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MISMATCHED PROPERTY RIGHTS

Liberating Split Estates

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The dominance of the severed mineral estate has been long been considered an axiomatic principal of oil and gas law. Within this paradigm, the split-estate mineral owner enjoys broad rights to use the surface estate as is reasonable and necessarily incident to mineral development. Dominance, accordingly, can be understood as exit: the right of the mineral owner to develop its subsurface property without association or coercion from others. However, this formalist view has eroded in the face of shifting social norms regarding environmental protection, the interests of privacy and enjoyment of surface owners, the recognition of new property interests in the subsurface, and changing sociological views regarding the value and utility of fossil energy production. While surface land has become increasingly fragmented and more valuable, advances in horizontal drilling technology have permitted erosion of the doctrine of mineral estate dominance. A realist view of the ordering between surface and mineral estates today indicates that the estates are increasingly enmeshed and indivisible within coupled human and natural systems. As a result, a binary and boundary-based adjudication of the concomitant rights of surface and mineral owners discourage cooperation and result in utilitarian concerns, environmental harms, and inefficient resource use. This article examines the convergence of surface and mineral estates within the framework of mismatched property interests and common resource problems. It challenges the binary dominant-servient ordering of surface and mineral property. It suggests that resource-scale management facilitates incorporation of liberal commons principals into governance of the vertical commons in a manner that supports more robust environmental regulation and economically and socially productive use of shared resources.

Keywords: Split Estates; Common Pool Resources; Implied Servitudes; Liberalism; Oil and Gas; Environmental Law

I. Introduction

Since the earliest days of oil and gas production, courts have recognized an implied servitude by which the owner of a severed mineral estate may use and occupy the overlying surface in order to remove the minerals (*Dark v. Johnston*, 1867). Thus, the mineral estate becomes the dominant tenement. When concurrent surface and mineral uses are incompatible, mineral development can move forward without coercion or interference from the surface owner (Hafer et al., 2010). Dominance, therefore, assures the mineral owners' rights of exit (Dagan & Heller, 2001; Peñalver, 2005).

Over the last 50 years however, the balance between the surface and mineral estates has shifted. Technological, sociological, and legal changes have transformed the means and markets of energy production, fragmented surface property into smaller and more valuable parcels of high-intensity use, and increased public consciousness and norms surrounding the environmental and social impacts of mineral development (House, 2013; Howard-Grenville, 2008). The development of overlapping property rights whose scale and impacts are increasingly mismatched with traditional property boundaries (Bradshaw & Lueck, 2015) have transformed jural relations between surface and mineral owners and applied unbearable tension to formalist legal rules.

This article suggests that the hierarchical and two-dimensional ordering between surface and mineral estates is over-simplified and no longer reflects customs and practices relative to oil and gas development.

Changes in technology, demand, and human awareness challenge the concept of separate and easily demarcated, overlapping surface and mineral fee estates along vertical boundaries. This contrived ordering creates the illusion of a tragic choice between forcing cooperation among surface and mineral owners and allowing exit (Dagan & Heller, 2001). Instead, surface and mineral property interests can be understood as a limited commons resource comprised of emmeshed and overlapping parts of coupled human and natural systems. Recognition of the changed social context of split estates permits doctrinal shifts and legal evolution (Demsetz, 1967). This article suggests that regulatory processes that encourage inclusive, resource-scale land planning to aggregate resources, often associated with more communitarian management (Dagan & Heller, 2001; Ellickson, 1993), may in fact provide opportunities to liberalize surface-mineral disputes.

This article begins with an examination of trends which have strained the limited commons of surface and mineral property: vertical and horizontal fragmentation of surface property, the emergence of the resource play, and loss of industry social license in light of climate concerns and diminishment of the perceived utility of fossil resources. Ellickson (1993) notes, "most tracks of land are suited to multiple uses for which scale efficiencies vary" (p. 1332). Resource fragmentation – either vertical or horizontal – complicates efficient resource coordination over landscape scale resources by creating a mismatch between parcel sizes and the efficient boundaries for management (Bradshaw & Lueck, 2015). The result is an increase in coordination, transaction costs, and conflict (Heller, 1999). These constraints, at times, create an anticommons (Heller, 1998; Leonard & Parker, in press) which impedes development of both mineral and surface resources.

