the land, stretching to the center of the earth.⁴⁶ Under the rule of capture, this owner may drill a well on its land and drain oil or gas from anywhere within the reservoir, including from beneath the land of a neighbor.⁴⁷ The negative rule of capture privileges the same landowner to inject fluid into the subsurface, even when it migrates under the land of a neighbor.⁴⁸ But these rights are limited to an extent by two additional doctrines: correlative rights and subsurface trespass. The correlative rights doctrine holds that owners in a common reservoir have mutual rights to use the reservoir and duties not to injure the common source of supply or take from it an “undue” portion.⁴⁹ Subsurface trespass doctrine prohibits the drilling of a well into a neighbor’s subsurface to produce oil and gas directly from their portion of a reservoir.⁵⁰

These doctrines have proven difficult to reconcile with one another. This has been a particularly acute problem in disputes involving horizontal drilling

43. See, e.g., Sprankling, *supra* note 4, at 981 n.1.

44. See, e.g., 1 PATRICK H. MARTIN & BRUCE M. KRAMER, WILLIAMS & MEYERS, OIL AND GAS LAW §§ 204.4–204.7, 227, 228 (Matthew Bender & Co. 2020); 1 KUNTZ, LAW OF OIL AND GAS §§ 4.1–4.8, 11.9 (2019). One treatise, *Summers Oil and Gas*, organizes and addresses these topics more cohesively in Sections 2 and 3. 1 NANCY SAINT-PAUL, SUMMERS OIL AND GAS §§ 2–3 (3d ed. 2020).

45. 1 KUNTZ, *supra* note 44, §§ 4.1–4.8; 1 SUMMERS, *supra* note 44, § 3:3 (describing correlative rights as “a bundle of legal rights and duties”).

46. See *infra* Part III.A.

47. *Infra* Part III.A.

48. See *infra* Part III.D.1.

49. See *infra* Part III.A.

50. See *infra* Part III.A.

and hydraulic fracturing technologies.⁵¹ Consider, for example, how the doctrines fit together (or not) when an oil and gas company with rights in a natural gas reservoir hydraulically fractures a well, sending fractures through the formation into the subsurface of a neighboring tract and draining gas from that tract. In the first precedential case to directly consider the question, *Coastal Oil & Gas Corp. v. Garza Energy Trust*,⁵² the Texas Supreme Court held that transboundary fracking is not actionable, yet the justices could not agree as to which of the various doctrines should control. The majority held that the rule of capture applied, privileging the transboundary fracking; the dissent took the contrary view that the subsurface trespass doctrine should apply, as the frack fissures drained oil in a similar manner as a trespassing wellbore.⁵³ The inability to reconcile these two doctrines seems to have led the justices to rely instead on policy considerations to resolve the issue.⁵⁴

Scholars are also divided in their views of which doctrine should control. Owen Anderson analyzes the question under a version of the doctrine of subsurface trespass and argues that invasions to effect “socially beneficial” uses should be privileged, so long as they do not cause actual damage.⁵⁵ David Pierce, on the other hand, argues that correlative rights doctrine, not trespass, applies and that disputes should be resolved based on whether the invasion is reasonably necessary to efficiently produce oil and gas from the reservoir.⁵⁶

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51. Briefly, horizontal drilling involves drilling wellbores laterally through a single oil and gas-bearing formation, which permits vastly more contact with the formation than drilling a conventional wellbore vertically through the formation. Horizontal wellbores (laterals) can be over a mile in length. See MARTIN, *supra* note 26, at 12 (discussing horizontal drilling and fracking). Fracking is a technique for stimulating production from oil and gas-bearing reservoirs. It is often utilized where the rock is “tight” because it has little natural permeability, such as unconventional shale formations. Fracking creates artificial permeability in the rock by fracturing it with large volumes of water, proppants (which remain in the formation to hold open the fracture), and chemicals injected into a well at high pressure. The resulting fractures or “frack fissures” extend laterally from the wellbore. They vary in length but are typically thousands of feet long. Each fissure has a “hydraulic length”—the total distance the fracture traveled, a shorter “propped length”—the farthest distance the proppants traveled to hold open the fracture, and a shorter “effective length”—the portion of the fracture that actually permits oil or gas to flow to the wellbore. *Coastal Oil & Gas Corp. v. Garza Energy Tr.*, 268 S.W.3d 1, 7 (Tex. 2008).
 52. 268 S.W.3d 1 (Tex. 2008).
 53. Compare *id.* at 13–14, with *id.* at 38 (Willett, J., concurring), and *id.* at 43–45 (Johnson, J., concurring in part). A “wellbore” is simply the hole made by a well. *Petro Pro, Ltd. v. Upland Res., Inc.* 279 S.W.3d 743, 751 (Tex. App. 2007).
 54. See *supra* text accompanying notes 44–49.
 55. See generally Owen L. Anderson, *Subsurface “Trespass:” A Man’s Subsurface Is Not His Castle*, 49 WASHBURN L.J. 247, 255–81 (2010) (arguing for application of the Restatement’s version of modified airspace trespass to the subsurface).
 56. David E. Pierce, *Carol Rose Comes to the Oil Patch: Modern Property Analysis Applied to Modern Reservoir Problems*, 19 PENN ST. ENV’T L. REV. 241, 247–50 (2011) (formulating a “reservoir community analysis” to determine intra-reservoir disputes).

There has been no successful effort to reconcile the doctrines or to demonstrate that they can coexist. The body of subsurface law as presently constituted cannot reconcile its most basic constituent principles.

2. *Functionalism*

This fragmentation contributes to the second source of incoherence in subsurface property law: the predominance of substantive (as opposed to formal) reasoning through the application of highly contextualized and subjective functionalist standards. Despite the laundry list of available doctrines governing subsurface rights, courts often eschew formal doctrinal analysis and instead apply less formal and more contextualized standards. Reliance on this reasoning elevates policy considerations like economics, special interests, politics, and institutional concerns. The influence of functionalism is especially prevalent in modern courts' application of subsurface trespass. Despite its name, modern subsurface trespass has assimilated principles of Restatement-style nuisance law, which require a showing of actual harm and wide-ranging utility balancing to determine whether a "trespass" occurred.⁵⁷

To illustrate this point, consider again the example of transboundary fracking. Unable to agree about whether an authoritative doctrinal reason exists for determining whether sending fractures across property lines is actionable, the divided *Garza* court relied instead on substantive reasons.⁵⁸ The majority based its conclusion that transboundary fracking is privileged on considerations of administrability and the institutional competence of courts as compared to oil and gas regulatory agencies, the economic and social importance of mineral development, and the preferences of the oil and gas industry as expressed in amicus curiae briefs.⁵⁹ All of these considerations, in the majority's view, favored wide use of hydraulic fracturing, which in turn justified excluding fracking from the traditional rules of trespass.⁶⁰ The concurring justice differed from the majority only on the particulars of the economic and political justifications for the decision.⁶¹ In his view, the common law could "ill afford" to limit hydraulic fracturing because energy demand was high, contributing to "\$145 a barrel crude and \$4 a gallon gasoline."⁶²

The dissenting justices took a different view of the social implications of hydraulic fracturing. Conceding, at least implicitly, that the question should

57. Schremmer, *supra* note 23, at 342–43; see also Henry E. Smith, *The Persistence of System in Property Law*, 163 U. PA. L. REV. 2055, 2078–80 (2015) (discussing the "assimilation of nuisance to trespass" as part of the realist agenda for property law reform).

58. *Garza*, 268 S.W.3d at 14–17.

59. *Id.*

60. *Id.*

61. *Id.* at 26–27 (Willett, J., concurring).

62. *Id.*

come down to a balancing of societal, industry, and landowner interests, the dissent criticized the balance struck by the majority because it might disadvantage small and unsophisticated mineral owners who lack the know-how to frack a well of their own.⁶³ Courts outside of Texas are split along similar policy divides. When a West Virginia federal court took up the same question, it held the fracking to be actionable, finding the *Garza* dissent's policy to be persuasive.⁶⁴ On the other hand, while declining to address the question directly, the Pennsylvania Supreme Court recently rejected the dissent's policy rationale.⁶⁵

*Lightning Oil Co. v. Anadarko E&P Onshore, LLC*⁶⁶ furnishes another recent example of the functionalism prevalent in subsurface property law.⁶⁷ The court considered whether the owner of a severed mineral estate, Lightning Oil, was entitled to enjoin a neighboring mineral estate owner, Anadarko, from drilling horizontal wellbores through the subsurface of the land where Lightning Oil's mineral estate was located to access Anadarko's neighboring mineral estate.⁶⁸ Anadarko claimed the right to do so pursuant to a lease it had received from the owner of the surface estate overlying Lightning Oil's minerals.⁶⁹ The court acknowledged that some of Lightning's oil and gas would be destroyed in the process but held that no trespass would occur because the harm was insignificant compared with the interests of Anadarko and the public at large in incentivizing the use of horizontal drilling.⁷⁰

In so holding, the court distinguished an earlier case, *Chevron Oil Co. v. Howell*,⁷¹ in which the court held that it would be a trespass for Chevron to drill a horizontal wellbore through Howell's mineral rights with only the permission of the overlying surface owner.⁷² As in *Lightning*, testimony in *Howell* established that the proposed drilling would cause "some damage" to the minerals.⁷³ Yet, writing in 1966—well before the unconventional drilling revolution that the *Lightning* court expressly wished to support—the *Howell* court did not consider the importance of horizontal drilling to the industry or the public and did not conceive that the utility of Chevron's proposed horizontal drilling may justify the (likely small) harm to plaintiff's minerals.⁷⁴ Therefore, *Lightning* ap-

63. *Id.* at 45–47 (Johnson, J., dissenting).

64. *Stone v. Chesapeake Appalachia, LLC*, No. 5:12-CV-102, 2013 WL 2097397 (N.D. W. Va. Apr. 10, 2013).

65. *Briggs v. Sw. Energy Prod. Co.*, 224 A.3d 334, 347–49 (Pa. 2020).

66. 520 S.W.3d 39 (Tex. 2017).

67. *See id.*

68. *See id.* at 46.

69. *Id.* at 49.

70. *Id.* at 51.

71. 407 S.W.2d 525 (Tex. Civ. App. 1966).

72. *Id.* at 528.

73. *Id.*

74. *See id.*

pears to be distinguishable from *Howell* on the basis of the court's perception of horizontal drilling's evolving social utility rather than on any factual or legal difference.⁷⁵

Similarly, in *Crawford v. Hrabe*,⁷⁶ the Kansas Supreme Court considered an oil and gas lessor's allegations of subsurface trespass against its lessee for disposing of off-lease water on the lessor's land.⁷⁷ After reviewing precedent, the court admitted that "[w]hile our discussion of trespass cases is helpful, it is not conclusive."⁷⁸ To decide the case, the court turned instead "to consideration of the economics and practical usage of salt water disposal or other water in a secondary recovery operation" and ultimately found that the increased economic productivity from such operations justified any interference with the lessor's interests.⁷⁹ The Texas Supreme Court, on the other hand, suggested in *FPL Farming Ltd. v. Environmental Processing Systems, L.C.*,⁸⁰ that the social and economic value of wastewater disposal would not justify privileging any resulting subsurface invasions.⁸¹ Nevertheless, the court indicated that invasions caused by injection of substances for secondary or enhanced oil and gas recovery might justify a privilege for resulting invasions, because injection for these purposes encourages economically valuable oil and gas recovery.⁸² Under this view, whether injecting saltwater into the ground is immune from trespass liability depends on a court's judgment about how much social or economic benefit the injection directly generates.

These illustrative cases demonstrate the predominance of substantive over formal reasoning. The opinions rely on economic, political, institutional, and other substantive considerations rather than on doctrine. As a consequence, there appears to be no authoritative, generally applicable legal norm by which judgment may be rendered in these cases.⁸³ When discussing doctrine at all, they give it only cursory treatment and, as in *Crawford*, often subordinate it to "consideration[s] of . . . economics and practical usage."⁸⁴ To the extent the

75. The *Lightning* court did not attempt to distinguish *Howell* except to suggest, without explanation, that the case involved "slightly different circumstances." *Lightning*, 520 S.W.3d at 46.

76. 44 P.3d 442 (Kan. 2002).

77. *Id.* at 444.

78. *Id.* at 452.

79. *Id.*

80. 351 S.W.3d 306 (Tex. 2011).

81. *Id.* at 314.

82. *Id.*

83. See Paul N. Cox, *An Interpretation and (Partial) Defense of Legal Formalism*, 36 IND. L. REV. 57, 59–68 (2003) (explaining the formalist notion of autonomous conceptions). Dickinson observed that doctrine "supplies a structure for [judges'] thought to follow, [and] draws a sketch map for [them] of the way into and through a case." John Dickinson, *Legal Rules: Their Function in the Process of Decision*, 79 U. PA. L. REV. 833, 849 (1931).

84. *Crawford v. Hrabe*, 44 P.3d 442, 452 (Kan. 2002).

decisions speak of legal doctrine, they tend to articulate vague balancing tests that weigh parties' interests with that of the oil and gas industry and the public at large, thereby inviting consideration of extra-legal, and often hotly contested, issues.⁸⁵

In yet another case, *Chance v. BP Chemicals, Inc.*,⁸⁶ the court summarily replaced traditional doctrine with an entirely new, and more flexible, rule.⁸⁷ There, the Ohio Supreme Court held that the plaintiffs' subsurface property interest included the right to exclude only invasions that actually interfere with the plaintiffs' reasonable and foreseeable use of the surface of the land.⁸⁸ In support of this holding—which supplanted the traditional doctrines of *ad coelum* and trespass—the court offered only its *ipse dixit*, declaring that “ownership rights in today’s world are not so clear-cut as they were before the advent of airplanes and injection wells.”⁸⁹ In the view of the *Chance* court, property rights are not fixed by any doctrine, but rather vary “with our varying needs.”⁹⁰

By elevating the *justification* for property rights—i.e., the service of “our varying needs”—above the doctrines that define those rights, the opinions in subsurface disputes evince a skepticism about formal reasoning and doctrine to achieve socially desirable results.⁹¹ A less formal and more substantive subsurface property law is the result. The law is consequently more vulnerable to the ideological commitments and policy preferences of particular judges. Because the outcomes of litigation (and the contours of property rights) appear to depend on ad hoc substantive criteria, the body of law lacks coherence and is practically unusable as *ex ante* guidance for participants in the legal system.

85. See generally Schremmer, *supra* note 23, at 342–73 (cataloguing cases to demonstrate the prevalence of balancing tests).

86. 670 N.E.2d 985 (Ohio 1996).

87. *Id.* at 991–92.

88. *Id.*

89. *Id.* at 992.

90. *Id.* (quoting *Hinman v. Pac. Air Transp.*, 84 F.2d 755, 758 (9th Cir. 1936)).

91. This sentiment echoes legal realism’s critique of classical formalism and common law doctrines. See Smith, *supra* note 57, at 2078–80. The case-law trend also highlights the incursion of other disciplines and methodologies into the law, such as economics. This incursion undermines the “autonomy of the law,” as Posner observed, as well as the confidence of lawyers and judges that legal doctrine alone, absent political and economic considerations, is capable of “put[ting] right the major problems” facing the legal system. See Richard A. Posner, *The Decline of Law as an Autonomous Discipline: 1967–1987*, 100 HARV. L. REV. 761, 768–69 (1987) (discussing the decline of law as an autonomous field and the rise of other disciplines’ influence over the law); accord ROBERT H. BORK, *THE TEMPTING OF AMERICA: THE POLITICAL SEDUCTION OF THE LAW* 262 (1990) (arguing that law “is being seduced by politics and is losing its identity as a discipline”).

C. *The Practical Need for Coherent Subsurface Property*

There are practical, as well as doctrinal and philosophical, reasons to develop a coherent set of legal principles to coordinate the use of subsurface resources. There may be more interest today in ownership of the deep subsurface of the earth than at any time since the commercial discovery of oil and gas in the United States.⁹² Contemporary interest is primarily the consequence of separate technological innovations: a revolution in unconventional oil and gas production and the advancement of renewable energy and carbon capture and sequestration technologies.

The unconventional, or “shale,” revolution has opened up previously unproducible, tight bearing formations through the use of horizontal drilling and large-volume fracking.⁹³ The revolution, which rocketed the United States to the top of global oil and gas production, has also spurred novel issues pertaining to the ownership and use of deep subsurface rock and pore space, both inside and outside of conventional oil and gas reservoirs.⁹⁴ The significance of unconventional production to the economy and national security of the United States, as well as its potential role in providing natural gas as a bridge fuel for a renewable-energy transition,⁹⁵ has focused the minds of many scholars on resolving questions about the legal relationship between neighboring subsurface owners.⁹⁶

Continuing innovation in renewable energy and carbon capture and sequestration techniques has likewise generated interest in the subsurface. Whereas the discovery of oil and gas touched off a revolution in *extracting* substances from subsurface reservoirs, these contemporary technological developments have excited interest in *injecting* substances into the subsurface for storage, or “sequestration.” Fluid injection has long been a part of oil and gas production. Injection wells are the primary means of wastewater disposal and secondary and enhanced recovery, both of which are essential to hydrocarbon extraction.⁹⁷ Underground injection of natural gas has also played an important

92. See James Terry Duce, *The Changing Oil Industry*, 40 FOREIGN AFFS. 627 *passim* (1962) (describing the discovery by Colonel Edwin Drake near Oil Creek Pennsylvania in 1859).

93. See *supra* note 51.

94. See James W. Coleman, *The Third Age of Oil and Gas*, 95 IND. L.J. 389, 418–19 (2020) (introducing the revolution in hydraulic fracturing technology).

95. A “bridge” fuel, such as natural gas, is one that can be produced cheaply in plentiful quantities to ease the transition to low-carbon energy production.

96. There is a large and growing body of literature on horizontal drilling, hydraulic fracturing, and related technologies. See, e.g., Pierce, *supra* note 56, at 249–50; Anderson, *supra* note 55, at 255–81; Keith B. Hall, *Hydraulic Fracturing: If Fractures Cross Property Lines, Is There an Actionable Subsurface Trespass?*, 54 NAT. RES. J. 361, 400–02 (2014).

97. Enhanced recovery is discussed *infra* in Part III.D.3.

role in the energy supply chain for a century.⁹⁸ While also energy-related, contemporary interest in subsurface injection and storage is focused on generating renewable energy and ameliorating the effects of greenhouse gas emissions from the use of fossil fuels.

It is helpful to think of recent advancements in injection technology as falling into two categories. The first major category of contemporary injection techniques relates to the storage of energy generated from renewable sources. Production of renewable energy, mainly wind and solar, has increased substantially since the turn of the twenty-first century “in connection with the efforts to develop a low carbon society and mitigate climate change.”⁹⁹ As sources of renewable energy proliferate, the need for large-scale storage of energy is necessary due to its inherent intermittency.¹⁰⁰ “Large-scale energy storage systems are needed to accommodate the excess off-peak energy generation and to deliver high power during peak load,” and various forms of underground storage in geologic reservoirs present hopeful solutions.¹⁰¹ Several ingenious methods of underground storage make use of the pore space within depleted oil and gas reservoirs, saline aquifers, salt formations, and engineered rock caverns in abandoned mines.¹⁰² These include compressed air energy storage (“CAES”), underground pumped hydro storage (“UPHS”), and underground thermal energy storage (“UTES”).¹⁰³

The second major category of contemporary injection and storage technologies relates to sequestration of anthropogenic carbon dioxide, often short-handed as carbon capture and storage (“CCS”). CCS has garnered substantial attention from policymakers as a means of controlling greenhouse gas emissions and mitigating climate change.¹⁰⁴ CCS seizes carbon dioxide at the point of combustion, compresses it into pipelines, and transports it to deep wells where it is injected into a geologic formation for secure, permanent storage.¹⁰⁵ As in energy storage, carbon sequestration is done in porous and permeable depleted

98. FED. ENERGY REGUL. COMM’N., CURRENT STATE OF AND ISSUES CONCERNING UNDERGROUND NATURAL GAS STORAGE 4 (2004) (noting the first successful natural gas storage project was completed in North America in 1915).

99. Matos et al., *supra* note 3, at 241.

100. *Id.* at 241–42.

101. *Id.* at 242.

102. *Id.* at 241, 243.