The transitioning geographical and social contexts within which mineral development occurs are transforming the legal doctrines governing split estates. Part II examines split-estates and the common law implied servitude and the extent to which it has evolved in response to changing oilfield practices whereas Part III looks at the principal legal developments which have altered the development of split-estates: surface damage or split-estate statutes, the accommodation doctrine, and regulation of energy land uses. Whereas land use changes have weakened the relative power of the surface estate (Wiseman, 2015), split-estate statutes have placed the surface owner's needs front and center in the development process and prioritized control of externalities over resource production.

A realist view of the surface-mineral relationship invites consideration of new frameworks for resolving land use disputes. In most situations, use and enjoyment of both mineral and surface estates are not irreconcilable. However, an increase in conflicts is concomitant with continued resource fragmentations and encroachment of mineral development and denser surface development. Part IV considers how legal changes could address the rising indomitability of the surface estate and the growing obsolescence of the boundary-based, parcel by parcel approach to resolving surface-mineral conflicts. Bradshaw and Lueck (2015) have observed that stakeholder collaborations that transect administrative and property boundaries may accommodate overlapping rights. This section considers how democratized and multilateral energy siting processes within oil and gas regulatory governance could facilitate a liberal legal regime that mediates resource-scale cooperation between surface and mineral owners for shared social and economic benefits. It offers that liberalizing and democratizing reforms to energy governance may improve resolution of split-estate conflicts and environmental protection.

II. A Transitioning Landscape

The United States is in the midst of a rapid energy transition marked by both increases in renewable generation and in fossil fuel production (Wiseman, 2013). Horizontal development and hydraulic fracturing have made it possible to develop oil and gas with a smaller footprint, to reach reserves from further away, and accordingly, spread infrastructure and development over a larger area. This same technology has opened up vast new areas of shale resources to development. Concurrently, expansion of the urban footprint has resulted in greater land and resource fragmentation (Burger et al., 2013). As a result, suburban and industrial development have collided, each encroaching into areas traditionally inaccessible to the other. The resulting clash has transformed communities and legal doctrines (Wiseman, 2013).

Expanding and overlapping vertical boundaries create burdensome administrative complexities and may invite new disputes vis-à-vis the severed mineral estate (Ellickson, 1993). Transitioning land uses and energy systems have extended these boundaries through the recognition of new surface property interests. As Professor Ehrman (in press) articulates, resource sight – the ability to perceive resources – shapes the application of property regimes. In response to emergent technologies such as carbon capture and sequestration and demand for waste water disposal, courts and states have vested surface owners with property interest in the pore spaces of the rock – the interstitial voids which encompass the hydrocarbons, brine, and gas within solid rock which can be used as "storage space for carbon dioxide or other substances"(Wyo. Stat. Ann. §34-1-152

[2020]). Additionally, the development of renewable technologies has created value in wind, air space, and solar radiation (Duvivier, 2014). Suprajacent and subsurface surface property may be co-occupied by mineral uses (*Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, 2015), require accommodation (*VirTex Operating Co. Inc., v. Bauerle*, 2017), and trigger statutory remedies for compensation (*Burlington Resources Oil & Gas Co. v. Lang and Sons Inc.*, 2011; *Mosser v. Denbury Res., Inc.*, 2015). At the same time, human understandings of subsurface systems have also expanded, challenging the early analogies to wild animals that underpinned the emergence of early property doctrines regarding mineral law (*Westmoreland & Cambria Nat. Gas Co. v. De Witt*, 1889). Like early cases involving subsidence (*Pennsylvania Coal Co. v. Mahon*, 1922), overlapping and concurrent development of vertically segregated resources has illustrated the interrelationship between the two estates (*BTU Western Resources, Inc. v. Berenergy Corp*, 2014; Kramer, 2007).

Changes in technology impact the application of property rules to limited common pool resources such as oil and gas (Kramer, 2014; Rose, 1998). Horizontal drilling and hydraulic fracturing have opened up new resources, allowing oil and gas production regions to expand into urban areas and those without historic mineral production. These same technologies have increased the intensity of development in some areas – increasing externalities such as well pad size, noise, and light – while making possible accommodation of a larger range of surface uses by liberalizing well site selection (*Andrews et al. v. Antero Resources Corp.*, 2019, *dissent*). For instance, horizontal drilling may make it possible to access subsurface resources from miles away whilst hydraulic fracturing may mobilize resources from underneath inaccessible parcels without drilling additional wells. These innovations may require combination of multiple parcels into one administrative unit for development, pooling to allocate costs and production within the unit, and development of field wide infrastructure such as flowlines, consolidated tank facilities, overhead power, and disposal wells (Kramer, 2014). Many of these new uses require a larger footprint and thus contradict the implied easement's inherent prohibition on use of the surface for extralateral parcels (*EQT Production Co. v. Crowder*, 2019) and have challenged courts to reexamine the bounds of the rule of capture (*Briggs v. Southwestern Energy Prod. Co.*, 2020).