103. For a full description of each, see generally *id.*

104. To incentivize private deployment of CCS technology, Congress passed a significant investment tax credit and the Department of Energy has funded nearly \$100 million in grants for projects to demonstrate the feasibility of commercial-scale CCS. See 26 U.S.C. § 45Q; *Energy Department Selects Additional Carbon Storage Feasibility Projects to Receive Nearly \$30M in Federal Funding*, U.S. DEP’T OF ENERGY, OFF. OF FOSSIL ENERGY & CARBON MGMT. (May 24, 2018), <https://perma.cc/AG9V-YSCT>.

105. BEREND SMIT ET AL., INTRODUCTION TO CARBON CAPTURE AND SEQUESTRATION 2 (2014).

oil and gas reservoirs and saline aquifers, where the injected carbon resides in the pore space within the subsurface rock formation.¹⁰⁶

The growing public and private investment in renewable energy storage and CCS projects has highlighted various legal obstacles to deployment of subsurface injection and storage technologies. Among the most important of these obstacles is the question of whether an injector may be liable for the migration of injected substances beneath neighboring lands.¹⁰⁷ A clear and consistent answer to these questions has yet to emerge from the case law in most states. The uncertainty is such that some states have adopted piecemeal legislation to clarify aspects of subsurface property rights.¹⁰⁸ Some of these statutes grant CCS developers condemnation authority over pore space,¹⁰⁹ and others empower developers to consolidate pore space rights for CCS through an administrative process akin to compulsory oil and gas unitization.¹¹⁰ North Dakota adopted legislation in 2019 providing that “[i]njection or migration of substances into pore space for disposal operations, for secondary or tertiary oil recovery operations, or otherwise to facilitate production of oil, gas, or other minerals is not unlawful and, by itself, does not constitute trespass, nuisance, or other tort.”¹¹¹ An ongoing constitutional challenge argues that the law constitutes an uncompensated taking of landowners’ pore space rights,¹¹² demonstrating the difficulty of legislative solutions in this area.

While these approaches might accomplish their narrow purposes, like enabling CCS projects, they do not address the ultimate question of how generally to coordinate competing uses within a common subsurface resource. Statutory solutions cannot address the wide array of subsurface issues that arise in the course of other activities, including subsurface uses that have yet to be invented.¹¹³ And of course, these statutes can only coordinate owners within the

106. Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change, Carbon Sequestration, and Property Rights*, 2010 U. ILL. L. REV. 363, 373 (2010).

107. Tade Oyewunmi, *Decarbonising Gas and Electricity Systems: An Outlook on Power-to-Gas and Other Technology-Based Solutions*, in *DECARBONISATION AND THE ENERGY INDUSTRY: LAW, POLICY, AND REGULATION IN LOW-CARBON ENERGY MARKETS* 100–02 (Tade Oyewunmi et al. eds., 2020).

108. KRIS KOSKI ET AL., U.S. ENERGY ASS’N, *STUDY ON STATES’ POLICIES AND REGULATIONS PER CO₂-EOR-STORAGE CONVENTIONAL, ROZ AND EOR IN SHALE: PERMITTING INFRASTRUCTURE, INCENTIVES, ROYALTY OWNERS, EMINENT DOMAIN, MINERAL-PORE SPACE, AND STORAGE LEASE ISSUES* 123–24, 130 (Sept. 2020).

109. *See, e.g.*, LA. REV. STAT. § 30:1108 (2020); IND. CODE § 14-39-1-7(b) (2020).

110. *See, e.g.*, KY. REV. STAT. ANN. § 353.652 (2019); MONT. CODE ANN. §§ 82-11-180 to -188 (2019); N.D. CENT. CODE ANN. § 38-08-09.5 (2020); WYO. STAT. ANN. § 30-5-110 (2020).

111. N.D. CENT. CODE § 47-31-09 (2019).

112. *Complaint, Nw. Landowners Ass’n v. North Dakota*, No. 05-2019-CV-00085 (N.E. Jud. Dist. N.D. July 29, 2019).

113. Schremmer, *supra* note 8, at 11–14 (discussing the limits of statutory regulation in this field).

jurisdictions where they are adopted. Statutory law is, at best, a partial solution to the problem of defining subsurface property rights.

The practical consequences of the legal muddle include more disputes over hydrocarbon extraction and less deployment of underground technologies like energy storage and CCS. The law in its present state fails to provide useful guidance for subsurface owners and developers to avoid these disputes or to invest the capital necessary to undertake these projects. Projects that are undertaken are likely more expensive because of the law's incoherence, as the costs of contracting and risks of uncertainty of litigation increase under an unclear legal regime.¹¹⁴ Although the state of the law certainly does not preclude hydrocarbon extraction or underground injection altogether, it probably deters an unknowable number of projects at the margin. For these reasons, subsurface owners and participants in the legal system are allied in the need for practically reasonable guidance to coordinate their actions *ex ante*.

II. SYSTEMATIZING THE LAW: WHY AND HOW

The central aim of this Article is to systematize subsurface property law into a normatively defensible formal doctrine. In service of this goal, this Part reviews the state of legal formalism in private law theory with a focus on the criteria by which leading theorists evaluate the normative authority of formal theories. Section A reviews some leading formalist theories of private law and their primary evaluative criteria. Section B distills a set of criteria from these theories by which to evaluate a formal theory of a field of private law. Section C defends the normativity of formal doctrine against standard functionalist critiques of its ability to adjudicate disputes and render desirable results. Section D outlines, step-by-step, the method by which I synthesize my formal theory of subsurface property law—the “fair opportunity doctrine.”

A. *Legal Formalism: A Review of Some Leading Theories*

Classical formalism dominated nineteenth century legal thinking in America, but it suffered from a shabby reputation among legal circles for most of the twentieth century.¹¹⁵ Classical formalists “believe that answers to legal questions could and should be based upon distinctly legal materials, without

114. The difficulty in contracting for the use of another's subsurface property against a backdrop of poorly delineated rights can be great. See Edward J. Janger, *Muddy Property: Generating and Protecting Information Privacy Norms in Bankruptcy*, 44 WM. & MARY L. REV. 1801, 1863 (2003) (“A second effect of a muddy property rule, however, is to deter transactions at the margin, because of the costs associated with litigation and the risk of judicial scrutiny.”).

115. See Ernest J. Weinrib, *Legal Formalism: On the Immanent Rationality of Law*, 97 YALE L.J. 949, 950 (1988) (“In current academic discussion, the avowed formalist is the missing interlocutor. Formalism is like a heresy driven underground, whose tenets must be surmised from the derogatory comments of its detractors.”).

reference to sources external to the law, most notably without reference to the social sciences.”¹¹⁶ Methodologically, formalists attempted to induce legal concepts from case law analysis and then logically derive particular legal rules from those concepts.¹¹⁷ Accordingly, classical formalists viewed the legal system as an autonomous, self-contained, internally coherent system, which has often been compared to the field of geometry.¹¹⁸

Formalism’s dominance eroded starting around the turn of the twentieth century. Dean Roscoe Pound’s sociological jurisprudence and Justice Holmes’ pragmatic jurisprudence each sought to understand the law by examining its effects within society.¹¹⁹ To these jurists, “law was a branch of the science of public policy, guided by and aimed at the ultimate goal of serving the sum of the interests of individuals and social groups.”¹²⁰ Subsequently, beginning in the 1930s, the legal realist movement adopted a highly skeptical view of legal doctrine premised on the idea that the behavior of legal actors (in particular, judges) could be explained by their ideological commitments and policy preferences, and not by legal doctrines or rules.¹²¹ These post-formalism movements embraced a “functional” jurisprudence that sought to explain and derive legal rules based on their social consequences and by using social science techniques. Legal functionalism doubts both the plausibility of formalism’s methodology and whether it provides a persuasive account of how purely autonomous legal rules are normatively appealing, such that they really do and should determine judges’ decisions and guide the actions of other participants in the legal system.

Legal formalism has enjoyed a sort of revival over the past thirty years, especially among private law theorists. Much of the modern formalist scholarship focuses on finding a normative account of private law that can be derived from a primarily internal perspective.¹²² H.L.A. Hart introduced the ideas of “internal” and “external” points of view in *The Concept of Law*.¹²³ Scholars have since referred to theories they might have previously described as “formal” as

116. Cox, *supra* note 83, at 59–60.

117. *Id.* at 59; *see also* Thomas C. Grey, *Langdell’s Orthodoxy*, 45 U. PITT. L. REV. 1, 3–4 (1983).

118. Cox, *supra* note 83, at 59.

119. *See generally* Grey, *supra* note 15, at 9–11 (sketching out the “pragmatic” functional jurisprudence of Holmes, Pound, and Cardozo).

120. *Id.* at 10.

121. *See, e.g.*, JEROME FRANK, *LAW & THE MODERN MIND* 119 (Transaction Publishers 2009) (1930) (“The peculiar traits, disposition, biases and habits of the particular judge will, then, often determine what he decides to be the law.”).

122. *See* Gold, *supra* note 15, at 1–2 (discussing the rise in the 1980s and 1990s of scholars interpreting private law from an internal point of view). *See generally* Miller, *supra* note 11 (describing the new formalist methodology and normative commitments of the New Private Law).

123. H.L.A. HART, *THE CONCEPT OF LAW* 18–36, 88–91 (3d ed. 2012) (discussing the internal and external points of view).

taking the “internal” perspective.¹²⁴ The internal point of view focuses on the law’s constitutive doctrines, procedures, and institutions from the vantage point of participants within the legal system.¹²⁵ A purely internal point of view eschews consideration of law’s social consequences, such as its economic efficiency or welfare effects, or the motivations of judges beyond the rationales expressed in court opinions. In contrast, these latter concerns are the central focus of the external (functionalist) point of view.¹²⁶ The leading internalist theories asserted during this contemporary revival have, like their classical forebearers, struggled to account persuasively for the normativity of private law. External theories ground law’s normativity in non-legal criteria. But it remains a question on what internal criteria a formal theory may be justified as authoritative.¹²⁷

Ernest Weinrib’s well-known theory of formalism exemplifies a purely internal approach. Weinrib asserts that the only purpose of private law is “to be private law” and the only way to understand private law is from an internal perspective focusing exclusively on private law’s central “institutional and conceptual features.”¹²⁸ These features, primarily, are “the bilaterality of pleadings, litigation, and adjudication, the correlative deontic logic of jural relationships, and the centrality of causation of wrongful injury in establishing defendants’ remedial liability to plaintiffs.”¹²⁹ To Weinrib, the bilaterality of litigation—the fact that private law adjudication paradigmatically involves two opposing parties—means that the structure, or “form,” of private law is Aristotle’s concept of corrective justice, which itself imposes a bilateral relationship between the doer and sufferer of a wrong.¹³⁰ Private law doctrines are therefore intelligible only in terms of the correlative, bilateral relationship between the doer and sufferer of a wrong.¹³¹ In Weinrib’s view, private law’s key characteristic is its internal coherence with these concepts. Thus, he rejects any attempt to justify the law on the basis of values that are external to this bilateral, corrective-justice relationship, on the grounds that such external considerations are incoherent within that relationship.¹³²

In contrast to Weinrib’s purely internal theory, a developing movement of other private law theorists attempts to combine a focus on the internal point of view with an interest in “externalist legal analysis,” including “functional analy-

124. *See, e.g.*, Gold, *supra* note 15.

125. *Id.* at 1–2.

126. *Id.*

127. *See generally* Sunstein, *supra* note 20 (asserting that formal theories can and must be justified, if at all, only on the grounds of external considerations).

128. ERNEST J. WEINRIB, *THE IDEA OF PRIVATE LAW* 5, 9–10 (1995).

129. Miller & Pojanowski, *supra* note 12, at 5 (citing WEINRIB, *supra* note 128, at 9–10).

130. WEINRIB, *supra* note 128, at 56–58, 75–76.

131. *Id.*

132. *Id.* at 32–36.

sis” and “the practical effects of legal doctrine.”¹³³ This so-called “New Private Law” movement encompasses a wide variety of approaches, many of which attend closely to legal concepts and institutions in the internalist tradition, yet attempt to normatively justify them using criteria or methodologies associated with the functionalist tradition.¹³⁴ According to Andrew Gold, New Private Law approaches tend to adopt “moderate interpretive criteria” for evaluating the authority of a given theory of private law, which “make room for multiple objectives to be included in an internal account,” and some of which “may track the content of external explanations.”¹³⁵ The leading criteria, according to Gold, are (i) fit, or how completely and accurately a theory accounts for the case law it seeks to explain; (ii) transparency, which is the degree to which a theory accurately describes the real reasons for judges’ decisions; (iii) morality, which “holds that a good legal theory should explain the law in a way that shows how the law might be thought to be justified”;¹³⁶ and (iv) coherence, or the degree to which a theory “render[s] the social practice of private law intelligible.”¹³⁷

In a forthcoming article, Paul Miller and Jeffrey Pojanowski criticize the largely “non-moralized understanding of the internal point of view” espoused by both Weinrib’s and the New Private Law’s approaches.¹³⁸ They suggest an alternative rendering of the internal point of view that is based on John Finnis’s natural law theory.¹³⁹ For Finnis, law is a morally necessary source of authority to effectively coordinate members of a community in their pursuit of the basic goods of human life.¹⁴⁰ People participate in these goods by making rational choices in conducting their affairs. The ability to reason correctly about what choices are best for oneself is what Finnis calls “practical reasonableness.”¹⁴¹ Practical reasonableness is both one of the basic goods as well as the means by

133. Gold, *supra* note 15, at 4.

134. *See id.* at 3–16 (describing a number of New Private Law approaches and the various criteria they employ to justify the normativity of the law).

135. *Id.* at 7.

136. *Id.* at 10 (quoting STEPHEN A. SMITH, *CONTRACT THEORY* 18 (2004)).

137. *Id.* at 11.

138. Miller & Pojanowski, *supra* note 12, at 12.

139. *See generally id.* at 1. Adam MacLeod similarly develops an internal understanding of property law from Finnis’s conception of natural law in ADAM J. MACLEOD, *PROPERTY AND PRACTICAL REASON* (2015), where he describes “the internal perspective of the one who owes duties and wants to know what he or she should do.” *Id.* at 177.

140. The basic forms of human good are intrinsic reasons for action, i.e., reasons for action that are not only instrumental means of achieving a further end. Finnis identifies the basic goods as life, knowledge, friendship, play, aesthetic experience, religion, and practical reason. JOHN FINNIS, *NATURAL LAW & NATURAL RIGHTS* 81–90 (1980). Importantly, Miller and Pojanowski point out that Finnis’s conceptualization of the internal point of view does not depend on whether one accepts Finnis’s account of these basic goods. Miller & Pojanowski, *supra* note 12, at 25.

141. FINNIS, *supra* note 140, at 100.

which people pursue the other goods.¹⁴² Finnis goes on to identify nine requirements for exercising practical reason, which include the principle that one should foster the common good of one's community.¹⁴³ This, in turn, requires individuals to coordinate with each other to achieve the common good and to respect each other's moral values, such as their interests in bodily autonomy, security in the use and enjoyment of property, and the free exercise of normative powers (e.g., the power to contract, make gifts, and associate with others).¹⁴⁴ The law's claim to normative or moral authority thus rests on its ability to coordinate the relevant community in pursuit of its common good by providing reliable guidance to reasonably practical people in their deliberations about how to order their affairs. Property rights serve the ends of coordination, practical reason, and ultimately the common good by securing owners, according to Adam MacLeod, "the freedom to manage and use things in community with others" and furnishing conclusive reasons for decision to guide the exercise of practical reason in planning private affairs and collaborating with others.¹⁴⁵

Finnis's theory proceeds from an internal point of view. Specifically, it takes the perspective of persons who look to the law for sound, practical guidance to aid them in the exercise of practical reason.¹⁴⁶ This is the perspective of a participant in the legal system who complies with the law's provisions on the belief that they offer normative guidance for how to order one's life. Proceeding from this version of the internal perspective, Miller and Pojanowski criticize the other formal theories for focusing too narrowly on the remedial or adjudicatory function of law.¹⁴⁷ While the law's ability to generate a desirable substantive end state of affairs following a litigated dispute is important, they argue, it is not the

142. *Id.* at 100–03.

143. *Id.* at 125. Finnis defines the common good as "a set of conditions which enables members of a community to attain for themselves reasonable objectives, or to realize reasonably for themselves the value(s), for the sake of which they have reason to collaborate with each other (positively and/or negatively) in a community." *Id.* at 155. A brief and helpful elucidation of Finnis's concept of the common good can be found in John M. Finnis, *What Is the Common Good, and Why Does It Concern the Client's Lawyer?*, 40 S. TEX. L. REV. 41 (1999). For Finnis, every community, no matter how small or informal, has a common good—not just a political community. *Id.* at 42–43. There is thus a common good of a law school or a legal journal, or, as relevant to this Article, of a community of owners in a semicommon subsurface reservoir. *Cf.* MACLEOD, *supra* note 139, at 222 (noting that riparian and littoral owners adjacent to a single water resource "are members of a community in a loose sense, who own the resource in a quasi-commons").

144. *See* FINNIS, *supra* note 140, at 154, 231–33 (discussing the need for collaboration among practically reasonable people and authority to coordinate such people in pursuit of their own objectives); *see also* Miller & Pojanowski, *supra* note 12, at 30 (discussing respect for others' objective moral values in a well-functioning community).

145. MACLEOD, *supra* note 139, at 185.

146. Miller & Pojanowski, *supra* note 12, at 23–24 (citing FINNIS, *supra* note 140, at 14–15).

147. *Id.* at 15–16.

only function of law that ultimately matters.¹⁴⁸ These other theories fail to account for the soundness of the law's *practical guidance* as key to its normative force and the ultimate reason for compliance with, and use of, the law's provisions by practically reasonable people.¹⁴⁹

Miller and Pojanowski's account also attempts to justify the technique of "togglng" between internal and external methodologies utilized by New Private Law theorists. They argue that scholars and officials within the legal system may, and should, pivot between these points of view in evaluating the practical reasonableness of the law.¹⁵⁰ In particular, they defend using externalist techniques and considering external perspectives to "assess the fitness of the law relative to its desired moral impact, acknowledging that the latter will be achieved through the normative guidance that the law supplies."¹⁵¹ In evaluating the law for this purpose, it is necessary to contemplate both whether practically reasonable people—who grasp and endorse the law's moral purpose in coordinating practically reasonable people toward the common good of the community—will comply with the law's guidance, as well as whether those who do not view the law as providing normative guidance but merely as a source of sanction or coercion, will conform to it.¹⁵² In determining the law's effectiveness at achieving compliance and conformity, Miller and Pojanowski endorse the use of social science techniques to inform practical deliberation and judgment.¹⁵³

B. Synthesizing a Workable Approach

The formal approach I use to systematize the law of subsurface property rights draws from Weinrib, the New Private Law movement, and the Finnisian account offered by Miller and Pojanowski. It adopts Miller and Pojanowski's premise that good law not only provides an effective remedy for the wrongful infringement of norms but also furnishes *ex ante* guidance to members of a community about those norms and how they should respect them.¹⁵⁴ Both logically and as a matter of procedural sequence, the provision of *ex ante* guidance is "prior or primary" to the law's remedial function in repairing wrongs and achieving substantively desirable end results.¹⁵⁵ The guidance must both be dis-

148. *Id.*

149. *Id.* Weinrib grounds the normative appeal of his account of formalism in Kantian right, which also makes use of the notion of practical will. See WEINRIB, *supra* note 128, at 19.

150. Miller & Pojanowski, *supra* note 12, at 38.

151. *Id.* at 38–39.

152. *Id.* at 39–40.

153. *Id.* at 40.

154. *Id.* at 30; see also Gregory C. Keating, *The Priority of Respect over Repair*, 18 LEGAL THEORY 293, 297 (2012) (defending prioritizing the latter function, which Keating calls the respect function, over the remedial function of law).

155. Miller & Pojanowski, *supra* note 12, at 30.

cernable and normative; it must give practically reasonable people a reason to comply with it and others, who do not necessarily grasp or endorse the law as having a moral purpose, to conform to it nonetheless. Its normativity stems from its effectiveness in guiding practically reasonable people in pursuit of their own moral interests in coordination with other members of the community.¹⁵⁶

For law to guide people's conduct *ex ante*, it must rely on formal reasons for decision. Substantive reasons (e.g., economic, political, and institutional-competency reasons) are adequate for resolving disputes, but they provide no *ex ante* guidance because, by their nature, they reject existing legal rules and decisions as an authoritative reason for decision.¹⁵⁷ To render a decision on substantive reasons, one must first select the particular reasons on which to base the decision, be they political, economic, moral, or otherwise. The decision-maker must then evaluate the chosen reason(s) (e.g., by asking what is moral? what economic values are most important?), much as a legislature would weigh pros and cons and costs and benefits in debating legislation. In this task, the decision-maker "would be in danger of going all the way back to the roots of the political theory and philosophical analysis."¹⁵⁸ Then the decision-maker must apply the resulting criteria to the relevant circumstances. There are, therefore, three levels of uncertainty inherent in substantive reasoning: uncertainty in the (i) selection, (ii) evaluation, and (iii) application of reasons for decision. Consequently, even if a participant in the legal system could predict which substantive reasons a court would select in adjudicating rights or liabilities, the participant would struggle to accurately predict how a court might evaluate and apply those reasons in an individual case. As P.S. Atiyah and Robert Summers have concluded, "[S]uch a system could not, therefore, adequately serve values characteristically associated with the rule of law, such as uniformity, predictability, freedom from official arbitrariness in the administration of law, and the like."¹⁵⁹

In contrast, formal reasons present decision-makers with legally authoritative guidance for decision or action. They exclude, override, or at least diminish the weight of any countervailing substantive reasons, which would otherwise inject layers of uncertainty into the criteria for decision or action.¹⁶⁰ Thus, when

156. Miller, *supra* note 11, at 198.

157. ATIYAH & SUMMERS, *supra* note 16, at 1–2.

158. *See id.* at 25.

159. *Id.* at 24. It was for this reason that Dean Roscoe Pound wrote that it is not "wise social engineering" to leave matters of property, in which security of acquisitions and transactions and certainty of use are of paramount importance, to courts' unfettered policy judgments. ROSCOE POUND, INTERPRETATIONS OF LEGAL HISTORY 153–54 (1923).

160. ATIYAH & SUMMERS, *supra* note 16, at 2; *see also* MACLEOD, *supra* note 139, at 175 ("When settled and specified, a right removes the reasons previously deliberated on—what Joseph Raz has called first-order reasons—from future consideration and thus acts as an exclusionary reason. It seems therefore that a use 'right' that is not conclusive is not a right in fact. If usufructs are merely reasons for action to be weighed against competing reasons, then they do not by themselves tell one what one should or should not do.").

the law is expressed as a formal doctrine, a practically reasonable person seeking guidance from the law faces only uncertainty in its application or extension to new cases. Formal doctrine, in other words, is instrumental to the law's purpose of providing normative *ex ante* guidance.¹⁶¹ Even when formal doctrine does not render highly determinate results, it is able to guide decision-making where substantive reasons cannot.¹⁶² In order to provide practical guidance *ex ante*, the law must be at least minimally formal.¹⁶³

While formality is essential to the normative purpose of law, it is not sufficient that the law be formal. If the only criterion for evaluating whether a theory or rule of law is normatively appealing were its formality, we might wish to reform every field of private law into a set of hard-and-fast rules that exclude all external considerations and discretionary standards in service of maximizing determinacy and predictability. There are, however, other criteria that must be considered. The appeal of a theory or rule rests not only on its ability to furnish usable guidance, but also on the normativity of that guidance.¹⁶⁴ If we accept Miller and Pojanowski's interpretation of Finnis, to be normatively appealing, law must furnish practically reasonable people with reasons for complying with the law; if it is to be normatively defensible, the law's guidance cannot be arbitrary because it would furnish no reason for compliance.

Moreover, an arbitrary formal rule is likely to fail to provide reliable guidance *ex ante* if it lacks an adequate normative (or we could say substantive) foundation. Such a rule would be an invitation for judges to resort to substantive reasons when the clear-cut-but-arbitrary formal rule fails to render desirable results. If the result of a case is perceived as undesirable and the rule that produced the result lacks sufficient grounding in persuasive substantive rationales, a judge may well find a substantive reason to avoid applying the rule.¹⁶⁵ Instances like this one might eventually overwhelm or obscure the formal rule and undermine the clarity of its guidance. To function as authoritative reasons for decision, therefore, formal doctrine must provide substantive reasons for

161. See MACLEOD, *supra* note 139, at 175–76 (noting that property rights “serve as premises and as guides to the practical reasoning of lawyers and their clients”).

162. On the guidance-providing function of legal principles, see Miller, *supra* note 11, at 207 (“[P]rinciples and maxims aid in the resolution of endemic decisional uncertainty in adjudication involving rules, standards and enabling doctrines.”).

163. See ATIYAH & SUMMERS, *supra* note 16, at 23 (“This is why detailed and precise rules with high content formality are often found preferable to broad rules of very low content formality.”).

164. Miller, *supra* note 11, at 198.

165. Cf. ATIYAH & SUMMERS, *supra* note 16, at 6 (noting how substantive reasons are utilized in common law adjudication where they may compel modifications or departures from existing rules that would render substantively undesirable results).

adherence even when the result of doing so may be less than desirable. In this way, substantive reasons must inform good formal legal rules.¹⁶⁶

Thus, a theory or a rule of law cannot derive its justificatory force from the fact of its formality alone; it must also be normatively appealing on other criteria. As noted, New Private Law theorists tend to use a number of criteria to evaluate the appeal of a theory that seeks to explain a field of private law. These include fit, transparency, morality, and coherence.¹⁶⁷ In Andrew Gold's account, morality and transparency are components of the fit criteria, since a theory that fits the case law will furnish a reason for legal decision-makers to view the law as both authoritative and proper for guiding their decisions.¹⁶⁸ The principal criterion for Weinrib's theory of private law is coherence within the bilateral structure of corrective justice. To be a good theory of private law, it must be completely coherent. For Weinrib, this means that it explains the field in terms of a unifying principle—e.g., in tort law, corrective justice.¹⁶⁹ All features of a private law doctrine must cohere around the unifying principle to have justificatory force. Miller and Pojanowski's chief criterion for private law appears to be whether it establishes authoritative norms that justify and effectively coordinate members of the community in pursuing their own moral interests and in understanding and respecting the moral interests of others (i.e., the community's "common good").¹⁷⁰

The criteria of fit and coherence may demand that a theory be more flexible and less determinate. To fit existing case law around a unifying principle, an explanation often must incorporate standards that render application of the theory less determinate.¹⁷¹ In the field of subsurface property law, hard-and-fast

166. See *id.* at 21, 23. To a degree, the mere fact that rules may be seen as a means of coordination of a community might itself furnish a substantive reason for compliance. Per Frederick Schauer:

By simplifying the decision process and by making certain results salient even if suboptimal, rules may assist in the solution of . . . coordination problems, or assist in other dimensions of co-operative enterprises, and thus an agent with a reason to participate in and assist in the effectiveness of some cooperative enterprise would have a reason for following rules emanating from that enterprise.

FREDERICK SCHAUER, *PLAYING BY THE RULES: A PHILOSOPHICAL EXAMINATION OF RULE-BASED DECISION-MAKING IN LAW AND IN LIFE* 125 (1991).

167. Gold, *supra* note 15, at 6–16.

168. *Id.* at 9–11.

169. *Id.* at 15 (citing WEINRIB, *supra* note 128, at 13–14, 19).

170. The authors go on to explain, “[p]ersons can neither flourish without goods associated with the realization of these interests, nor can we live peaceably in community with others without their security.” Miller & Pojanowski, *supra* note 12, at 30.

171. Miller, *supra* note 11, at 210. Miller observes, “Private law is replete with standards, principles and maxims, and thus often supplies guidance that is relatively indeterminate. We haven’t suffered terribly as a result; indeed, one suspects that often the guidance supplied is as determinate and practically reasonable as might be hoped.” *Id.*

rules like trespass, despite their high degree of determinacy, do not fit the actual substance of the case law or provide a transparent explanation of what courts actually do in the cases.¹⁷² Nor do hard-and-fast rules effectively coordinate members of a community in the use of common nonexclusive subsurface property.¹⁷³ Hence, they do not satisfy the criteria of fit or transparency, nor do they achieve the law's primary function of providing useable coordinating guidance.

For these reasons, in developing a systematic doctrine of subsurface property rights, I seek to achieve a formal rule that (i) fits the existing case law, (ii) is internally coherent, and (iii) effectively coordinates the use of shared subsurface property by members of the community. While the resulting doctrine certainly provides more practical *ex ante* guidance than the status quo, it is not perfectly determinate. Moreover, in pursuing a theory that satisfies multiple criteria, it is possible the criteria may conflict, and it is necessary to reconcile or prioritize them. For instance, a theory of subsurface property that is extremely coherent may not (in fact, often will not) perfectly fit the case law. The criteria should be prioritized according to the law's normative purpose of providing *ex ante* guidance to participants in the legal system in the exercise of practical reason to order their affairs and pursue their moral interests in coordination with others in the community.

Coherence is more essential than fit to achieving this purpose because coherence contributes to a doctrine's effectiveness in furnishing useable guidance and thus coordinating community members.¹⁷⁴ A doctrine is coherent in the Weinribian sense if all of its features hang together within a unifying principle. Participants in the legal system that grasp the unifying principle can readily understand the doctrine's features and, through deductive reasoning, predict the doctrine's application to new facts. Likewise, effectiveness (i.e., that the doctrine effectively coordinates the use of shared subsurface property by members of the community) is more important than fit, as it more directly serves the overarching goal of providing normative guidance. It is doubtful that the effectiveness criterion would conflict with coherence, since the more coherent the doctrine is, the more likely it is to effectively establish and inform participants of the legal norms coordinating their use of shared subsurface property. A coherent doctrine is effective, and vice versa.¹⁷⁵ Thus, while it is well to attend to each as a distinct criterion, it is not necessary to determine the relative priorities of coherence and effectiveness.

In subsurface property doctrine, coherence derives from the unifying principle that every owner of an interest in a shared subsurface resource is entitled

172. See generally Schremmer, *supra* note 23.

173. See generally *id.*

174. Miller, *supra* note 11, at 208 (“[T]he effectiveness of law in guiding adjudication is a matter of the intelligibility of the outcomes of adjudication and public reasons for judgment by light of applicable law.”).

175. See *id.*

to the fair opportunity to use and enjoy a proportional amount of the resource. This principle emanates from the physical characteristics of subsurface resources that render them a semicommons and the correlativity of the relationship among semicommons owners.¹⁷⁶ From the fair opportunity principle derive the particular entitlements of subsurface property ownership and the elements of liability for infringing those entitlements. The resulting theory systematizes the body of cases in a manner that is coherent and that largely fits the cases themselves. The fit is imperfect, however, because the theory excludes external substantive considerations that permeate the case law, as they do not serve the unifying fair opportunity principle. The resulting doctrine is also likely to be effective at achieving coordination among owners within a common subsurface resource.¹⁷⁷

In addition to satisfying the internal evaluative criteria of fit, coherence, and effectiveness, the fair opportunity doctrine is defensible on external substantive grounds. By furnishing useable and coherent guidance for reasonably practical participants within the legal system *ex ante*, the fair opportunity doctrine removes two elements of uncertainty from the case law as presently organized. First, it removes the uncertainty about what law applies because it unifies the various, fragmented doctrines that comprise the body of subsurface property rights, such as the rule of capture, doctrine of correlative rights, and subsurface trespass.¹⁷⁸ Second, it eliminates the uncertainty in predicting which substantive reasons any given court might select and how it might evaluate and apply them.

By reducing uncertainty in this area, the fair opportunity doctrine also lowers one of the significant barriers to large-scale deployment of emerging, capital-intensive subsurface technologies, like CCS. Formal doctrine permits parties to arrange their affairs and dealings to accomplish their goals with greater certainty, and it prevents disputes by enabling counsel to advise their clients "with an assurance which does not need to be tested by resort to the courts in every instance."¹⁷⁹ This is particularly valuable in the case of subsurface property rights, because projects require massive capital investments and entail significant risk of legal uncertainty. More certainty in the law may well reduce the need for the kind of piecemeal legislation adopted by states interested in developing CCS.¹⁸⁰ The social costs of legal uncertainty are impossible to calculate, especially if we could account for the lost value of marginal projects that were abandoned or never pursued because of legal uncertainty.

Formal doctrine is also instrumental in supporting rule of law values, including transparency, predictability, and the relative independence of the judi-

176. *See supra* Part I.A.

177. *See infra* Part IV.E.

178. *See supra* Part I.B.1.

179. Dickinson, *supra* note 83, at 847.

180. *See supra* Part I.C.

ary from politics.¹⁸¹ Without the constraint of formal doctrine, courts deciding subsurface property cases are left to their own preferences for what would make a good result.¹⁸² When bound by formal doctrine, however, judges have been shown in other contexts to be less likely to render decisions based on bare political preferences, and their decisions are more likely to be predictable.¹⁸³ Empirical study of judicial decision-making suggests that judges render “law-abiding and predictable decisions where clear precedent and judicial oversight exist,” and are more likely to render decisions based on personal ideologies where they are absent.¹⁸⁴ Clear doctrine has also been shown to partially constrain politically motivated and results-oriented decision-making by federal circuit court judges.¹⁸⁵

Before detailing the method used to systematize this doctrine, I will next address the most important aspects of the functionalist critique of formal doctrine and reasoning.

C. Addressing the Functionalist Critique of Formal Adjudication

The functionalist critique of formalism focuses on the adjudicatory or remedial aspect of the law rather than on the guidance–furnishing aspect. While the guidance function is primary, it is important to briefly address the critique of formal doctrine’s power to decide actual cases and achieve substantively desirable results.

Perhaps the key functional criticism “is that adjudication by reference to rule—the mechanical adjudication generally attributed to classical formalism—is highly implausible.”¹⁸⁶ Legal scholars doubt the efficacy of syllogistic reasoning (in which a legal rule sits as the major premise for a legal conclusion) and often view its application as a pretense for the court’s real motivation.¹⁸⁷ Another standard critique of formalism is really a critique of rules-based reasoning. Because rules are inevitably over- and under-inclusive, they fail to achieve their purposes in many cases. Moreover, it is supposed that because rules constrain

181. See Grey, *supra* note 15, at 15.

182. This concern led Scalia to exclaim “Long live formalism. It is what makes a government a government of laws and not of men,” ANTONIN SCALIA, *A MATTER OF INTERPRETATION* 25 (new ed. 2018), and Bork to assert that “legal reasoning must begin with a body of rules or principles or major premises that are independent of the judge’s preferences,” BORK, *supra* note 91, at 264–65.

183. Nancy C. Staudt, *Modeling Standing*, 79 N.Y.U. L. REV. 612 *passim* (2004).

184. *Id.*

185. Emerson H. Tiller & Frank B. Cross, *What Is Legal Doctrine*, 100 NW. U. L. REV. 517, 521–22 (2006) (finding a partial constraint of political decision-making by politically mixed panels of federal judges but not panels that were politically united).

186. Cox, *supra* note 83, at 70 (citing BENJAMIN CARDOZO, *THE NATURE OF THE JUDICIAL PROCESS* 112–15 (1921)).

187. See *supra* text accompanying notes 121–26.

the universe of relevant facts in any given case, their application can produce absurd or unjust results that contextualized standards could avoid by enabling the court to consider more of the surrounding circumstances.¹⁸⁸

The refutations of these critiques are as standard as the critiques themselves. The first defense relates to the law's guidance function. It is often uncertainty that leads to litigation—uncertainty both about what the law is and how it should apply in any given case. Systematizing the law into a formal articulation reduces uncertainty about its content, thus making its application simpler and more predictable.¹⁸⁹ When it is formally organized, the law provides a decision-making tool that enables laypersons and lawyers to avoid and resolve disputes privately without judicial intervention.¹⁹⁰ Functionalist standards, in contrast, rely principally on adjudication to resolve disputes, or at least on the settlement of claims undertaken in the shadow of it. Individualistic adjudication with reference to all surrounding facts and circumstances is particularly undesirable in matters of property, where predictability is key to the security of transactions and investments.¹⁹¹

Adjudication under formalist rules works most of the time because most cases are easy. Hard cases, though, do arise where there are gaps between formal rules, multiple possible rules could apply with differing consequences for the decision, or the formal doctrine would produce a result that seems substantively unacceptable. Despite what C.C. Langdell might have believed about there being a "true" rule for every case,¹⁹² the functionalist critique has traction as applied to hard cases. Yet, functionalist standards also cannot render easy and unerringly correct resolutions to cases that do not clearly fall within established rules. Courts will err in (for example) weighing a plaintiff's harm with utility of a defendant's conduct as surely as rules will err in recalcitrant cases, and likely with even greater frequency. Under formalist adjudication, at least hard cases need be hard only once, provided their resolutions are formulated as to enable principled adjudication of future cases.¹⁹³ Moreover, where doubtful cases arise, they are usually simpler to resolve under a formal analysis because the doubt exists as to the facts of the situation and the proper application or

188. *Id.* at 69–70.

189. This was Holmes's observation in *The Path of the Law*, *supra* note 9.

190. Cox, *supra* note 83, at 71; Dickinson, *supra* note 83, at 847.

191. POUND, *supra* note 159, at 153–54.

192. See Grey, *supra* note 117, at 3–4 (detailing Langdell's rejection of the mailbox rule cases as inconsistent with the "true" principle of contract acceptance).

193. Antonin Scalia, *The Rule of Law as a Law of Rules*, 56 U. CHI. L. REV. 1175, 1177 (1989) (explaining that high courts may adjudicate cases in a manner that confers wide discretion on future courts or, alternatively, by constraining discretion through establishment of general rules that are relatively principled).

extension of the rules to those facts rather than as to the content of applicable rules or relevant substantive interests or policies.¹⁹⁴

As for cases that are hard because their resolution under formal doctrine produces a normatively intolerable result, the same moral quandary attends all rules-based reasoning.¹⁹⁵ The importance to the rule of law of relative certainty, transparency, and predictability in adjudication provide compelling consequentialist reasons for tolerating normatively questionable results from the application of normatively good rules.¹⁹⁶ As Emily Sherwin has put it, good rules should be treated as “exclusionary reasons for action, providing both a first-order reason to act or decide as the rule requires and a second-order reason not to act or decide based on contrary reasons for action that fall within the general range of reasons the rule maker considered in enacting the rule.”¹⁹⁷ This is particularly persuasive given that such cases are comparatively rare and may often be ameliorated where necessary in equity.¹⁹⁸

Finally, a word about the charge that formalism merely conceals the true, but unstated, grounds for judicial decisions, which are thought to be social, political, economic, and policy preferences.¹⁹⁹ New Private Law scholars recognize “a moral duty of good faith that requires judges to decide in accordance with the law and to avoid subterfuge in giving public reasons for judgment” and “operate with a defeasible presumption that judges comply with this duty.”²⁰⁰ This presumption is supported by empirical studies of judging that belie the claim that formal doctrine gives cover to ideological decision-making.²⁰¹ Moreover, skepticism of formal doctrine’s ability to constrain, rather than merely conceal, judges’ decision-making only maximizes judicial discretion and undermines judicial independence. When doctrine is discarded or discounted, parties and amicus curiae are invited to argue from grounds of substantive policy, and the rulings of judges are more readily susceptible to political influence and cri-

194. Dickinson, *supra* note 83, at 847.

195. See SCHAUER, *supra* note 166, at 55–62, 213–15.

196. For additional exploration of the role of formal rules in the purpose and functioning of law, see *id.* and see also generally Larry Alexander, “*With Me, It’s All er Nuthin’*”: *Formalism in Law and Morality*, 66 U. CHI. L. REV. 530 (1999).

197. Emily Sherwin, *Formalism and Realism in Private Law*, in THE OXFORD HANDBOOK ON THE NEW PRIVATE LAW 471 (Andrew Gold et al. eds., 2021) (citing JOSEPH RAZ, THE MORALITY OF FREEDOM 57–62 (1986)); see also MACLEOD, *supra* note 139, at 185 (characterizing property rights as exclusionary reasons for action or non-action).

198. Sherwin, *supra* note 197, at 475–77.

199. See Holmes, *supra* note 9, at 467–68; see, e.g., JEROME FRANK, LAW AND THE MODERN MIND 111 (1930) (“The peculiar traits, disposition, biases and habits of the particular judge will then often determine what he decides to be the law.”). Contemporary legal theorists remain highly skeptical about formalism. See DUNCAN KENNEDY, CRITIQUE OF ADJUDICATION (*Fin de Siècle*) 25 (1997).