Land fragmentation has weakened the position of individual surface property interests, divorced the economic interests of surface owners from mineral production, and enhanced coordination issues. Smaller parcels, particularly those with split-estate minerals, are more likely to result in conflicting tenure, require greater coordination of resources, and mismatches in property rights (Bradshaw & Leonard, in press). For instance, a property owner in a subdivision is unlikely to own the minerals under her property. Larger spacing units necessitated by horizontal drilling have marginalized the relative economic value of production attributed to small residential parcels relative to the proportionately greater value of home equity. Additionally, the owner of a small tract has very little power to block development or control its location or manner of development (Wiseman, 2015). Population growth and sprawl in areas of historic resource development has increased land use conflicts between surface and mineral owners.

Lastly, sociological transformations have resulted in more visibility, connectivity, and diminished social license for fossil fuel development (Van de Biezenbos, 2019). Fossil fuel development was once the cornerstone of many western communities and drew strong social and legal license as a result (Klass, 2008). Even within historically resource-dependent economies such as the Colorado front range, new industries are displacing the economic and social prominence of the extractive industries whilst alternative technologies are undermining their presumed necessity. Concurrently, social media and other factors have made apparent the impacts of fossil production and raised the public's environmental consciousness. As a result, mineral development has lost much of the trust and support of communities.

Technological, social, and land use changes have wrought legal transformations in upstream oil and gas. Development and coordination of resources now takes place on a larger scale, requiring greater collaboration and coordination of resources that exist within coupled systems. These shifts have upended settled expectations relative to surface and mineral property and resulted in a mismatch of property interests in the limited vertical commons.

III. Split-Estates and The Implied Servitude

The *ad coelum* maxim imagines a fee interest in property as extending from the sky to the center of the earth.[1] However, an owner of land may alienate and convey its various incidents and carve its fee-simple into smaller estates by horizontal or vertical division. For instance, an owner may sever and convey all of

[1] Lord Coke is attributed with the maxim, *cujus est solum, ejus est usque ad coelum et ad inferos*, which is translated as "To whomsoever the soil belongs, he owns also to the sky and to the depths" (Black, 1979).

the minerals throughout the parcel, the rights within a specified depth or strata, one specific mineral, or convey only the surface and reserve the minerals (*Beulah Coal Mining Co. v. Heihn*, 1920). The conveyance or reservation of an interest in the minerals creates two separate fee estates of equal value and dignity, each with rights of development, enjoyment, and exclusion, one which underlies the other (*Bilby v. Wire*, 1956).

Where the instrument severing surface and mineral interests contains no reference to surface use, courts burden the surface estate with a common law implied servitude that grants the mineral owner the right to use the surface as is reasonable and necessarily incident to its enjoyment of its estate in the underlying minerals (*Baker v. Royaly Lead & Spar Co.*, 1908; *Feland v. Placid Oil. Co.*, 1969). A servitude may be implied into a conveyance of real property for the purpose of "honoring the intention of the parties and avoiding injustice" (*Lobato v. Taylor*, 2002). As with all easements, the implied servitude for mineral development creates a hierarchical ordering between the two estates wherein the parcel enjoying the easement is dominant and the burdened parcel is servient (*Dark v. Johnston*, 1867).

The implied easement derives from the natural and physical relationships between the two estates and the relationship of the parties at the time of the severance. The minerals, owing to their physical location under the surface, are inaccessible except by and through use of the surface. Thus, without a right of access to the minerals, the estate created by the severance would be "meaningless and worthless" (*Hunt Oil Co. v. Kerbaugh*, 1979, p. 135). This same logic formed the basis of decisions applying the "surface destruction test" to determine whether unnamed minerals in a general grant were included in the surface or mineral estate (*Acker v. Guinn*, 1971). Just as the seller of severed minerals must have presumed the purchaser would have required some surface access and use, he or she also would not have reserved the surface had the parties expected it to be completely destroyed and consumed by mineral development.