200. Miller, *supra* note 11, at 208.

201. See *supra* text accompanying notes 184–85.

tique. A formalist or New Private Law view judges this fact to be a deficiency, rather than a feature, of the common law system.²⁰²

D. *The Method of Systematizing Formal Property Doctrine*

The preceding sections address the reasons in favor of synthesizing a coherent formal theory of subsurface property rights. This section explains how this is to be done. The method employs traditional doctrinal analysis²⁰³ to induce a unifying principle—fair opportunity—of subsurface property ownership from the relevant bodies of case law and then identify the essential features of the legal relations among owners within common subsurface resources that give substance to that principle. From the principle and these features, lawyers and their clients can deduce guidance for ordering their private affairs and avoiding and dealing with disputes, and judges can deduce the resolution of particular cases in the process of adjudication.

The method unfolds in three steps. The first is to identify the case law to examine. As noted, commentators and treatise writers do not generally treat subsurface property law as a unitary field.²⁰⁴ Rather, the area is fragmented into various sets of rules. These include, as illustration, (i) the rule of capture, (ii) correlative rights, (iii) subsurface trespass, (iv) trespass related to secondary and enhanced oil and gas recovery, (v) the right to inject fluids, (vi) waste, and (vii) recovery of damages for negligent or wasteful injury to a reservoir. To unify the field, one must examine cases applying each of these sets of rules, with the result that the synthesized doctrine covers all property disputes involving interconnected subsurface resources. The synthesized doctrine defines property rights in both the substances (e.g., oil and gas) contained within subsurface formations, as well as the rock and pore space that constitutes the formations themselves.²⁰⁵

The second and third steps proceed by inducing from the case law the unifying principle and essential features of the legal relationship among property owners in a common subsurface resource.²⁰⁶ Step two (*infra* Part III.A) identifies the nature of the subsurface property interest and the legal relationship among owners in a common subsurface resource. The nature of this legal relationship provides the unifying concept of the doctrine and furnishes the

202. Miller, *supra* note 11, at 214.

203. I have in mind as an exemplar of the “traditional kind” of legal-doctrinal analysis Eugene Wambaugh in his classic, *THE STUDY OF CASES: A COURSE OF INSTRUCTION IN READING AND STATING REPORTED CASES, COMPOSING HEAD-NOTES AND BRIEFS, CRITICIZING AND COMPARING AUTHORITIES, AND COMPILING DIGESTS* (2d ed. 1894).

204. *See supra* Part I.B.1.

205. Not examined were cases involving shallow groundwater reservoirs and non-migratory minerals, which are subject to separate bodies of law. *See supra* Part I.A.

206. *See Weinrib, supra* note 115, at 966–67.

basis for determining which invasions or infringements of a plaintiff's subsurface interest are actionable.²⁰⁷ Briefly, the legal relations among subsurface property owners are nonexclusive and correlative, owing to the interconnectedness of the common resource.²⁰⁸ Each owner has the freedom to access and use a common subsurface resource and its contents and none may be excluded. In this way, each owner has *an equal, fair opportunity* to access and utilize the common subsurface property. Accordingly, owners within a common subsurface resource are free to use the resource in ways and for purposes that are consistent with the other owners' opportunity to do likewise.²⁰⁹ Thus, the fair opportunity concept is the unifying principle of the system of subsurface rights, privileges, and duties.

Step three (*infra* Parts III.B and IV) defines the essential elements of liability for invading another's fair opportunity to use a common subsurface resource. These elements form a test for determining whether legal injury has been done to a plaintiff's subsurface property interest. An element is essential if it must be explained, or explained away, to give an accurate and complete account of the cases.²¹⁰ To be essential, an element must not only appear regularly in the cases but must also give effect to the fair opportunity concept underpinning the legal relationship among owners of common subsurface property. This is necessary to ensure that, as an ensemble, the essential elements are coherent, i.e., that they are connected by and pull in the same direction as the fair opportunity principle.²¹¹ For instance, many cases expressly or impliedly consider the interests of the oil and gas industry in deciding the extent of a party's liability for causing a subsurface invasion of another's property; but this cannot be an essential element of liability because it is not necessary to effectuate the plaintiff's fair opportunity to use the common resource. The industry's interest, therefore, is not an element of the fair opportunity doctrine. In reviewing the case law, it is necessary to ignore such external substantive reasons to maintain the doctrine's coherence and thereby ensure its ability to provide practical ex ante guidance. Consequently, the doctrine does not perfectly fit the cases insofar as the cases render decisions on the basis of substantive reasons.

The resulting test for liability is as follows: (1) an act by the defendant (2) causes a physical invasion of the plaintiff's property boundaries and (3) damages the plaintiff either by (a) harming its ongoing subsurface activities or (b) depriving it of a fair opportunity to use the subsurface or produce its contents

207. See Richard A. Epstein, *Nuisance Law: Corrective Justice and Its Utilitarian Constraints*, 8 J. LEGAL STUD. 49, 50–51 (1979) (explaining the first step in formulating a corrective justice theory of nuisance law is identifying the plaintiff's protected right).

208. See Schremmer, *supra* note 8, at 7–11.

209. Inversely, there is no liability for owners' activities that take place exclusively within their own tract and do not cause waste.

210. See Weinrib, *supra* note 115, at 967.

211. *Id.* at 968.

without extending a fair, reasonable, and nondiscriminatory offer to participate in the defendant's enterprise.

While these elements describe most of the essential features of the relationship between subsurface owners and account for the vast majority of the existing cases, they leave out a small but important group of cases in which no physical invasion necessarily occurs: cases of waste. These cases hold a subsurface owner liable not for invading a neighbor's property, but for using the common subsurface resource in a manner that is deemed wasteful. Accordingly, Part IV, *infra*, expands the test to encompass liability for waste, which in turn requires a doctrinal analysis of waste cases to synthesize its essential elements around the fair opportunity principle. In short, a subsurface owner is liable for waste when it uses a common resource in a manner that reduces the resource's total net value to all its owners, regardless of whether it causes a physical invasion of another's subsurface tract.²¹² In this way, waste is wrongful because it deprives other common owners of the opportunity to access or use the wasted portion of the common resource for a beneficial purpose. Together, the three-element fair opportunity doctrine and the prohibition against waste constitute a unified doctrine of subsurface property rights.

III. SYNTHESIZING THE FAIR OPPORTUNITY DOCTRINE

A. *Defining the Boundaries of the Plaintiff's Subsurface Property Interest*

The first step in articulating a test to determine liability for invasion of another's subsurface property interest is to identify the protectable interest, if any, that is at stake.²¹³ What right or rights does the plaintiff enjoy by virtue of owning a subsurface property interest that may not be injured by the defendant's actions? This question has both a physical and a legal aspect. The physical aspect merely defines the physical boundaries of the plaintiff's property claim. In the case of subsurface property, boundaries are typically drawn vertically from the surface of the land. Under the *ad coelum* doctrine, the owner of land owns the column of rock and all entrained substances (including oil and gas, as well as pore space) below the land to the center of the earth.²¹⁴ Subsurface boundaries may also be drawn horizontally, such that the owner's claim extends only to certain formations lying at defined depth intervals.

Additionally, subsurface property may be physically divided by severance of one or more substances underlying the land. A common severance is of "oil,

212. Righetti & Schremmer, *supra* note 19, at 611–12 (defining the "waste principle").

213. *See, e.g.*, *Allen v. Alaska Oil & Gas Conservation Comm'n*, 147 P.3d 664, 672 (Alaska 2006) (determining whether the plaintiff owned an interest in a subsurface reservoir of oil and gas as a prerequisite to determining whether its correlative rights had been violated).

214. *See, e.g.*, Sprankling, *supra* note 4, at 980–81.

gas, and other minerals.” Severance creates multiple legal estates, typically called a “mineral” estate and the “surface” estate from which it was severed, which coexist within a given set of physical boundaries.²¹⁵ Absent controlling language in the instrument creating the severance, the owner of the surface estate is typically entitled to the entire subsurface, including the physical strata of rock and interstitial pore space, while the severed mineral estate’s only claim is to the oil, gas, and other, similar minerals themselves.²¹⁶

These physical boundaries alone, however, do not define the plaintiff’s protectable claim. The cases are replete with examples of invasions into the physical boundaries of another’s subsurface that were not actionable. To be tortious—i.e., to violate the plaintiff’s protectable property interest—an invasion must infringe on the *legal* boundaries of the subsurface property interest.²¹⁷ In this regard, surface interests and severed mineral interests in the subsurface are indistinguishable.²¹⁸ The subsurface property interest, whether surface or mineral, entitles the owner only to the *fair opportunity* to exploit the subsurface rock and pore space or minerals (as the case may be) within the physical boundaries of the owner’s interest, or their equivalent from elsewhere in the common formation, without having to incur unreasonable expense to do so.²¹⁹

Thus, the owner of a mineral estate owns only the fair opportunity to produce the oil and gas reserves that exist within the boundaries of its mineral estate or an equivalent amount of reserves from elsewhere in the oil and gas reservoir. This is true in all jurisdictions, regardless of whether they consider the severed mineral interest to be a fee estate in land or merely a nonpossessory *profit a prendre*.²²⁰ Likewise, the owner of a subsurface surface estate owns only the fair opportunity to use the pore space and rock strata within the bounds of its surface estate or an equivalent amount of pore space and strata elsewhere in the reservoir.²²¹ This seemingly straightforward pronouncement of the fair opportunity principle hides a good deal of complexity about the nature and extent of the subsurface interest.

As previously discussed, the limited extent of the subsurface property interest arises from the nature of the subsurface itself. The deep subsurface of the

215. 1 KUNTZ, *supra* note 44, § 3.1. Physical ownership of minerals may be further severed to include only certain phases of hydrocarbons, e.g., only gas or only oil; this is often called “phase severance.” Ralph A. Midkiff, *Phase Severance of Gas Rights from Oil Rights*, 63 TEX. L. REV. 133, 135–37 (1984).

216. *Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, 520 S.W.3d 39, 47–48 (Tex. 2017).

217. *Id.* at 49.

218. *See* Schremmer, *supra* note 8, at 7–11 (demonstrating that rights in pore space are correlative in the same way as rights in oil and gas).

219. This is a paraphrase of Robert Hardwicke and M.K. Woodward’s classic statement of the “fair share” principle of oil and gas correlative rights. Robert E. Hardwicke & M.K. Woodward, *Fair Share and the Small Tract in Texas*, 41 TEX. L. REV. 75, 93 (1962).

220. 1 KUNTZ, *supra* note 44, § 3.2[a].

221. Schremmer, *supra* note 8, at 66–72.

earth is largely interconnected by porous and permeable rock layers (reservoirs) that hold and transmit pressure and fluids, like oil and gas, as well as saltwater, across property lines.²²² Neighboring subsurface owners whose estates exist within a common reservoir physically cannot exclude the effects of their neighbors' use of the reservoir, whether for mineral production or fluid injection and storage, just as neighboring landowners cannot block the migration of odors from a neighboring sewage treatment plant or smoke and vapors from a nearby oil refinery.

The fluid and migratory nature of oil and gas within reservoirs gave rise to the rule of capture.²²³ The rule permits a mineral estate owner to drill wells into a common reservoir to "reasonabl[y] and legitimate[ly]" drain oil and gas without liability to neighboring owners from whose physical boundaries the oil or gas was drained.²²⁴ A necessary corollary to the rule, the "offset drilling corollary," provides the owner that has lost oil or gas through drainage only one remedy: drill wells on its own estate to "reasonably and legitimately" drain from the estates of others without "waste."²²⁵ "In this manner," the Texas Supreme Court has explained, "if all operators exercise the same degree of skill and diligence, each owner will recover in most instances his fair share of the oil and gas. This reasonable opportunity to produce his fair share of the oil and gas is the landowner's common law right . . ."²²⁶

Put another way, subsurface property owners' rights are mutually relative, or "correlative," because one interest owner's use of the common reservoir necessarily impinges upon the ability of other owners to use the reservoir.²²⁷ The Utah Supreme Court has described a correlative right as "a right to undifferentiated and unquantifiable interest in an oil or gas pool beneath one's land. The right initially is nothing more than an 'opportunity' to produce a 'just and equitable share' of oil and gas 'without waste.'"²²⁸ Describing subsurface rights as correlative is merely another expression of the fair opportunity principle.

While courts and commentators universally acknowledge the correlative nature of subsurface rights, there is much confusion about exactly what it means to have only a fair opportunity to utilize the common reservoir. Despite early commentary to the contrary, it is generally accepted that the fair opportunity

222. *See id.* at 7–11.

223. *See* Bruce M. Kramer & Owen L. Anderson, *The Rule of Capture—An Oil and Gas Perspective*, 35 ENV'T L. 899, 906 (2005) (citing *Westmoreland & Cambria Nat. Gas Co. v. DeWitt*, 18 A. 724 (Pa. 1889)).

224. *Elliff v. Texon Drilling Co.*, 210 S.W.2d 558, 562 (Tex. 1948).

225. *See id.*; accord *Barnard v. Monongahela Nat. Gas Co.*, 216 Pa. 362, 362 (1907) (holding that the plaintiff's remedy for drainage is to "go and do likewise").

226. *Elliff*, 210 S.W.2d at 562.

227. *Samson Res. Co. v. Corp. Comm'n*, 702 P.2d 19, 22 (Okla. 1985).

228. *Cowling v. Dep't of Nat. Res.*, 830 P.2d 220, 225 (Utah 1991) (citing UTAH CODE ANN. § 40-6-2(2) (1988)).

principle does not guarantee owners any particular portion of subsurface property, nor does it prevent owners from using or producing more than their ratable share.²²⁹ If one owner fails to take its opportunity to produce the oil or gas or use the storage space within its estate, another owner in the common reservoir may legitimately exercise its opportunity to produce or use more than its ratable share.²³⁰ The trouble comes in attempting to define the limits of the principle—what kind of activity is not “reasonable and legitimate,” what constitutes a “just and reasonable share,” and what is “waste”? In other words, what conduct violates the fair opportunity principle underpinning an owner’s correlative rights?

B. Element One: An Act by the Defendant

1. Specifying the Elements of Actionable Conduct Generally

The next step in delineating a formal definition of subsurface property rights is to specify the type of conduct by a defendant that amounts to an actionable interference of a plaintiff’s subsurface interest.²³¹ Here, the focus of the inquiry shifts from the nature of the *property* interest to the elements of *tort* liability for infringing the property interest. While defining the underlying property interest is generally a prerequisite to determining the applicable regime of tort liability to protect it, when courts systematically fail to make this initial step explicit, it is necessary to deduce the nature of the protected property interest from the tort doctrine that courts actually apply.

When pieced together in this fashion, the elements of liability for subsurface property invasions closely resemble the tort of nuisance, more so than trespass.²³² The mere fact of an unauthorized entry, or invasion, into the physical boundaries of another’s subsurface property does not result in liability in the cases, as it would were trespass the applicable tort. Rather, invasions that have resulted in liability have occasioned some kind of substantial harm to the plaintiff’s existing *use or enjoyment* of (or fair opportunity to use or enjoy) the subsurface property. This conclusion is consistent with the characterization of the legal nature of subsurface property as affording the owner only a nonexclusive opportunity to exploit commonly owned resources rather than a right of exclusive possession.²³³

Analyzing the cases in this way reveals three essential elements of liability for unauthorized invasion of another’s subsurface property interest. First, there

229. Pierce, *supra* note 36, at 800.

230. Robert E. Hardwicke, *Oil-Well Spacing Regulation and Protection of Property Rights in Texas*, 31 TEX. L. REV. 99, 106 (1952).

231. See Epstein, *supra* note 207, at 53.

232. Schremmer, *supra* note 23, at 342–43.

233. *Id.* at 340–42.

must be an affirmative act of the defendant; mere nonfeasance or natural conditions beyond the defendant's control do not cause an actionable invasion. Second, the defendant's conduct must cause an actual physical invasion, that is, entry into the physical boundaries of the plaintiff's subsurface property claim, although the entry need not be one that would suffice for trespass liability. Third, the invasion must actually interfere with the plaintiff's ongoing use of its subsurface property or its fair opportunity to use the property. These three elements capture the bulk of reported subsurface property disputes.

2. *Specifying the First Element: An Act by the Defendant*

To amount to an actionable interference with a plaintiff's subsurface interest, the defendant must have undertaken or ratified an affirmative act or created a subsurface condition that causes a physical invasion of the boundaries of the plaintiff's interest. A defendant is not liable if it merely failed to act, such as when the invasion and harm to the plaintiff resulted from natural conditions or occurrences outside of the defendant's control. In other words, a defendant is liable for misfeasance but not its nonfeasance. Thus, in *Larkins-Warr Trust v. Watchorn Petroleum Co.*,²³⁴ the defendant was not liable for a subsurface flow of saltwater that originated in the defendant's well and watered out the plaintiff's well because the defendant did not cause the water flow, and, moreover, immediately attempted to seal it off.²³⁵

In some cases, however, the indirect effects of a defendant's actions can cause actionable harm to the plaintiff. In *Higgins Oil & Fuel Co. v. Guaranty Oil Co.*,²³⁶ the plaintiff alleged that the defendant failed to plug a dry well on its property, which allowed air to infiltrate the producing formation and interfere with the operation of plaintiff's downhole pumps.²³⁷ In holding the defendant liable, the court explained the act requirement:

Were this result brought about by the mere inaction of defendant, plaintiff could not complain. An owner is not bound to do anything to save his neighbor from loss. The only restriction upon him is that he abstain from doing anything that may cause a loss. In the present case defendant is not charged with mere inaction, but with the action of having bored this well and thereby opened a vent for the air to penetrate where it causes injury. Had defendant left things in their original condition, plaintiff would not be suffering. Defendant is causing this air to pass from its land to that of plaintiff. True, defendant is now merely passive or inactive; but the agency complained of

234. 174 P.2d 589 (Okla. 1946).

235. *Id.* at 593-94.

236. 145 La. 233 (1919).

237. *Id.* at 234-35.

was set in motion by defendant. Defendant alone is responsible for its beginning and its continuing: its activity is therefore that of defendant.²³⁸

The act requirement ensures that the defendant did something to cause the harm to the plaintiff's interest, either through a direct affirmative act or indirectly by creating the conditions that resulted in the harm. By requiring some culpability on the part of the defendant, the act requirement excludes a pure form of strict liability. Rather, courts tend to require, if the defendant's act is intentional, that the consequences be foreseeable²³⁹ or, if the defendant's act is unintentional, that the act be negligent or reckless.²⁴⁰

Strict liability can be imposed by statute or constitutional provision. Oklahoma courts interpret a provision of that state's constitution, which "removes the common law elements of carelessness or unreasonableness" from the doctrine of private nuisance, as imposing strict liability for subsurface injuries.²⁴¹ In Oklahoma, a defendant may be liable for injury to a plaintiff's subsurface property as long as it was legally caused by an act of the defendant, apparently regardless of whether the act was volitional or its consequences reasonably foreseeable.²⁴² Yet, strict liability remains the minority rule, despite some support in the literature.²⁴³

At bottom, the basis for liability for subsurface interference resembles the Restatement's version of nuisance. Where the other elements of liability are

238. *Id.* at 248; *accord* *Atkinson v. Va. Oil & Gas Co.*, 79 S.E. 647, 712 (W. Va. 1913) (holding plaintiff had a good cause of action against defendant for damage to plaintiff's gas well arising from defendant's failure to plug a dry well on its land).

239. *See, e.g.*, *Tidewater Oil Co. v. Jackson*, 320 F.2d 157, 164 (10th Cir. 1963); *accord* *McCoy v. Ark. Nat. Gas Co.*, 143 So. 383, 384–86 (La. 1932) (dismissing initial complaint for failure to allege any fault beyond mere "bad judgment"); *McCoy v. Ark. Nat. Gas Co.*, 165 So. 632, 633 (La. 1936) (finding an allegation that the same defendant had acted "willfully and intentionally" to be sufficient).

240. *Elliff v. Texon Drilling Co.*, 210 S.W.3d 558, 582–83 (Tex. 1948).

241. *Greyhound Leasing & Fin. Corp. v. Joiner City Unit*, 444 F.2d 439, 441–42 (10th Cir. 1971); *Fairfax Oil Co. v. Bolinger*, 97 P.2d 574, 575–76 (Okla. 1939). Kansas also has a statute making it illegal to permit releases or flow of saltwater, oil, or refuse into freshwater sources, which the Kansas Supreme Court interpreted to create a private cause of action for absolute liability. *Polzin v. Nat'l Coop. Refinery Ass'n*, 266 P.2d 293, 297 (Kan. 1954).

242. *Greyhound Leasing*, 444 F.2d at 441.

243. The leading proponent for strict liability among scholars, Owen Anderson, would require payment of actual damages for any substantial harm resulting from a defendant's subsurface activities, regardless of whether the defendant acted negligently or whether the social utility of the defendant's conduct outweighs the gravity of harm suffered by the plaintiff. Anderson, *supra* note 55, at 248–50. Anderson's position is overbroad because it requires compensation for *any damage* to the plaintiff's subsurface property, rather than merely for *legal injury* to the plaintiff's property interest. The starting point for a formal delineation of liability must be the nature of the plaintiff's legal interest—the fair opportunity to use—rather than the standard of fault.

satisfied, an act of the defendant will constitute an actionable violation of the plaintiff's subsurface property interests if the act is either (i) intentional and its consequences foreseeable, or (ii) unintentional and otherwise actionable under the rules of negligence, recklessness, or strict liability.²⁴⁴ As with nuisance, liability for subsurface invasions turns on the type of harm—interference with the plaintiff's fair opportunity to use—rather than on any particular conduct of the defendant. Where a culpable act of the defendant legally causes the type of harm—interference with the plaintiff's fair opportunity to use—liability should result.

C. Element Two: Physical Invasion of the Plaintiff's Subsurface

The cases demonstrate that there is generally no liability for actions undertaken within the physical boundaries of the defendant's own tract. To make a prima facie case for violation of its subsurface rights, a plaintiff must show that the defendant's actions invaded the physical boundary lines defining the plaintiff's subsurface claim. The physical invasion requirement comports with the structure of the relationship among subsurface owners in a common resource. The rule of capture and offset drilling corollary protect owners' fair opportunity rights only if all subsurface owners are secure in their exclusive use of the portion of the common reservoir underlying their land. If the subsurface structures within an owner's claim are damaged or occupied by another, it could interfere with the owner's ability to "go and do likewise" and thus might infringe the owner's property right to a fair opportunity to use a proportional share of the common property. Moreover, the physical invasion requirement draws a bright line separating potentially actionable from nonactionable conduct, making it simpler to delineate the parties' property rights and determine causation in any given case.²⁴⁵

The physical invasion requirement exempts from liability subsurface activities that do not extend beyond the boundary lines of the defendant's own subsurface claim. Subsurface mineral owners are therefore entitled to any oil and gas drained from a well located exclusively within their estate under the rule of capture²⁴⁶ and are protected from any other person physically invading the boundaries of their estate to produce oil or gas, such as through a deviated, or

244. Cf. RESTATEMENT (SECOND) OF TORTS § 822(d) (AM. L. INST. 1969).

245. See Epstein, *supra* note 207, at 55–60 (discussing the importance of the physical invasion requirement in determining causation for his corrective justice model of nuisance law); Smith, *supra* note 57, at 2079 (noting "the coherence lent to nuisance by the role that exclusion plays in it").

246. Kelley v. Ohio Oil Co., 49 N.E. 399, 401 (Ohio 1897); see also Higgins Oil & Fuel Co. v. Guar. Oil Co., 82 So. 206, 211–12 (La. 1919) (permitting use of artificial pumps to drain oil and gas from a reservoir).

“slant-hole,” well.²⁴⁷ Similarly, subsurface owners are entitled to inject fluids to store in the pore space of reservoirs, so long as the injectate does not migrate beyond the boundaries of the injector’s property.

Depending on the physical extent of the injector’s estate, migration and physical invasion into the bounds of other estates is usually likely. It does not follow automatically, however, that subsurface injection always violates the rights of the owners whose estates are physically invaded. On the contrary, there must be a physical invasion *and* a substantial interference with the use or enjoyment of the other’s subsurface interest under the third element of the doctrine.²⁴⁸

As with nuisance, the kind of physical invasion that suffices to trigger liability for subsurface invasion is less than that required for traditional trespass liability. An actionable invasion may involve tangible objects or fluid substances, as well as intangible energy and pressure. Courts have found actionable violations of subsurface property rights based on invasions by water,²⁴⁹ frack fluids and proppants,²⁵⁰ slant-hole and directional wellbores,²⁵¹ tunnels,²⁵² natural gas,²⁵³ toxic gas,²⁵⁴ fire,²⁵⁵ air,²⁵⁶ and vibrations.²⁵⁷

Even the mere invasion by pressure or energy has triggered liability.²⁵⁸ If there is any distinction between matter and energy, it is of little consequence in this area, as in nuisance law,²⁵⁹ except insofar as it complicates the determina-

247. *See, e.g.*, *Shell Oil Co. v. Richter*, 125 P.2d 930, 931–32 (Cal. Ct. App. 1942) (subsurface trespass by slant drilling); *Alphonzo E. Bell Corp. v. Bell View Oil Syndicate*, 76 P.2d 167, 171 (Cal. Ct. App. 1938).

248. *See infra* Part III.C–D.

249. *See, e.g.*, *Tidewater Oil Co. v. Jackson*, 320 F.2d 157, 164 (10th Cir. 1963); *Atkinson v. Va. Oil & Gas Co.*, 79 S.E. 647, 648 (W. Va. 1913).

250. *See, e.g.*, *Stone v. Chesapeake Appalachia, LLC*, No. 5:12-CV-102, 2013 WL 2097397, at *8 (N.D. W. Va. Apr. 10, 2013).

251. *See, e.g.*, *Bell View Oil Syndicate*, 76 P.2d at 175 (slant-hole well); *Chevron Oil Co. v. Howell*, 407 S.W.2d 525, 528 (Tex. Civ. App. 1966) (horizontal wellbore).

252. *See, e.g.*, *Smith v. City of Atlanta*, 17 S.E. 981, 981 (Ga. 1893); *City of Chicago v. Troy Laundry Mach. Co.*, 162 F. 678, 679 (7th Cir. 1908).

253. *See, e.g.*, *Hammonds v. Cent. Ky. Nat. Gas Co.*, 75 S.W.2d 204 (Ky. 1934); *ANR Pipeline Co. v. 60 Acres of Land*, 418 F. Supp. 2d 933 (W.D. Mich. 2006).

254. *See, e.g.*, *Swift Energy Operating, LLC v. Regency Field Servs. LLC*, 608 S.W.3d 214 (Tex. App. 2019) (dismissing the claim under the statute of limitations).

255. *See, e.g.*, *Elliff v. Texon Drilling Co.*, 210 S.W.2d 558 (Tex. 1948).

256. *See, e.g.*, *Higgins Oil & Fuel Co. v. Guar. Oil Co.*, 82 So. 106 (La. 1919).

257. *See, e.g.*, *Fairfax Oil Co. v. Bolinger*, 97 P.2d 574, 575 (Okla. 1939).

258. *See infra* text accompanying notes 266–69.

259. *Martin v. Reynolds Metals Co.* held that invasion of invisible, intangible fluoride particles into plaintiff’s property could constitute an actionable nuisance because modern physics had shown that energy is merely matter in another form. 342 P.2d 790, 794–96 (Or. 1959) (en banc). So, too, with subsurface invasions, where courts have held that pressure or force is a sufficient physical invasion to justify liability for a violation of correlative rights.

tion of causation. In cases where the physical invasion is by mere force, pressure, or energy, to cause the plaintiff actual damage of any sort the invading element must interact with some tangible, physical object or substance. It is not the intangible element itself that directly causes any injury, but the physical damage it causes.²⁶⁰

*Comanche Duke Oil Co. v. Texas Pacific Coal & Oil Co.*²⁶¹ is demonstrative. The plaintiff alleged that the defendants destroyed the oil producing formation within the plaintiff's tract by "shooting" a well located on the defendants' own tract with 600 quarts of nitroglycerine.²⁶² It was not the blast from the nitroglycerine itself that destroyed the plaintiff's formation, but rather a flood of saltwater from another formation that was unleashed by the force of the blast.²⁶³ The court attributed responsibility to the defendant for both the aggregate impact of the blast plus the breach of the saltwater-bearing formation because each link in the causal chain was individually traceable as a natural and probable consequence of the defendant's act.²⁶⁴ The court explained:

The fact of use of a large alien force with scienter that a portion of it would in obedience to natural laws and by natural means inevitably reach across the boundary supplies the element of "naturalness", or "probability" as that element is known in the law of causation. That fact and that scienter, plus knowledge or notice that the degree of alien force as it should cross the boundary might be of destructive measure so as alone or in concurrence with one or more contributing forces (other than the injured person's wrong) such, e.g., as vicinal presence and movement of salt-water, to produce some such injury as that complained of make up a basis for whatever foresee-ability, or anticipation, is required in proximate causation.²⁶⁵

Cases involving fracking operations that cross property lines within unconventional, or "tight," rock formations raise difficulty in applying the invasion requirement. As noted previously, there have been several such cases, with differing results.²⁶⁶ Despite the difficulty, hydraulic fracturing and the presence of

260. See *Kennedy v. Gen. Geophysical Co.*, 213 S.W.2d 707, 711–12 (Tex. App. 1948) (finding no liability for invasion by seismic vibrations when the vibrations did not cause actual damage to the plaintiff's property).

261. 298 S.W. 554 (Tex. Comm'n App. 1927).

262. *Id.* at 559.

263. See *id.*

264. *Id.* at 564–66.

265. *Id.* at 564 (citations omitted).

266. See, e.g., *Gregg v. Delhi-Taylor Oil Corp.*, 344 S.W.2d 411, 416 (Tex. 1961) (noting in dicta that cross-boundary fracking would constitute a subsurface trespass); *Coastal Oil & Gas Corp. v. Garza Energy Tr.*, 268 S.W.3d 1 (Tex. 2008) (dismissing mineral owners' claims of trespass by frack); *Stone v. Chesapeake Appalachia, LLC*, No. 5:12-CV-102, 2013 WL 2097397 (N.D. W. Va. Apr. 10, 2013) (recognizing a claim for trespass by frack); Max

tight shale formations do not change the physical invasion requirement.²⁶⁷ Even where no foreign matter, like proppants, enters the plaintiff's subsurface boundaries, the pressure or energy from a frack treatment alone satisfies the physical invasion requirement. Cases alleging trespass by frack usually fail not on the physical invasion requirement but on the third element of the doctrine because transboundary fracking generally does not interfere with the plaintiff's fair opportunity rights.²⁶⁸

Proving the fact of a physical invasion occurring deep underground is frequently difficult. Many claims for relief have failed for lack of sufficient evidence of a physical invasion.²⁶⁹ As *Comanche Duke* acknowledged, “[a] litigant, however, is not required to prove his cause or defense to the extent of certainty,” and may create a fact issue with at least “proof of the kind of which the nature of the case permits (in this instance and on this point, circumstantial).”²⁷⁰ Often that proof is in the form of expert evidence.²⁷¹ Invasion is easier to prove in cases in which it results in actual physical interference with the plaintiff's ability to use its subsurface property, which is often detectable at the surface of the earth, and more difficult where the result is a change in subsurface conditions that have no palpable effect on the plaintiff's activities.

In this regard, the physical invasion requirement provides a natural check on the litigation of subsurface disputes, permitting claims for invasions that are likely to also satisfy the third element of liability (interference with the plaintiff's existing operations or its fair opportunity to use) to proceed while throwing up an obstacle to those claims that are unlikely to satisfy the third element. Thus, liability often—but by no means always—attaches in cases that involve relatively obvious physical invasions, such as where the defendant drills a slanted wellbore into the plaintiff's subsurface tract or the defendant allows re-

Oil Co. v. Range Prod. Co., 681 F. App'x 710 (10th Cir. 2017) (dismissing vertical well operator's tort claims against a horizontal well operator based on fracking interference as untimely); *Briggs v. Sw. Energy Prod. Co.*, 224 A.3d 334 (Pa. 2020) (recognizing mineral owners' claims of trespass by frack and remanding for factfinding).

267. *Briggs*, 224 A.3d at 347–49.

268. See *infra* Part III.D.

269. See, e.g., *Briggs*, 224 A.3d at 352 (holding that it is necessary to allege a physical invasion to state a prima facie case for subsurface trespass and finding that plaintiff's petition lacked such an allegation); *Chance v. BP Chems., Inc.*, 670 N.E.2d 985, 993 (Ohio 1996) (noting the plaintiffs' “hypothetical models” that attempted to demonstrate the defendant's chemical injectate invaded the plaintiffs' subsurface were “somewhat speculative” and dismissing their claims for trespass); *ANR Pipeline Co. v. 60 Acres of Land*, 418 F. Supp. 2d 933, 939 (W.D. Mich. 2006) (holding that a natural gas storage facility operator could be liable for trespass for injected substances that moved onto the plaintiffs' property, but plaintiffs failed to present evidence that an invasion occurred).

270. *Comanche Duke Oil Co. v. Tex. Pac. Coal & Oil Co.*, 298 S.W. 554, 566 (Tex. 1927).

271. See, e.g., *Hill v. Sw. Energy Co.*, 858 F.3d 481, 485–87 (8th Cir. 2017) (reviewing district court's excluding as speculative plaintiff's expert testimony pertaining to the migration pattern of defendant's injected “fracking waste”).

fuse to enter the plaintiff's water well, and often does not result in cases where the invasion makes no mark of actual physical damage.

D. Element Three: Impairment of the Plaintiff's Existing Use or Fair Opportunity to Use

The third element of liability for subsurface intrusions is substantial impairment of the plaintiff's existing use or its fair opportunity to use the subsurface. It is principally this element of the test that determines whether harm caused by a physical invasion into a plaintiff's subsurface constitutes legal injury to the plaintiff's property interest or instead is merely *damnum absque injuria*.²⁷² And it is on this third element of the test that most allegations of subsurface injury fail.

In explaining why any given intrusion is or is not actionable, courts employ a variety of tests and rationales. To discern the difference that actually governs the distinction, it is necessary to compare the cases where a physical invasion did not result in liability with cases in which similar invasions were held to be actionable and identify the fact or facts that distinguish them. This analysis produces the third element of liability: that the defendant's physical invasion of the plaintiff's subsurface boundaries substantially impairs either the plaintiff's (i) existing use of the subsurface reservoir, for example oil or gas production or saltwater disposal or (ii) its fair opportunity to use the subsurface reservoir for a similar use as the defendant's, or in other words, that precludes the plaintiff from "doing likewise."

In addition to being faithful to how the cases were decided, this analysis gives effect to the fair opportunity principle underlying the nature of the subsurface property interest. Ordinarily, an owner's subsurface right to a fair opportunity to use the common reservoir is protected from injury by the rule of capture and offset drilling corollary, which provide a potential plaintiff with a self-help remedy in lieu of a cause of action. When, however, one subsurface owner's actions in a shared reservoir interfere with another's lawful use of its portion of the reservoir or its fair chance to make use of the reservoir, self-help cannot rebalance the correlative relationship of the subsurface owners; only a legal action can do so. A plaintiff whose well is ruined by the intrusion of saltwater, for instance, cannot fully recover the loss simply by drilling a new well or by destroying a well of the defendant that caused the intrusion. Likewise, a plaintiff whose portion of a subsurface reservoir is flooded with carbon dioxide from a neighboring defendant's CCS operation may not have the physical ability to use the flooded formation within her property for any purpose,

272. Put another way, the test determines when a physical invasion is unlawful so as to constitute a trespass. See *Boudreaux v. Jefferson Island Storage & Hub*, 255 F.3d 271, 274 (5th Cir. 2001) (defining a trespass as "an unlawful physical invasion" and addressing whether defendant's saltwater injection was "unlawful" (quotations and citations omitted)).

including her own CCS operation. Nothing a plaintiff in these and similar situations can do on her own will remedy her loss of a fair chance to use or continue using the subsurface resource.

The analysis of the third element proceeds by comparing cases of no liability for subsurface invasions with those in which liability was found. This will be done across three typical kinds of invasions: those from (i) disposal and storage operations, (ii) deviated and horizontal wellbores and fracking, or (iii) secondary and enhanced hydrocarbon recovery operations. The discussion demonstrates the necessity of either actual substantial interference with the plaintiff's ongoing use or preclusion of its fair opportunity to use the subsurface resource.²⁷³

1. Invasions from Disposal and Storage Operations

There are many reported cases in which a physical subsurface invasion was not actionable. A significant number of these no-liability cases involve the invasion of injected saltwater or other fluid wastes. For instance, in *West Edmond Salt Water Disposal Association v. Rosecrans*,²⁷⁴ the plaintiffs, subsurface owners in a common reservoir with the defendants, sued the defendants for ejection and damages on the basis that the defendants had injected "great quantities" of produced saltwater into the reservoir that physically invaded the plaintiff's boundaries.²⁷⁵ The court held that the mere fact of a physical invasion of saltwater was insufficient to establish injury to the plaintiff's property absent accompanying "actual damage" or deprivation "of any right pertaining to, or consistent with, the full and complete use, occupation, or enjoyment" of the plaintiff's interest.²⁷⁶ Courts across jurisdictions have denied liability on similar

273. Incidentally, J.E. Penner has also observed that the tort of nuisance, like the fair opportunity theory, includes or encompasses a "deprivation tort" that protects an owner against the wrong of being excluded (or precluded) from its property. J.E. Penner, *Property*, in THE OXFORD HANDBOOK OF THE NEW PRIVATE LAW 291 (Andrew Gold et al. eds., 2021) (citing Donal Nolan, *The Essence of Private Nuisance*, in 10 MODERN STUDIES IN PROPERTY LAW 72 (Ben McFarlane ed., 2019)).

274. 226 P.2d 965 (Okla. 1950).

275. *Id.* at 967.

276. *Id.* at 969.

facts,²⁷⁷ as well as in cases involving invasions of injected natural gas that do not interfere with the plaintiff's actual or foreseeable use of its subsurface.²⁷⁸

Courts have employed a number of rationales to justify denying liability in these cases. The court in *Rosecrans*, for instance, rested its decision on two rationales. First, it reasoned that the defendants abandoned title to the injected saltwater when it migrated across the property line, relieving them of responsibility for it.²⁷⁹ Second, the court relied on the principle "that a person may use his property in any lawful manner, except that he must not use it so as to injure or damage his neighbor."²⁸⁰ Notwithstanding the conclusory nature of the court's justifications, the true principle supporting this and similar results in other cases is clear when they are compared with cases in which the defendant was held liable for its physical invasion.

Compare the above no-liability cases with those in which invasions were held to be actionable. Straightforwardly, liability lies when the invasion adversely affects an ongoing subsurface activity. Thus, in *West Edmond Hunton Lime Unit v. Lillard*,²⁸¹ the court affirmed a jury verdict against an injector whose injected saltwater entered the plaintiff's subsurface and ruined its producing oil well.²⁸² On this same basis, in *Hanson v. North Dakota Industrial Commission*,²⁸³ an order of the state conservation commission denying an operator's application for saltwater injection authority did not violate the operator's

277. See, e.g., *Boudreaux*, 255 F.3d at 275; *Raymond v. Union Tex. Petrol. Corp.*, 697 F. Supp. 270, 273–75 (E.D. La. 1988); *Crawford v. Hrabe*, 44 P.3d 442, 452 (Kan. 2002); *Cassinovs v. Union Oil Co. of Cal.*, 18 Cal. Rptr. 2d 574, 577–78 (1993); *FPL Farming Ltd. v. Env't Processing Sys., L.C.*, 351 S.W.3d 306 (Tex. 2011); see also Schremmer, *supra* note 23, at 343–52 (surveying waste injection cases); cf. *Chance v. BP Chems., Inc.*, 670 N.E.2d 985, 992 (Ohio 1996) (denying liability for alleged invasion of chemical injectate).

278. *ANR Pipeline Co. v. 60 Acres of Land*, 418 F. Supp. 2d 933, 940–41 (W.D. Mich. 2006); *Baatz v. Columbia Gas Transmission, LLC*, 929 F.3d 767, 773, 777 (6th Cir. 2019); see also Schremmer, *supra* note 23, at 355–58 (surveying gas injection cases).

279. *Rosecrans*, 226 P.2d at 972–73.

280. *Id.*

281. 265 P.2d 730 (Okla. 1954).