The implied easement for surface use is subject to three important common law limitations, each of which emanates from the necessity required by the severance. First, access is presumed to have been included and priced within the transaction creating the severance. Thus, courts considered damages caused by mineral development *damnum absque injuria* and thus did not permit the surface owner to any additional notice or recovery of compensation (Korngold, 2004, §3.01(a); *Koury v. Morgan*, 1926). Second, the right of the mineral owner to use, destroy, access, and occupy the surface is limited to those uses reasonably necessary for development which could be exercised with due care and regard for the rights of others (*Chartiers Block Coal Co. v. Mellon*, 1893; *Williams v. South Penn Oil Co.*, 1902). Third, surface use pursuant to the implied easement is confined to that necessary to the purpose for which it was created, thus enjoining use for development of extralateral parcels (Browder, 1963; *EQT Production Co. v. Crowder*, 2019). Any deviation renders the mineral owner an excessive user of its surface easements and potentially liable for trespass. (Martin & Kramer, 2008). Some early courts were so faithful to these limitations that a mineral owner's abuse of its privilege to utilize the surface estate under either express or implied easements resulting in a finding of trespass ab initio (*Coffindaffer et al. v. Hope Natural Gas Co.*, 1914).[2]

The presumptive grant of a dominant servitude for split estate minerals can be understood as a commitment to the preservation of rights of exit in severed mineral property. Dagan and Heller define exit, as a liberal value, as the right to withdraw, dissociate, or to "cut oneself out of relationship with other persons" (2001, p. 568). The implied easement to develop the surface, like other easements of necessity, assures a mineral owners' unilateral right of access and exit and guarantees voice in decision making. As such exit serves to protect the mineral owners from opportunistic or harmful interference by others in the shared property – namely the surface owner. Second, the right of exit shapes the relationship between mineral and surface owners from the point of severance, promoting trust and cooperation in bargaining over use of the surface.

The implied easement for surface use is increasingly mismatched with modern production techniques, thus weakening the mineral owners' opportunity for individual exit. Use of the surface is confined to the purposes necessary to development of the severed mineral estate. Necessity varies with the customs and practices and available methods of extraction that predominate at the time of use (Martin & Kramer, 2017). Thus, the uses which are permitted pursuant to the implied easement for mineral development are vast and vary significantly based on the ever-changing yardstick of reasonableness (Kramer, 1986; Martin & Kramer, 2017). Rather than resulting in an enumerated list of permitted and prohibited uses, in holding that geophysical operations were a permissible use of the surface, the North Dakota supreme court in *Hunt Oil Co. v. Kerbaugh* (1979) held that the reasonableness and necessity of the mineral owner's use is examined

[2] Modern courts however have been less inclined to apply the doctrine of trespass ab initio, instead limiting liable to the damages caused by the tortuous conduct. (see, e.g., *Simpson v. Phillips Pipeline Co.*, 1990, p. 310–311). This shift weakens the bargaining position of the surface estate.

in light of "usual, customary and reasonable practices in the industry under like circumstances of time, place and servient estate uses" (p. 136). Applying this standard, courts have also permitted construction of power lines (*Trivette v. Consolidation Coal Co.*, 1944), cutting trees (*Gulf Refining Co. v. Davis*, 1955), roads (*Gulf Oil Corp. v. Walton*, 1958), drilling locations and pits for cuttings and waste disposal (*Whiteman v. Chesapeake Appalachia, LLC*, 2013), use of surface owner water (*Russell v. Texas Co.*, 1956), and the housing of employees (*Livingston v. Indian Territory Illuminating Oil Co.*, 1937). Despite this inherent dynamism, uses which today are reasonable and necessary frequently clash with the prohibition on use for the benefit of extralateral parcels.