282. *Id.* at 732–33; accord *Tidewater Oil Co. v. Jackson*, 320 F.2d 157 (10th Cir. 1963) (holding defendant liable to plaintiff for causing water to destroy its wells); *Sheridan Oil Co. v. Wall*, 103 P.2d 507 (Okla. 1940) (finding liability for the seepage of water from defendant's negligently plugged well when it polluted plaintiff's water well); *Higgins Oil & Fuel Co. v. Guar. Oil Co.*, 82 So. 206 (La. 1919) (finding liability for damages based on the fact that defendant permitted air to enter its plugged well and interfere with the operation of plaintiff's downhole pump); *Atkinson v. Va. Oil & Gas Co.*, 79 S.E. 647 (W. Va. 1913) (permitting a plaintiff to recover damages for destruction of his well resulting from a saltwater infiltration caused by defendant's failure to plug its well).

283. *Hanson v. N.D. Indus. Comm'n*, 466 N.W.2d 587 (N.D. 1991). Many more cases are collected at Anderson, *supra* note 55, at 255–81.

correlative rights because there was substantial evidence that the proposed injection would risk damage to an offsetting operator's oil and gas production.²⁸⁴

While actual damage to a plaintiff's ongoing subsurface operation is sufficient to create an actionable violation of the plaintiff's subsurface rights, it is not necessary. As the following subsections illustrate, many courts find violations even in the absence of physical property damage.

2. *Invasions from Deviated and Horizontal Wells and Frack Fissures*

The classic case of subsurface trespass involves a defendant intentionally drilling a wellbore that deviates from the surface of its tract and into a producing formation underlying the plaintiff's tract. The opinions in these "slant-hole well" cases uniformly find liability for trespass and conversion of mineral when the deviated wellbore produces oil or gas from the plaintiff's side of the property line.²⁸⁵ However, where the wellbore is unproductive of mineral and merely takes up space in the deep subsurface of the plaintiff's tract, courts are apt to find any damage to be "wholly inconsequential."²⁸⁶ The nature of the legal injury in slant-hole well cases is clearly the conversion of valuable mineral more so than the physical entry of an unauthorized drill bit and wellbore.²⁸⁷

Similarly, outside of the oil and gas context, courts tend to deny liability for tunneling deep below the surface of a plaintiff's land when the tunnel causes no interference with the plaintiff's ability to use and enjoy the surface. In one such case denying relief, a New York appellate court concluded that the plaintiff's claim for damages for the defendant's tunnel, which was to be located 150 feet below the surface of the plaintiff's land, "was unsubstantial and fanciful, with no sound basis to rest upon."²⁸⁸ Yet, in cases where the defendant's subsurface tunneling actually harmed the plaintiff's ability to use and enjoy the surface of its land, such as where the plaintiff's building sunk into the tunnel after

284. *Hanson*, 466 N.W.2d at 594.

285. See generally Mortimer Kline, *Subsurface Trespassing*, 5 J. MARSHALL L.Q. 30 (1939) (discussing the cases); Note, *Suing a Slant-Driller for Subsurface Trespass or Drainage*, 15 STAN. L. REV. 665, 680 (1963) (discussing the cases as the earliest form of subsurface trespass in the oil and gas context).

286. *Union Oil Co. of Cal. v. Domengeaux*, 86 P.2d 127, 130 (Cal. Ct. App. 1939).

287. See *Alphonzo E. Ball Corp. v. Bell View Oil Syndicate*, 76 P.2d 167, 175 (Cal. Ct. App. 1938) ("We do not need to discuss the injury to the real estate, as these actions are not based upon damages suffered to the real estate but are based upon the wrongful conversion of oil, gas, and other hydrocarbons from beneath the property."); see also Schremmer, *supra* note 23, at 358–61 (synthesizing several such cases).

288. *In re Tunnel Street in City of N.Y.*, 144 N.Y.S. 1002, 1003 (N.Y. App. Div. 1913), *aff'd*, 106 N.E. 1043 (N.Y. 1914).

construction²⁸⁹ or the tunneling removed valuable sand that the plaintiff would have otherwise sold,²⁹⁰ courts have granted relief.

The advent of large-scale horizontal drilling in the oil and gas industry presented courts with the question of whether the act of drilling horizontally through the mineral estate of another to reach the driller's minerals in an adjacent tract constitutes a trespass to the plaintiff's mineral interest. The seminal case is *Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, discussed previously, which held that the mere fact that a wellbore penetrates an owner's mineral estate without permission does not establish liability.²⁹¹ The court's opinion explained that the plaintiff could only speculate that the defendant's wellbores and drilling activities would "interfere with both the surface and subsurface spaces necessary for it to exercise its right to develop the minerals in the future."²⁹² The plaintiff could not demonstrate either that its existing operations were affected by the defendant's drilling or that it had lost the opportunity to commence any new drilling operations to further produce the areas where the defendant's wellbores were to be located.²⁹³ Setting aside the court's policy reasoning that encouraging horizontal drilling served the public interest and justified any interference with the plaintiff's mineral estate,²⁹⁴ this explanation is consonant with the nature of the plaintiff and defendant's legal relationship as adjoining subsurface owners.

The same reasoning applies in transboundary fracking cases like *Garza*, discussed previously.²⁹⁵ Where, as in *Lightning*, there is no interference with ongoing operations, nor any evidence that the defendant's frack fissures would preclude future development by the plaintiffs, including by reciprocally fracking into the defendant's subsurface, there is no liability for the invasion.²⁹⁶

Stripped of their policy reasoning, the bulk of the cases demonstrate that the mere presence of an unpermitted intrusion by a wellbore is not actionable without accompanying production from the wellbore within the plaintiff's tract or proof that the wellbore actually precludes the plaintiff's current or future plans of development.

But the question remains why a defendant's slant-hole well that produces oil or gas directly from a plaintiff's tract should be held actionable when hydraulic frack fissures that drain oil or gas from a plaintiff's tract into the defendant's well should not. It is possible to answer this question on functionalist grounds, as the cases tend to do. The decisions weigh the social importance of

289. *City of Chicago v. Troy Laundry Mach. Co.*, 162 F. 678, 679 (7th Cir. 1908).

290. *Smith v. City of Atlanta*, 17 S.E. 981 *passim* (Ga. 1893).

291. *See supra* text accompanying notes 69–70.

292. *Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, 520 S.W.3d 39, 49 (Tex. 2017).

293. *Id.* at 49–51.

294. *See supra* text accompanying notes 66–70.

295. *See supra* text accompanying notes 51–53, 60–63.

296. *Coastal Oil & Gas Corp. v. Garza Energy Tr.*, 268 S.W.3d 1, 14 (Tex. 2008).

oil and gas production with the policy of protecting holdout and small-tract landowners from the actions of offset oil and gas operators.²⁹⁷ Results vary unpredictably with the proclivities of particular judges. Alternatively, the answer could proceed internally from the legal nature of the parties' relationship as co-owners in an interconnected subsurface reservoir and from the fair opportunity principle that gives substance to that relationship.

Applying the fair opportunity principle, it is plain that the slant-hole well impinges on the plaintiff's ability to produce the reserves within its tract, whereas frack fissures alone do not. The presence of a slant-hole wellbore physically precludes the plaintiff from placing a well in the same location and producing the proximate oil or gas; the presence of frack fissures, in contrast, does not prevent the plaintiff from drilling or fracking into the same portion of the reservoir. State well-spacing regulations, furthermore, prohibit the drilling of new wells within the near vicinity of existing wells but do not generally limit the placement of wells in the vicinity of frack fissures.²⁹⁸ Consequently, the damage done by a producing slant-hole wellbore is not necessarily remediable by simply allowing the plaintiff to drill its own slant-hole wellbore, whereas the damage done by cross-boundary frack fissures can be remedied by allowing the plaintiff to do the same. The distinction thus turns on the conduct's effects on a plaintiff's fair opportunity to develop its portion of the subsurface.

3. *Invasions from Secondary and Enhanced Recovery Operations*

Secondary and enhanced recovery operations are conducted in mature oil and gas producing fields to reenergize the reservoir by injecting water ("secondary recovery," and sometimes called a "waterflood") or other substances like carbon dioxide, detergents, steam and fire, or dry natural gas ("tertiary" or "enhanced recovery").²⁹⁹ By their nature, secondary and enhanced operations require use of the whole of a reservoir formation. Consequently, such operations implicate the interests of numerous owners across large areas of reservoir, which are typically consolidated or "unitized" by an administrative authority.³⁰⁰ Despite the availability of compulsory unitization, it is often the case that some reservoir owners' interests are not committed or subject to the secondary or enhanced recovery operations. These non-joiners ("window interests") some-

297. Compare *id.* (striking the balance in favor of hydraulic fracturing and production), with *Stone v. Chesapeake Appalachia, LLC*, No. 5:12-CV-102, 2013 WL 2097397, at *6–8 (N.D. W. Va. Apr. 10, 2013) (striking the balance in favor of the interests of small holders).

298. See, e.g., Establishment of Drilling Units for Gas Production from Conventional and Unconventional Sources of Supply Occurring in Certain Prospective Areas Not Covered by Field Rules, 178-00-15 ARK. CODE R. § 002-B-43(i) (Nov. 11, 2021).

299. Gaylen C. Methvin, *Secondary Recovery Operations: Rights of the Non-Joiner*, 42 TEX. L. REV. 364 *passim* (1964).

300. *Id.* at 365.

times sue the operator of a neighboring unit when the operator's injected fluids cross the boundary line of the unit and sweep valuable minerals from the window tract into the unit.³⁰¹

Discovering a unifying principle in these cases that explains when and why such invasions are actionable is important not only in understanding the nature of a subsurface owner's right to conduct secondary and enhanced recovery operations but also the right to use a subsurface reservoir or saline aquifer to inject large volumes of carbon dioxide for CCS, which uses most or all of a geologic formation.

a. No-Liability Cases

Cases and commentary exist suggesting that a non-joining reservoir owner has no cause of action against the operator of a neighboring secondary or enhanced recovery unit for the invasion of fluid that causes the loss of valuable minerals under the plaintiff's tract. The leading example is *Railroad Commission v. Manziel*.³⁰² The plaintiff asked the Texas Supreme Court to set aside an order of the Railroad Commission allowing an operator to drill injection wells at irregular locations near the plaintiff's tract to waterflood a common reservoir. The plaintiff claimed trespass, arguing that the waterflood would encroach under his tract and cut short the life of his producing well. Citing a leading oil and gas treatise for a principle called the "negative rule of capture," the court held that the plaintiff had no cause of action against the Commission for authorizing secondary recovery operations, and that "a trespass does not occur when the injected, secondary recovery forces move across lease lines."³⁰³ The court reached this conclusion by balancing the "interests of society and the oil and gas industry as a whole against the interests of the individual operator who is damaged."³⁰⁴

b. Liability Cases

Despite the broad proclamation of the negative rule of capture and the opinion in *Manziel*, there are many cases in which a non-joining plaintiff recovered damages for subsurface invasions caused by an offset secondary or enhanced recovery unit. The first category of these cases is familiar, as they involve circumstances in which the fluids injected by the unit operator actually damage the ongoing subsurface operations of a non-joiner. In *Hartman v. Texaco, Inc.*,³⁰⁵ for example, a unit operator was held liable for trespass when water

301. See, e.g., *R.R. Comm'n v. Manziel*, 361 S.W.2d 560 (Tex. 1962).

302. 361 S.W.2d 560 (Tex. 1962).

303. *Id.* at 568-69 (citing 1 WILLIAMS & MEYERS, OIL AND GAS LAW § 204.5).

304. *Id.* at 568.

305. 937 P.2d 979 (N.M. Ct. App. 1997).

it had injected escaped the unit and migrated into the plaintiff's oil and gas lease, causing the plaintiff's well to blow out.³⁰⁶ Likewise, in *Jackson v. Tidewater Oil Co.*,³⁰⁷ the unit operator was held liable for watering out the plaintiff's well outside the unit.³⁰⁸ Similarly, the damage resulting from saltwater encroachment into a plaintiff's fresh groundwater aquifer has led to liability.³⁰⁹

In the second category of cases, liability hinges not on physical damage to a plaintiff's ongoing operations but on the plaintiff's lost opportunity to use the reservoir because the unit operations virtually preclude any other reservoir activity. As Eugene Kuntz observed about secondary recovery operations,

[I]t is not always possible for each operator to "go and do likewise" and thereby obtain his fair share of the common source of supply. It may not be feasible for the operator to "go and do likewise," because he may still be on primary production and is not ready to undertake a secondary recovery project. It may also not be feasible for the operator to "go and do likewise," because of the type of the secondary recovery operation and the nature of the formation from which he is producing.³¹⁰

In many cases, non-joining subsurface owners suffer by being left out of reservoir-wide operations.³¹¹ Several reported cases have permitted such non-joining owners to recover damages against the operator of an offset secondary or enhanced recovery unit. These opinions demonstrate that the total preclusion of a subsurface owner's fair opportunity to use its portion of the subsurface injures its legal interest.

A trio of Arkansas cases demonstrates the principle. Starting in 1969, Ethyl Corp. operated a saltwater recycling project by which it produced saltwater from a reservoir approximately 8,000 feet below the surface. It then removed valuable minerals from the saltwater (including bromine) and re-injected the spent saltwater back into the reservoir.³¹² Ethyl purchased or leased the subsurface rights in most, but not all, of the brine field but did not unitize the field.³¹³ As a consequence, Ethyl defended repeated litigation brought by non-joining subsurface owners, which resulted in three reported cases.

306. *Id.*

307. 320 F.2d 157 (10th Cir. 1963).

308. *Id.* at 163–64. *See also* *Mowrer v. Ashland Oil & Refin. Co.*, 518 F.2d 659, 661 (7th Cir. 1975) (holding a secondary recovery unit operator liable for oil seepage caused in a neighboring plugged and abandoned well on a theory of strict liability for abnormally dangerous activities).

309. *Gulf Oil Corp. v. Hughes*, 371 P.2d 81, 84–85 (Okla. 1962).

310. 1 KUNTZ, *supra* note 44, § 4.8.

311. *See id.*

312. *Jameson v. Ethyl Corp.*, 609 S.W.2d 346, 347–48 (Ark. 1980).

313. *Id.*

In the first of these, *Budd v. Ethyl Corp.*,³¹⁴ the plaintiff owned an interest in two tracts, one 240-acre tract lying *outside* of the recycling project and another 40-acre tract *encircled* by Ethyl's injection wells.³¹⁵ Alleging trespass, the plaintiff claimed that the recycling project encroached under his tracts and replaced the *in-situ* brine water with less valuable water that had been stripped of its minerals.³¹⁶ The court denied relief as to the 240-acre tract lying *outside* the boundaries of the project on the grounds that the rule of capture barred the plaintiff's cause of action.³¹⁷ As to the 40-acre tract—the one situated *within* the recycling project—the court denied relief on other grounds unrelated to the rule of capture.³¹⁸

Four years later, another plaintiff sued, alleging trespass and conversion of bromine in *Young v. Ethyl Corp.*³¹⁹ The plaintiff's tract was surrounded by Ethyl's injection wells.³²⁰ The Eighth Circuit Court of Appeals, sitting in diversity and applying *Budd*, correctly recognized that it is material whether the lands at issue are inside or outside of the periphery of the defendant's operations, as *Budd* treated differently the tract lying *within* the recycling operation.³²¹ In articulating the reason for the distinction, however, *Young* interpreted *Budd* to hold that the rule of capture applies to the "draining" of minerals, as from the tract on the periphery of the defendant's operations, but not the "pushing" of minerals that occurred under the tracts located within the defendant's operations.³²² Accordingly, the court granted relief to the plaintiff in the form of damages because its minerals had been "pushed" instead of "drained" by the defendant's operations.³²³

The Arkansas Supreme Court heard the third and final reported case against Ethyl and took its furthest step toward clarity in reasoning in *Jameson v. Ethyl Corp.*³²⁴ The plaintiff's 95-acre tract was encircled by Ethyl's injection wells but was not joined in the recycling project.³²⁵ This time, the court permitted the plaintiff's claim for damages for the drainage of valuable saltwater caused by encroachment from Ethyl's injection operations.³²⁶

314. 474 S.W.2d 411 (Ark. 1971).

315. *Id.* at 412.

316. *Id.*

317. *Id.*

318. *Id.* at 413.

319. 521 F.2d 771 (8th Cir. 1975).

320. *Id.* at 772.

321. *Id.* at 773.

322. *Id.* at 772–73.

323. *Id.*

324. 609 S.W.2d 346 (Ark. 1980).

325. *Id.* at 348.

326. *Id.* at 352.

The court's interpretation of its earlier holding in *Budd* avoided the "pushing" versus "draining" distinction relied on by *Young* and instead focused on the protection of the plaintiff's correlative rights in the reservoir.³²⁷ Specifically, the court noted that the problem of competing correlative rights presented in the case was similar to that involved in the secondary recovery of common pools of oil and gas for which the State of Arkansas (like many others) had adopted legislation providing for unitization.³²⁸ While noting that the state's unitization laws did not apply in the case, the court explained that the laws' underlying rationale did apply: "Inherent in such laws," the court explained, "is the realization that transient minerals such as oil, gas, and brine will be wasted if a single landowner is able to thwart secondary recovery processes [by not participating], while conversely acknowledging a need to protect each landowner's rights to some equitable portion of pools of such minerals."³²⁹ Ultimately, *Jameson* resolved the dilemma by holding that the rule of capture does not apply to "operations related to lands within the peripheral area affected" because it would "extend the bargaining power of [unit operators] to reduce royalty payments to landowners who are financially unable to 'go and do likewise.'"³³⁰ In short, the rule of capture does not apply where it would impair a landowner's fair opportunity to use the common formation likewise.

Additionally, the court held that "reasonable and necessary secondary recovery processes of pools of transient materials should be permitted," on two conditions: (i) "when such operations are carried out in good faith for the purpose of maximizing recovery from a common pool," and (ii) the extracting party "compensate[s] the owner of the depleted lands for the minerals extracted in excess of natural depletion, if any, at the time of taking and for any special damages which may have been caused to the depleted property."³³¹ Similar results have obtained under Oklahoma law in *Greyhound Leasing & Financial Corp. v. Joiner City Unit*³³² and *Boyce v. Dundee Healdton Sand Unit*,³³³ both involving claims for damages for lost productivity of wells on the periphery of an authorized secondary recovery unit.

Jameson's reasoning and result are consistent with the legal relationship of the parties as co-owners in a common source of supply. As each is entitled to the fair opportunity to extract the reservoir's contents, neither may block the other's chance to do so. When Ethyl commenced its recycling operation throughout the common brine field, it precluded the plaintiff's chance to extract a proportional share of the minerals, not because the plaintiff was finan-

327. *Id.* at 349–50.

328. *Id.* at 350–51.

329. *Id.* at 351.

330. *Id.*

331. *Id.*

332. 444 F.2d 439, 445–46 (10th Cir. 1971).

333. 560 P.2d 234, 237–38 (Okla. Ct. App. 1975).

cially unable to go into the bromine-production business, but because it would have been impracticable to extract bromine from her own tract in the middle of an ongoing recycling project.³³⁴ The only mechanism by which the parties' correlative rights could be equalized after Ethyl's act was thus an action for damages; self-help would not do.

Contrast the situation in *Jameson* with the circumstances surrounding the *Budd* plaintiff's 240-acre tract, lying outside of the periphery of Ethyl's project. No cause of action was necessary to equalize that the plaintiff's correlative rights because the brine could be developed under the 240-acre tract independently of Ethyl's recycling project. No legal remedy was necessary to vindicate the plaintiff's fair opportunity.

c. The "Fair Offer" Exception

There is an exception to liability for precluding another's opportunity to exploit the reservoir, which applies when the plaintiff has rejected an offer from the defendant to participate in the operations on terms that are fair, reasonable, and nondiscriminatory.³³⁵ *Tidewater Associated Oil Co. v. Stott*³³⁶ is illustrative. There, the defendants held oil and gas leases on the plaintiffs' land as well as the surrounding lands.³³⁷ In 1939, the defendants approached the plaintiffs with an offer to unitize their tract with the surrounding lands to conduct gas recycling operations, which the plaintiffs rejected.³³⁸ Similar to the recycling operations in *Jameson*, the defendants' gas recycling project produced "wet gas," extracted the valuable liquids, then reinjected the less-valuable "dry gas."³³⁹ The court found that the defendants' offer to permit the plaintiffs to participate in the unit was made on the same terms as were offered to other royalty owners within the proposed unit and that "both sides carried on negotiations in good faith."³⁴⁰ The recycling operation on the surrounding leases caused the wet gas under the plaintiffs' tract to be gradually replaced with dry gas.³⁴¹

334. *Jameson*, 609 S.W.2d at 349. The peculiarities of the owner of a subsurface interest, her occupation, financial status, sophistication in matters of law or any particular industry, etc., are irrelevant to whether the owner has a fair opportunity to develop subsurface resources. It is an objective question of whether, under the circumstances surrounding the subsurface resources, there is available to the owner a reasonably practicable means of development. In *Jameson* there was not.