The rights of the dominant estate similarly do not extend beyond the physical boundary lines of the parcel (*Krenz v. XTO Energy, Inv.*, 2017).[3] The mineral owner's surface use must be exclusively for the development of the underlying minerals and not for adjacent or extralateral parcels (*EQT Production Co. v. Crowder*, 2019; *Robinson v. Robbins Petroleum Corp.*, 1973; *Russell v. Tex. Co.*, 1956). Off-tract use for the benefit of or to extract minerals from neighboring parcels, including through combined facilities or operations, is an excessive use of the implied easement (Kramer, 2014). This limitation is perhaps more important now, in the era of shale gas development, than ever before. Shale development frequently requires the aggregation of numerous parcels of land into large drilling units for horizontal development which are served by consolidated facilities including multi-well pads, roads, tank batteries, compressor stations, and facilities for water handling, injection, or evaporation. Consolidated or field-wide facilities frequently defy confinement to individual surface or mineral parcels, thus making the extra-lateral use prohibition a significant limitation (*See, e.g., Corbello v. Iowa Production*, 2003; *Farragut v. Massey*, 1992; *Roberts Ranch Co. v. Exxon Corp.*, 1997). As a result, in many scenarios, severed mineral property can only be fully enjoyed through association and cooperation with others.

IV. The Indomitability of the Surface Estate

Laws which protect the surface from damage or disruption have reallocated priority among surface and mineral estates based on time of use and mandate contracting and association with the surface owner as a precursor to development. Although formalist doctrines maintain the dominance of the mineral estate, in some scenarios mineral development may be impossible or economically impracticable as a result of laws and regulations governing mineral development or the economic impracticability of contracting with surface owners.[4]

Over time, courts have evolved the due regard doctrine to incorporate increased attentiveness to the concerns and investments of surface owners (*Getty Oil Co. v. Jones*, 1971). The modern accommodation doctrine provides a framework for resolving conflicts between surface and mineral uses while still maintaining the dominant rights of the mineral estate (*Merriman v. XTO Energy, Inc.*, 2013). It requires accommodation of existing surface uses where (1) the proposed mineral use would completely preclude or substantially impair the existing surface use; (2) the surface owner has no reasonable alternative method available by which to continue that use; and, (3) there are reasonable, customary, and industry-accepted alternative methods available to the mineral owner by which to recover the minerals. This requires a series of fact-based inquiries regarding the availability of alternative, and non-conflicting, methods of development to the surface and mineral owners. Importantly, the surface owner does not need to demonstrate that its existing use would be impossible by any means, so long as the anticipated mineral development would be a substantial impairment to its existing and preferred methods of surface use (*VirTex Operating Co. Inc., v. Bauerle*, 2017). Frequently, determinations regarding the reasonableness and feasibility of accommodations are made by juries, which are likely to be more favorable to surface owners.[5]

The mineral owner's obligations of accommodation and due regard expand as the surface owner develops its property into more dense, sensitive, or intensive uses. The implied easement for surface development differs in certain material respects from specific easements for access and use in that it lacks a specific width, length, or location. It is not fixed, nor does it assure any specific point of use or entry. Rather, its scope is determined by the necessity of the use. Thus, encroachments by the surface owner will only be restricted if they unreasonably interfere with the dominant estate's enjoyment of the easement (*Gerrity Oil & Gas*

[3] Subsequent division of surface ownership does not limit the implied rights granted at severance, *Wall v. Shell Oil Co.*, 1962, p. 518).

[4] An initiative which would have imposed larger setbacks from property lines, schools, and occupied dwellings in Colorado was estimated to have rendered up to 90% of certain areas undevelopable (see generally, Colo. Oil & Gas Conservation Comm'n, 2016).

[5] Courts have limited the mineral owner's duties of accommodation to alternatives that can be accomplished on the leased premises and have not required the mineral owner to improve the surface or purchase goods from the surface owner. (See, *Harrison v. Rosetta Resources Operating, LP*, (2018)).

Corp. v. Magness, 1997; *Southern Star Central Gas Pipeline, Inc. v. Cunning*, 2007). For instance, in most cases the servient owner is not required to restrict its use of the parcel to avoid interference with the mineral owner's implied easement. In *Osage Nation v. Osage Wind, LLC*, (2011) the mineral owner sought to enjoin development of the surface property as a wind farm on the basis that it would restrict the area available for future development of the mineral estate. Despite finding that development of the parcel might make mineral development more difficult or costly, the court found that the mineral owner did not have any right to any specific point of entry. Instead, the court found that the mineral owner's rights were limited to those they could exercise with due regard for the surface owner and refused to limit the surface owner's proposed use in the absence of an actual interference. Although courts are unlikely to require accommodation of future or anticipated uses (*Amoco Production Co. v. Thunderhead Investments Inv.*, 2002), once developed, "first in time" uses are afforded additional protections (Schremmer, in press). In *Gerrity Oil & Gas Corp. v. Magness* (1997), the Colorado Supreme Court found that despite references to split estates as dominant and servient, "in a practical sense both estates are mutually dominant and mutually servient because each is burdened with the rights of the other" (p. 927). These same protections are often incorporated into statute (*see, e.g.*, La. Civ. Code Ann. art. 743 [2019]; Oil and Gas Conservation Act, Colo. Rev. Stat. Ann. §34-60-127(1)(a) [2019]).