335. See Earl A. Brown & Raymond M. Meyers, *Some Legal Aspects of Water Flooding*, 24 TEX. L. REV. 456 (1946); Methvin, *supra* note 299, at 369-70.

336. 159 F.2d 174 (5th Cir. 1946).

337. *Id.* at 175-76.

338. *Id.* at 176.

339. *Id.*

340. *Id.*

341. *Id.*

The plaintiffs sued to recover the difference in the royalty value of the dry gas produced and the wet gas that was lost.³⁴² The district court denied relief, holding that the plaintiffs “may not refuse to cooperate with their lessees for their mutual protection in the adoption of the practicable customary method or plan universal in [this particular gas field] offered them by [the defendants] and at the same time assert and demand damages.”³⁴³ The court further noted that the plaintiffs still had the option to “correct the situation for the future by participating in recycling operations ‘on the same basis as other royalty owners in the field.’”³⁴⁴

The same principle has been applied to non-joining mineral owners lacking any contractual relationship with the unit operator. In *Baumgartner v. Gulf Oil Corp.*,³⁴⁵ the plaintiff owned a leasehold interest in the oil and gas in a tract (“Section 16”) and rejected an offer to join in a secondary recovery unit organized by the defendant and approved by the state.³⁴⁶ Later, the plaintiff sued alleging a willful trespass when water from the defendant’s secondary recovery unit encroached and swept oil from under Section 16.³⁴⁷ The court denied relief, holding that each affected subsurface owner must receive an opportunity to participate in unitized secondary recovery operations on “fair and equitable” terms, but that any who refuse are thereafter barred from suing for resulting invasions:

Although Section 16 was excluded from the project, everyone involved, including the plaintiff would understand that there was no way to seal off the oil under Section 16 from the pool, and that from its very nature water injected into wells 1 and 2 would eventually reach the narrow portion of the reservoir in Section 16 and sweep oil from it. It is this very fact which required that plaintiff be afforded an opportunity to join the project. Plaintiff was offered this opportunity on a fair and equitable basis. As an oil operator, he was fully cognizant of the fact that unless the other operators in the field were willing to abandon the project and thus waste more than a million and a half barrels of recoverable oil, they would either be forced to meet his demand for an unreasonable return at their expense, or go ahead with the project without him and incur possible liability for sweeping oil

342. *Id.*

343. *Id.* at 179; *accord* *Syverson v. N.D. State Indus. Comm’n*, 111 N.W.2d 128, 132–34 (N.D. 1961).

344. *Stott*, 159 F.2d at 179.

345. 168 N.W.2d 510 (Neb. 1969).

346. *Id.* at 511–12.

347. *Id.* at 512.

from under his leased land in the process. They did the latter. Did they incur liability for willful trespass? We hold they did not.³⁴⁸

Several cases can be found across jurisdictions following or acknowledging the same principle.³⁴⁹ Differing justifications have been advanced for this "fair offer" exception to trespass liability for secondary and enhanced operations. Courts often cite public policy in support of its application.³⁵⁰ One court grounded the exception in the avoidance of unjust enrichment.³⁵¹ Early commentators advanced estoppel as the basis for the exception.³⁵² There is, however, a simpler explanation than any of these. The fair opportunity principle, when applied to the particular facts involved in these cases, entitles the plaintiff to only the fair opportunity to participate in the defendant's resource-wide operations. This principle requires that the plaintiff have the right to accept or reject the opportunity, just as the plaintiff may choose whether or not to develop the subsurface resources within its claim.

The difficulty in applying the fair offer exception is not in recognizing it as a corollary to the fair opportunity principle, but rather in identifying when an offer has been made and rejected and whether its terms are fair, reasonable, and nondiscriminatory. Much could be said about the requisites for a fair and reasonable offer.³⁵³ At a minimum, the fair opportunity principle requires that there be a genuine contractual offer and a rejection. Further, the terms must not seek to reduce the offeree's proportionate interest in the resource³⁵⁴ or furnish

348. *Id.* at 515–16.

349. *See, e.g.*, *Cal. Co. v. Britt*, 154 So. 2d 144 (Miss. 1963); *Reed v. Texas Co.*, 159 N.E.2d 641 (Ill. Ct. App. 1959); *W. Gulf Oil Co. v. Superior Oil Co.*, 206 P.2d 944 (Cal. Ct. App. 1949); *Cotton Petroleum Corp. v. U.S. Dep't of the Interior*, 870 F.2d 1515, 1526 n.3 (10th Cir. 1989); *Bogges v. Milam*, 34 S.E.2d 267 (W. Va. 1945); *Sun Expl. & Prod. Co. v. Pitzer*, 822 S.W.2d 294 (Tex. App. 1991). Counterexamples also exist, where the court did not deny recovery for trespass to a subsurface owner that apparently exercised its right not to join a secondary or enhanced recovery project. *See, e.g.*, *Hunter v. Hussey*, 90 So. 2d 429 (La. App. 1956); *Bernstein v. Bush*, 29 Cal. 2d 773 (1947); *Jameson v. Ethyl Corp.*, 609 S.W.2d 346 (Ark. 1980). The point did not appear to be at issue in any of these cases, and no opinion appears to reject the principle outright. The nearest a court has come to rejecting the principle was in *Greyhound Leasing & Fin. Corp. v. Joiner City Unit*, 444 F.2d 439 (10th Cir. 1971). In declining to preclude the plaintiffs from recovering damages because they had not joined the unit voluntarily, the Tenth Circuit noted that it could find no such authority in Oklahoma law. *Id.* at 444–45.

350. *See, e.g.*, *Baumgartner v. Gulf Oil Corp.*, 168 N.W.2d 510, 514, 517 (Neb. 1969); *Tidewater Associated Oil Co. v. Stott*, 159 F.2d 174, 178–79 (5th Cir. 1946).

351. *Reed v. Texas Co.*, 159 N.E.2d 641, 644 (Ill. Ct. App. 1959).

352. *Hardwicke & Woodward*, *supra* note 219, at 97–98.

353. For additional discussion, see 3 ERNEST SMITH & JACQUELINE WEAVER, *TEXAS LAW OF OIL AND GAS* § 12.3(B)(1)(a), at 23-0 (1990).

354. *Carson v. R.R. Comm'n*, 669 S.W.2d 315, 318 (Tex. 1984). This requirement does not preclude an offer from including a risk factor or penalty where one is necessary to equalize the rights of an owner that had the opportunity to participate at an earlier date but elected

the offeree less favorable terms than were offered to other similarly situated owners,³⁵⁵ and must account for any special damages to the offeree's interest.³⁵⁶ Determining whether any given offer is fair, reasonable, and nondiscriminatory raises many factual issues, but this framework of principles is capable of resolving the question in myriad factual settings.

IV. WASTE

The discussion thus far offers an incomplete account of subsurface property rights, privileges, and liabilities. This is because one subsurface owner may violate a neighboring owner's fair opportunity to access and use the shared resource *without entering the neighbor's subsurface tract*. For example, if *A* were to drill a well into a common oil reservoir and let all the oil spill uselessly onto the ground, reservoir owners *B* and *C* would have a cause of action for injury to their subsurface interest. The term used for this kind of injury is "waste." To fully effectuate the fair opportunity principle, as well as to account for all the existing case law, it is necessary to address cases involving waste.

Although some uncertainty attends the precise legal definition of "waste," the case law yields a formal definition that is internally consistent with the fair opportunity principle. Waste is a nonphysical interference with another subsurface owner's opportunity to use and enjoy a common resource. This can occur when the defendant's actions reduce the total net value of the common resource available to all owners.³⁵⁷ Couched in terms of the fair opportunity doctrine, waste occurs when (1) an act by the defendant (2) interferes with another subsurface owner's (a) existing subsurface activities or (b) its opportunity to use and enjoy the common subsurface resource. Thus, liability for waste lies when each of the elements of the fair opportunity doctrine are satisfied except the requirement of physical invasion. Consequently, the justification for prohibiting waste is found within the legal relationship of common subsurface owners.

not to until after the participating owners had expended money to develop the operations. *Buttes Res. Co. v. R.R. Comm'n*, 732 S.W.2d 675, 678 (Tex. App. 1987). Indeed, a risk penalty may be a necessary element in some offers to participate to prevent unjust enrichment of the offeree. *Id.*

355. See *J.P. Furlong Co. v. Bd. of Oil, Gas & Mining*, 424 P.3d 858, 863–66 (Utah 2018) (upholding conservation agency order finding that the terms of a unit operator's joint operating agreement offered to a non-joining interest owner were just and reasonable because the agreement was consistent with industry standards and was materially identical to the agreements the operator obtained from the other interest owners in the unit); *Coleman v. R.R. Comm'n*, 445 S.W.2d 790, 797 (Tex. App. 1969) ("It is doubtful that an [offer] could be fair and reasonable that imposes on one owner of land all detriment and damage that production of oil might cause to his land or its surface, while another owner escaped a proportion of such burdens.").

356. *Johnson v. Kell*, 626 N.E.2d 1002, 1004–06 (Ohio Ct. App. 1993).

357. For a full analysis of this principle, see generally Righetti & Schremmer, *supra* note 19.

A. Prevailing Definitions of Waste

“Waste” has resisted easy conceptualization. At the highest level of generality, waste may be defined as “an unreasonable or improper use, abuse, mismanagement, or omission of duty touching real estate by one rightfully in possession, which results in its substantial injury.”³⁵⁸ The term has been given distinct definitions in real property estates,³⁵⁹ water law,³⁶⁰ and oil and gas law.³⁶¹ In defining the term’s meaning within oil and gas law, authorities often subdivide waste into “physical” and “economic” types and further subdivide the physical category into “surface” and “underground” waste.³⁶² Physical waste, in the oil and gas context, “is the loss of oil or gas that could have been recovered and put to use.”³⁶³ “Examples of [surface waste] are flaring of gas and storage of oil in earthen pits. Examples of [underground waste] are inefficient use of reservoir energy, [and] excessive production rates resulting in [c]hanneling and bypassing [which strand reserves permanently in the formation].”³⁶⁴ Economic waste is essentially “the sale of oil or gas at too low a price at the wellhead.”³⁶⁵ Few attempts have been made in the literature to abstract a generalizable definition or conception of waste from these fragmented types.³⁶⁶

In modern practice, waste of oil and gas resources is principally a matter of administrative law. State statutes tend to prohibit waste for regulatory purposes with extreme particularity. Texas’s oil and gas conservation act, for instance, defines “waste” as any of eleven separately enumerated acts.³⁶⁷ Some of these, such as the “creation of unnecessary fire hazards,”³⁶⁸ appear to have nothing to do with the legal relationship among owners in a common source of supply. Colorado recently amended the definition in its conservation act to exclude “the nonproduction of oil [or gas] from a formation if necessary to protect public health, safety, and welfare, the environment, or wildlife resources as determined

358. George D. Schrader, *Oil and Gas—Waste of Oil and Gas as Between Adjacent Landowners*, 44 KY. L.J. 118, 119 (1955) (quotations omitted) (quoting TIFFANY REAL PROPERTY 629 (3d ed. 1939)).

359. See, e.g., Righetti & Schremmer, *supra* note 19, at 6–15.

360. See, e.g., *id.* at 24–31.

361. See, e.g., *id.* at 18–24.

362. See, e.g., 8 MARTIN & KRAMER, *supra* note 44, *Waste*.

363. *Id.*

364. *Id.* (citations omitted).

365. *Id.*

366. *Id.* (“The term is too broad and has too many meanings for a one- or two-sentence definition.”).

367. TEX. NAT. RES. CODE § 85.046(a) (2020); see also, e.g., N.M. STAT. ANN. § 70-2-3 (2020) (six separate acts); 52 OKLA. STAT. ANN. §§ 86.2(A) (2020) (five separate acts for oil); *id.* § 86.3 (seven separate acts for gas); MODEL OIL & GAS CONSERVATION STAT. § 1(24)(A) (2004) (five separate acts).

368. TEX. NAT. RES. CODE § 85.046(a)(5).

by the commission.”³⁶⁹ This turns the settled definition of “physical waste,” as the loss of recoverable oil or gas, on its head. The regulatory definition of waste is, apparently, whatever the legislature wants it to be.

Relatedly, murkiness surrounds the legal justification for prohibiting waste, however defined. It is often said that prohibiting waste in the use of common pool resources like oil and gas serves to protect the public’s interest in such resources.³⁷⁰ The U.S. Supreme Court has upheld multiple statutes prohibiting the use of natural gas for manufacturing carbon black³⁷¹ on the basis that the statutes protected the public’s interest against the gas supply being consumed for purposes the legislature found undesirable.³⁷² It follows from such a broad rationale that the legislature may define waste in any way that it deems, not irrationally, to serve the public interest. As a justification for limiting subsurface property rights, the public interest pulls in various, often competing directions. Whereas it was once believed that natural gas was so important to society that the public interest required it be put to its highest use, it is now thought (e.g., by the Colorado Legislature) so potentially harmful to the public that its production must be curtailed.³⁷³ As perceptions of the public interest change, so too does the regulatory definition of waste.

When viewed from within the legal relationship among owners in a common subsurface resource, however, the concept of waste looks quite different—and more coherent. To give effect to the unifying principle of subsurface property ownership—the fair opportunity principle—waste must protect subsurface owners’ correlative right to a fair opportunity to access and use the common resource. Waste is wrongful because it impinges on this correlative right.³⁷⁴

369. COLO. REV. STAT. § 34-60-103(12)–(13) (2020).

370. *See, e.g.*, *Commonwealth v. Trent*, 77 S.W. 390, 393 (Ky. Ct. App. 1903) (“The right of the owner of property to do with [the oil and gas] as he pleases is subject to the limitations that he must have due regard for the rights of others. To allow the storehouse of nature to be exhausted by the waste of the gas would be to deprive the state and its citizens of many advantages incident to its use.”).

371. Carbon black can be produced through the incomplete combustion of oil or gas and is used primarily in rubber manufacturing. Carbon black manufacturing is deemed to be a wasteful use of oil and gas by many state statutes because “[i]t may also be manufactured from other products in more abundant supply.” 8 MARTIN & KRAMER, *supra* note 44, *Carbon Black*.

372. *Walls v. Midland Carbon*, 254 U.S. 300, 324 (1920); *Henderson Co. v. Thompson*, 300 U.S. 258, 267 (1937).

373. *See* COLO. REV. STAT. § 34-60-103(12)–(13) (2020).

374. *See* 1 MARTIN & KRAMER, *supra* note 44, § 204.6 n.3 (collecting cases); *see also* W.L. Summers, *Legal Rights Against Drainage of Oil and Gas*, 18 TEX. L. REV. 27, 31–32, 37–38, 46–47 (1939) (demonstrating how waste prevention protects correlative rights); Sidney J. Strong, *Application of the Doctrine of Correlative Rights by the State Conservation Agency in the Absence of Express Statutory Authorization*, 28 MONT. L. REV. 205, 218–19 (1966) (discussing the correlative-rights protection that flowed incidentally from the state’s waste-prevention statutes).

Despite later cases locating the justification for prohibiting waste in the public interest, in its earliest waste case the Supreme Court acknowledged the *internal* justification for preventing waste. In *Ohio Oil Co. v. Indiana*,³⁷⁵ the Court explained:

Hence it is that the legislative power, from the peculiar nature of the right and the objects upon which it is to be exerted, can be manifested for the purpose of protecting all the collective owners, by securing a just distribution, to arise from the enjoyment by them, of their privilege to reduce to possession, and to reach the like end by preventing waste.³⁷⁶

Waste is thus intertwined with the correlative right of having a fair chance at the resource, and to be complete, a model of subsurface property must account for both. Yet waste is not perfectly coextensive with correlative rights (nor vice versa), as appears from several important waste cases for which the fair opportunity doctrine does not account. Working from these cases, the following section synthesizes a specific definition of waste that, when set alongside the fair opportunity doctrine, produces a unified formal theory of subsurface rights in both mineral and nonmineral resources.

B. *Synthesizing a Coherent Conception of "Waste"*

In modern practice, regulatory law governs most waste issues. Cases pre-dating such regulation raised waste as a common law claim. The common law prohibits all kinds of physical waste of common reservoirs, including loss of oil and gas reserves by accidental destruction or malicious dissipation, as well as inefficient or imprudent production practices.

1. *Destruction and Dissipation*

A number of reported cases involve claims of waste by one subsurface owner against another for accidentally destroying all or part of a common oil or gas reservoir. The most famous of these is *Elliff v. Texon Drilling Co.*,³⁷⁷ where Elliff sued Texon for waste after Texon's gas well blew out, rapidly draining and releasing "huge quantities" of hydrocarbons from under Elliff's neighboring tract.³⁷⁸ There was no allegation that Texon had physically invaded the boundaries of Elliff's subsurface tract, and Texon pled the rule of capture as a defense.³⁷⁹ Finding Texon's dissipation of the hydrocarbons was not "a legitimate

375. 177 U.S. 190 (1900).

376. *Id.* at 210.

377. 210 S.W.2d 559 (Tex. 1948).

378. *Id.* at 557-58.

379. *Id.* at 560.

drainage of the minerals . . . nor a lawful or reasonable appropriation of them,” the court held Elliff had established a claim of waste and was entitled to damages.³⁸⁰

A related line of cases involves waste claims arising from the defendant’s alleged intentional, even malicious, dissipation of a common reservoir. In *Louisville Gas Co. v. Kentucky Heating Co.*,³⁸¹ for example, the plaintiff and defendant had competed over a single market for the natural gas from a common reservoir underlying their separate tracts.³⁸² After the plaintiff secured the only market, the defendant devised a plan to “cripple” the plaintiff as a rival, by drilling a number of wells and constructing a sham lampblack factory³⁸³ as a pretense for burning as much gas from the reservoir as possible.³⁸⁴ The court enjoined the defendant’s deliberate waste of gas, invoking the public interest to explain that “a man is only allowed to make a reasonable use of those natural gas supplies which are for the common benefit of all.”³⁸⁵

Under the fair opportunity doctrine, the above cases should not have resulted in liability for drainage, as the defendant did not physically invade the plaintiff’s subsurface. Ordinarily, drainage unaccompanied by a physical invasion is privileged under the rule of capture. In the venerable case of *Barnard v. Monongahela Natural Gas Co.*,³⁸⁶ for example, the court denied the plaintiffs’ request for an injunction against the defendant’s operation of a natural gas well extremely close to the plaintiffs’ property line.³⁸⁷ The plaintiffs’ only remedy for drainage was to “go and do likewise.”³⁸⁸ Similarly, in *Kelley v. Ohio Oil Co.*,³⁸⁹ the court denied the plaintiff’s request for an injunction against the defendant who drilled a series of wells virtually on top of the property line to drain gas from the plaintiff’s land, even though the court acknowledged the defendant’s “motives of unmixed malice.”³⁹⁰

Elliff and *Louisville Gas Co.* can be squared with *Barnard* and *Kelley*. The specific difference is that the natural gas drained in *Elliff*, *Louisville Gas Co.*, and like cases was dissipated into the atmosphere, destroyed in the inferno of a wild well, or combusted only to destroy it, whereas the production in *Barnard*

380. *Id.* at 563; accord *McCoy v. Ark. Nat. Gas Co.*, 165 So. 632, 633 (La. 1936); *La. Gas & Fuel Co. v. White Bros.*, 103 So. 23, 23 (La. 1923).

381. 77 S.W. 368 (Ky. 1903).

382. *Id.*

383. Lampblack is produced through the incomplete combustion of carbonaceous materials, including oil and gas, and is used chiefly as a pigment in paints, etc. *Lampblack*, MERRIAM-WEBSTER, <https://perma.cc/ULA8-W4D4>.

384. *Kentucky Heating Co.*, 77 S.W. at 369.

385. *Id.*

386. 65 A. 801 (Pa. 1907).

387. *Id.* at 801.

388. *Id.* at 801–03.

389. 49 N.E. 399 (Ohio 1897).

390. *Id.* at 401.

and *Kelley* was apparently marketed for beneficial use. It is not obvious that this distinction implicates the plaintiff's fair opportunity to produce from a common reservoir, but an illustration helps demonstrate the link.

Suppose *A*, *B*, and *C* each owned gas wells producing from a common reservoir.³⁹¹ *A* and *B* shared a market for their gas, while *C* lacked access to any market. Attempting to secure the benefit of *A* and *B*'s market, *C* flared gas from its well to deplete the reservoir available to *A* and *B* and threatened to continue doing so unless paid to shut in. The consensus view is that *C* has committed actionable waste. Has *C* infringed *A*'s and *B*'s fair opportunity to produce a proportional share of the gas reserves? Case law establishes that if *C* had sold the gas rather than flare it, *A* and *B* would have no actionable complaint—even if *C* had extracted the same quantity of gas from the reservoir, depriving *A* and *B* of the opportunity to produce to the same extent. Moreover, if *C* had simply left its share of gas in the reservoir rather than flare it, *A* and *B* each could have produced and sold roughly one half of *C*'s share, increasing the total value of the reserves and their value to *A* and *B*. But by *producing and squandering* its portion of the reserves, *C* damaged *A* and *B* by foreclosing their opportunity to benefit from their share of the squandered reserves, without producing any offsetting benefit to *C*. Thus, common owners are entitled not to an opportunity to produce and squander a proportional share of reserves, but to an opportunity to produce *for a beneficial purpose* a proportional share of reserves.

This gives meaning to the *fair* in "fair opportunity." A *fair* opportunity to use the common resource means an opportunity to use it for purposes that produce a benefit that justifies the reduction in the available remainder. When one owner's extraction from a common resource produces insufficient benefits to justify the loss it imposes on other owners (thereby diminishing the resource's total net value to all its owners), the extraction infringes the other owners' chance to fairly use that portion of the resource.³⁹² This is a formal definition of "waste."³⁹³ Note that this definition does not require there be a physical invasion of the plaintiff's subsurface.

391. These facts are taken from the controversial case of *Hague v. Wheeler*, 127 A. 714, 717–18 (Pa. 1893). In the actual case, the court declined to enjoin *C*'s flaring, but it is generally believed that the case was either decided on other grounds or was wrongly decided. 1 MARTIN & KRAMER, *supra* note 44, § 204.6 ("It seems safe to say that whatever the theory of the nature of the landowner's interest in oil and gas, no court today, even apart from statutory regulations to prevent waste of natural resources, would permit such profligate waste."); Pierce, *supra* note 56, at 258–59.

392. Kuntz explained as much: "That is, the privilege of producing from the common source of supply to the economic disadvantage of another owner may be exercised solely for purposes of realizing direct economic gain and not for a sinister purpose of inflicting harm deliberately upon another." 1 KUNTZ, *supra* note 44, § 4.6.

393. See generally Righetti & Schremmer, *supra* note 19, for the full analysis of this principle across property, natural resources, and public trust law.

2. *Inefficient Production Practices*

Thus conceptualized, waste encompasses any act that, without causing physical invasion, interferes with an owner's fair opportunity to use a proportional amount of a common subsurface resource. In addition to the accidental and intentional destruction of common reserves, as addressed respectively in *Elliff* and *Louisville Gas Co.*, the concept of waste encompasses the use of production techniques that physically damage the common reservoir.

As the court in *Manufacturers' Gas & Oil Co. v. Indiana Natural Gas & Oil Co.*³⁹⁴ explained, "The right of each owner to take the gas from the common reservoir . . . is rendered valueless if one well owner may so exercise his right as to destroy the reservoir, or to change its condition in such manner that the gas will no longer exist there."³⁹⁵ Applying this principle, the court enjoined the defendant's use of vacuum pumps to produce natural gas from a common reservoir, finding that the pumping excessively pulled saltwater into the producing formation and threatened to prematurely strand recoverable gas.³⁹⁶

These production practices were subject to injunction because they threatened to waste gas reserves, i.e., to exclude them from the potential enjoyment of common owners like the plaintiff without sufficient justification (beneficial use). The fact the defendant would have produced gas from the use of vacuum pumps and thus benefited from their use, does not distinguish *Manufacturers' Gas* from *Elliff* or *Louisville Gas Co.* The focus of the inquiry is not on the gas the defendant produced, but rather on the gas the defendant's production technique threatened to destroy. The use of vacuum pumps to produce 100,000 cubic feet of gas per day at the cost of causing saltwater to encroach upon and destroy 10,000,000 cubic feet of gas *in situ* would waste the 10,000,000 cubic feet of gas, not the 100,000 cubic feet.

3. *Economic Waste*

This conception of waste does not necessarily extend to cases of "economic waste"—those alleging that a defendant's use of production from a common pool for beneficial, but relatively uneconomic purposes constitutes legal injury. *Sneed v. Phillips Petroleum*³⁹⁷ provides one of the few examples of such a claim appearing in a reported case. The plaintiff sued the defendant for waste, claiming that the defendant's use of gas to manufacture low-value gasoline (a process called "stripping") dissipated the reservoir backpressure needed for the plaintiff to produce higher-value oil.³⁹⁸ The claim failed on procedural grounds, but the

394. 57 N.E. 912 (Ind. 1900).

395. *Id.* at 915.

396. *Id.* at 917.

397. 76 F.2d 785, 785 (5th Cir. 1935).

398. *Id.* at 785–86.

dissent argued that the majority should have dismissed the claim on its merits.³⁹⁹ Similarly, the court denied an economic waste claim in *Corzelius v. Harrell*,⁴⁰⁰ holding that the plaintiff had “no interest” in whether the defendant maximized the economic value of the gas it produced from the same reservoir by extracting valuable liquids in processing.⁴⁰¹

There may be a variety of substantive reasons for not extending the waste principle to alleged economic waste, such as problems of administrability or institutional competence.⁴⁰² But such justifications can easily pull in conflicting directions, given that they are not internal to the legal relationship of the common owners.⁴⁰³ The internal, formal justification is that one owner’s particular post-production use of resources in a common pool—so long as it produces *some* benefit—has no bearing on another owner’s fair opportunity. Such an instance lacks the fruitless destruction or dissipation of shared resources that occurred in *Elliff, Louisville Gas Co.*, and *Manufacturers’ Gas*. The harm of making relatively uneconomic use of one’s take of oil or gas from a common pool redounds to the taker, not to other owners within the common pool.⁴⁰⁴

C. *The Continuing Significance of Common Law Waste*

Having a systematic account of common law waste claims may not prove especially useful in the regulation of common pools of oil and gas, since comprehensive conservation regulation has occupied the field.⁴⁰⁵ But, as with the fair opportunity doctrine in general, this account of waste may prove helpful in fashioning common law rules for the use of common pore space for disposal and storage purposes, which is not presently subject to existing waste-prevention legislation. The economic value of these purposes will vary significantly. As pore space capacity grows scarcer, storage space that was once economically

399. *Id.* at 789 (Hutcheson, J., dissenting).

400. 179 S.W.2d 419 (Tex. App. 1944).

401. *Id.* at 422.

402. For discussion, see Righetti & Schremmer, *supra* note 19, at 637–38.

403. See WEINRIB, *supra* note 128, at 6–8 (discussing the externality of functionalist considerations to the law).

404. A harder case may present where one subsurface owner’s operations virtually preclude another owner from making a like use of its own portion of the resource. In such a case, any harm that results from the defendant’s relatively uneconomic use is not the defendant’s alone to bear; it reduces what the plaintiff could have obtained from the common resource, by virtue of the fact that the plaintiff cannot now pursue its own ends for the resource. It may not be assumed, however, that such a plaintiff has not had the benefit of a fair opportunity to put a portion of the reservoir to a more economically valuable use before the defendant commenced its operations. The facts in such a case may, or may not, indicate that the plaintiff’s fair opportunity to use the resource for reasonable benefit has been infringed.

405. Righetti & Schremmer, *supra* note 19, at 638–39.

valueless will increase in value.⁴⁰⁶ As this occurs, claims of waste based on a reservoir owner's uneconomic use of pore space may abound. The question may arise, for example, whether one owner's use of common pore space for disposal of produced water from oil and gas operations is wasteful when compared with another owner's use of the pore space for sequestration of carbon. Based on the foregoing account of waste and correlative rights, such actions should fail if the defendant's use of pore space has any beneficial purpose, regardless of whether it lacks high economic value. Conversely, the use of pore space for purely spiteful purposes or to extort other reservoir owners clearly should be actionable as waste and thus as a violation of correlative rights.⁴⁰⁷

D. Evaluating the Unified Theory

The fair opportunity doctrine holds that an owner of subsurface property has a co-equal fair opportunity to use and enjoy a proportional part of a common subsurface resource without causing waste. This doctrine recognizes a legal injury when: (1) an act by the defendant (2) causes either waste or a physical invasion of the plaintiff's property boundaries and (3) damages the plaintiff either by (a) harming its ongoing subsurface activities or (b) depriving it of a fair opportunity to use the subsurface or produce its contents when the defendant has failed to make a fair, reasonable, and nondiscriminatory offer to participate. Waste, in turn, is an act by the defendant that interferes with the plaintiff's opportunity to use or produce a proportionate part of the property for beneficial purposes and thereby reduces the total net value of the common resource available to all the owners.

Viewed as a whole, the elements derived from the case law furnish a comprehensive, internally coherent, and autonomous set of principles to coordinate the legal relations among subsurface owners in a common resource. The unified theory satisfies the evaluative criteria of fit, coherence, and effectiveness in furnishing normative *ex ante* guidance to coordinate the conduct of reasonably practical participants within a subsurface semicommons.⁴⁰⁸ While remaining true to the vast majority of the cases, the theory unifies the case law around a coherent principle, constrains the universe of relevant facts in any given dispute, and excludes destabilizing functionalist considerations. This organization of the law permits property owners, lawyers, and judges alike to derive useable gui-

406. See Schremmer, *supra* note 8, at 59–61 (predicting growing scarcity of pore space storage space).

407. Of course, legislatures would have the authority to adopt broader definitions of waste by statute, as they have done in the oil and gas context. Statutory definitions might permissibly define waste expressly in terms of the public interest, although a formal common law definition could not.

408. These are the evaluative criteria synthesized in Part II.B, *supra*.

dance in conducting their affairs and resolving novel and difficult cases based on the parties' legal relationship.

Moreover, the fair opportunity doctrine's guidance effectively coordinates members of a subsurface semicommons in their use and enjoyment of the property. It limits and regulates conduct within a common subsurface resource while also permitting common owners a wide degree of discretion to pursue their particular goods. It guides owners to cooperate with each other in pursuit of their common interests. Incidentally, the fair opportunity doctrine also generates public goods by enabling beneficial development of subsurface resources. In this one sense, the formal doctrine is actually *more* functional than the functionalist standards that it recasts. For instance, consider the privilege created by the fair offer exception to use the entire extent of a subsurface resource without the assent of the resource's other owners. As noted, nearly all oil and gas producing states provide for compulsory pooling and unitization to provide for oil and gas drilling and secondary and enhanced recovery operations within fragmented reservoirs, and some have adopted a compulsory unitization regime for carbon dioxide storage.⁴⁰⁹ This arrangement of the cases reveals something like a common law scheme of compulsory unitization, which exists independently of any statute.⁴¹⁰

The revelation that common law principles underpinning the legal relations among owners in a common subsurface resource permit such extensive use of a resource may be particularly significant to efforts to use pore space for carbon dioxide storage. Would-be carbon storage projects otherwise waiting for a legislative solution to the problem of consolidating pore space, like compulsory unitization or eminent domain authority, may, with greater clarity about the common law principles, fashion a private-law solution based on the fair offer exception. Advocates in states that have resisted adopting compulsory unitization legislation for carbon dioxide storage may find a persuasive justification in the fact that such legislation would merely codify and administer existing common law principles.

409. This was not always the case, of course. In Texas, the need for a compulsory pooling statute was recognized years before the legislature adopted one. In the meantime, Hardwicke and Woodward reviewed the Texas precedents to devise a "makeshift" solution that relies on many of the same principles as the fair opportunity doctrine. Hardwicke & Woodward, *supra* note 219, at 94–96.

410. Indeed, before the state adopted compulsory pooling legislation, Mississippi courts recognized just such a doctrine, albeit in a different form than the doctrine elaborated here. *See, e.g.,* Griffith v. Gulf Refin. Co. 60 So. 2d 518, 522 (Miss. 1952); Superior Oil Co. v. Beery, 64 So. 2d 357, 359 (Miss. 1953); Placid Oil Co. v. N. Cent. Tex. Oil Co., 19 So. 2d 616, 618–19 (La. 1944). For a discussion of Mississippi's "equitable" or "judicial" pooling doctrine, see 1 BRUCE M. KRAMER & PATRICK H. MARTIN, *THE LAW OF POOLING AND UNITIZATION* § 7.02 (3d ed. 2021); Norman B. Gillis, Jr., *Involuntary Equitable Pooling in Mississippi*, 27 MISS. L.J. 10 (1955).

As others have correctly observed, consolidation of interests under common law principles leaves unresolved many practical considerations that administrative law schemes typically address.⁴¹¹ These may include such questions as whether an offeree who rejects a fair and reasonable offer of participation may later assent to participation, whether consent may later be withdrawn, what is the proper areal extent of the combined operations, what is their proper duration, which parties are liable for any damage to third parties resulting from the operations, which parties retain executive authority over the operations, and by what standards and procedure the suitability of the resource for its intended use is to be determined. In the absence of a regulatory scheme to resolve these issues, their answers will be determined under principles of contract law and the private arrangements of the parties.⁴¹²

V. ABOVE AND BEYOND THE SUBSURFACE: THE REACH OF THE FORMAL METHOD

This Article's theoretical approach and analytical method furnish the basis for a wider formal articulation of real property and natural resources doctrines. While the law of subsurface property rights provides an excellent subject for the development and demonstration of this method, the method is by no means limited to that field. Many natural resources are commons or semicommons, subject to overlapping, nonexclusive claims by a limited (though possibly large) group of rights-holders and may be understood through the same unifying principle of co-equal, fair opportunity.⁴¹³ The law of nuisance also seeks to coordinate conflicting land uses and so, too, could draw upon the fair opportunity principle as a source of internal coherence.⁴¹⁴

The formal method is not confined, however, to semicommons, the fair opportunity principle, or even the field of natural resources law. It is a general jurisprudential approach to practicing, understanding, and reformulating private law. As a methodology, it is more practically usable than leading contemporary theories of property. The formal *method* is superior to any *theory* because it is usable and transportable to many disparate areas of law and does not turn on any particular ideology. For example, compare the formal method to a leading formal theory of property law, Henry Smith and Thomas Merrill's "new

411. 1 KRAMER & MARTIN, *supra* note 410, § 7.02; *see also* 1 KUNTZ, *supra* note 44, § 4.7.

412. The "empty spaces" for private action undirected by law is a hallmark of formal doctrine and one of the characteristics that distinguishes formal private law from public law. Cox, *supra* note 83, at 77–83.

413. Common examples include groundwater and surface water resources, common pastures and grazing lands, and fisheries.

414. Nuisance law is notoriously incoherent. *See generally* Epstein, *supra* note 207 (describing the incoherence of nuisance doctrine and synthesizing a formal "corrective justice" restatement).

essentialism.”⁴¹⁵ Katrina Wyman has observed that Smith and Merrill’s theory “ultimately does not provide a determinable definition . . . because their analysis leaves property rights contingent on a calculus,” specifically a cost-benefit analysis that attempts to economize on information and transaction costs.⁴¹⁶ Instead, Wyman continues, “[t]heir reconceptualization of property is best understood as providing a loose framework for thinking about property law, rather than a stable theory that will resolve live issues in the field.”⁴¹⁷ In contrast, as an approach to legal analysis and organization, the formal method generates doctrinal solutions that are more coherent, less “malleable,” and ultimately more effective at providing practical ex ante guidance to members of a community than does the economically influenced new essentialism.

The formal method builds upon the traditional method of formal doctrinal reasoning practiced by generations of academics, judges, and practitioners.⁴¹⁸ The method is adept at “resolving live issues in the field,” because it embodies a way to implement law rather than merely a way to think about it. Indeed, the formal method’s very normative force comes from its power to derive *practically usable* doctrine that will guide reasonably practical participants in the legal system.⁴¹⁹

Moreover, all-encompassing normative theories about property are subject to criticism for being ideologically motivated. Critics of new essentialism argue that it embodies an individualistic conception of property, often associated with conservative ideals of classical liberalism and that it blocks needed regulation and redistribution.⁴²⁰ Other leading property theories, such as Hanoch Dagan and Michael Heller’s theory of “liberal property” and the broader “progressive property” movement, likewise proceed from a political ideology and are subject to critique on that basis.⁴²¹

The formal method, in contrast, does not rely on service to or consistency with any political ideology or economic theory for its normative force. Doctrine generated by a proper application of the method will not reliably serve any particular policy or political ideal. The fair opportunity doctrine, for instance,

415. Katrina M. Wyman, *The New Essentialism in Property*, 9 J. LEGAL ANALYSIS 183, 184–86 (2017) (discussing the “new essentialism” of Smith and Merrill and identifying the “malleability” of the theory).

416. *Id.* at 186.

417. *Id.*

418. See generally WAMBAUGH, *supra* note 203 (describing and instructing on the implementation of doctrinal analysis).

419. See *supra* Part II.A–B.

420. Wyman, *supra* note 415, at 185 & n.8.

421. See Dagan & Heller, *supra* note 41, at 552–54 (describing liberal values in the context of commons property); Gregory S. Alexander et al., *A Statement of Progressive Property*, 94 CORNELL L. REV. 743, 743–44 (2009) (calling for change to property law so as to serve politically progressive values). For a broader discussion of the difficulties with the new essentialism and progressive property families of theory, see Eric R. Claeys, *Labor, Exclusion, & Flourishing in Property Law*, 95 N.C. L. REV. 413, 415–17 (2017).

neither fits neatly into a classical liberal or progressive liberal framework, nor does it favor any type of use of the subsurface, such as oil and gas production or climate change mitigation. Systematizing property rights around the discernable nature of the resource and the relationship among its owners produces results that are less prone to normative critique and therefore more likely to be predictable.

CONCLUSION

The formal, systematic organization of subsurface property rights begins with the concept underpinning the legal relationship among owners of a naturally interconnected underground resource: each possesses a co-equal, fair opportunity to use and enjoy a proportional amount of the resource. The various other property rights, privileges, and duties—including the rule of capture, correlative rights, and subsurface trespass—hang together under this unifying principle. This principle and subsidiary doctrines take form in the “fair opportunity” and “waste” doctrines, which together define the subsurface property rights.

This form arises from the unchanging nature of the legal relationship among owners in the same subsurface resource. In contrast to the dominant fragmented and functional approach, these formal doctrines provide normatively sound, practical guidance for real-world use and enjoyment of subsurface property—largely by avoiding reliance on subjective evaluations and judgments. Nor are they receptive to the preferences of interest groups like the oil and gas industry or environmental interests.

Systematizing the law into formal doctrine does not make the task of predicting legal outcomes easy, but only more tractable. As the hard cases are litigated and decided with reference to the doctrine rather than to a diverse array of substantive considerations, guidance will sharpen, and the task will become easier. When planning becomes possible because doctrine is coherent and the process of adjudication is more transparent, reasonably practical subsurface owners will undertake more projects to make beneficial use of their subsurface resources.

Some of these projects will be for CCS or underground storage of renewably generated energy, while others will involve the exploration and production of oil and gas. On the basis of normative formal guidance, practically reasonable people may pursue a variety of goods within the guidance’s enabling rules. Yet, despite those various aims, they will be guided toward cooperation with other members of the community in securing them. Regardless of the nature and end purpose of subsurface activity, the fundamental legal relationship among subsurface property owners remains constant. Maintaining the coherence of the law governing this relationship is essential to enabling and encouraging socially beneficial use of subsurface resources.

Finally, the formal method developed here provides a way of understanding and recasting property and natural resources law generally, not only for the subsurface. Such an analysis may be particularly useful for legal fields that, like subsurface property, are fragmented, uncertain, or underdeveloped. And within these areas, this method can be deployed as readily in legal briefs and court opinions as in academic journals.