A number of states have also passed laws expressly protecting split-estate surface owners from damage, loss of value, or disruption resulting from the lawful use of the mineral owner (Kulander, 2007). Split estate or surface damage statutes add formal procedures for governance. They require collaboration and negotiation between surface and mineral owners as a condition precedent to permitting, access, or surface disturbing activities and provide surface owners with statutory remedies. These laws retroactively create a new stick in the surface owner's bundle of rights by insuring against loss of value or damages from mineral owner's lawful use. Courts have upheld this as a valid exercise of the police power to guarantee "that the development of one industry is not undertaken at the expense of another" (*Davis Oil Co. v. Cloud*, 1986, p. 1351) "even at the cost of an uncompensated destruction of other interests" (*Murphy v. Amoco Production Co.*, 1984, p. 555). Although surface damages and split-estate statutes frequently include a declaration that they do not change the common law of mineral dominance, the private benefits these statutes confer fundamentally alter the relative value and relationship between the two estates. This in turn is fortifying customs of private ordering. As a result, the surface owner has become an indispensable participant in mineral development, driving environmental protection and limiting development through private governance and requiring the mineral owner to internalize the most immediate surface externalities of its lawful use.

Public governance mechanisms to protect public health, safety, and welfare also favor surface protection and limit development. The energy regulatory space includes federal and state actors which limit oil and gas development spatially and temporally to accommodate other property and wildlife (Righetti, 2020). Local governments may enjoy concurrent and overlapping authority to regulate the aesthetic impacts of oil and gas production (Local Government Land Use Control Enabling Act of 1974, Colo. Rev. Stat. Ann. §29-20-104 [2019])], providing opportunities for land use exactions. (Selmi, 2011). These regulations may apply even where they result in the non-production of oil and gas. (*see* Oil and Gas Conservation Act, Colo. Rev. Stat. §34-60-103(11)(B) [2019]). The common law has always recognized that development of the mineral estate was limited by doctrines of nuisance and subject to regulation to prevent public injury. However, the expansion of oil and gas regulations has inured to the benefit of the surface estate, providing additional avenues to limit development on split-estate parcels.

Where surface and mineral conflicts are examined only on a parcel by parcel basis, conflicts between uses appear irreconcilable. A split-estate mineral owner who cannot develop its property as a result of surface use or restrictive regulations has few opportunities for meaningful exit. Laws which mandate negotiation and compensation to surface owners, or which restrict locations for subsurface access, limit exit within the vertical commons. Takings law, often considered the last preservation of exit (Peñalver, 2005), provides mineral owners with little reprieve. Takings claims based on split-estate statutes (*Murphy v. Amoco Production Co.*, 1984), judicial interpretations limiting reasonableness or necessity of easements (Barros, 2012), or regulations which prohibit surface uses or fracturing have largely failed to overcome defenses of nuisance (Lynch, 2016). However, the lack of exit available to mineral owners imposes real costs. Where exercise of the police power in this manner principally confers a private benefit to surface owners – chiefly the extinguishment or weakening of the implied servitude and guarantee of compensation through private contract – reliance on public compensation mechanisms is inefficient and inequitable (Epstein, 1986; Thomas, 2004). Moreover, lack of opportunities for meaningful and individual exit may frustrate cooperation

(Dagan & Heller, 2001). Finally, concerns over diminished revenue[6] or interference with investment backed expectations of mineral owners may encourage state legislators to internalize the costs of public regulation of oil and gas development and externalities, thus leading to greater compromise and restraint (Rose, 1996; Rose, 2007).

Like other common law implied servitudes (Karp, 1993), the right of access for mineral development arises as a result of a complex system, comprised of natural limitations, such as the physical stratigraphy and structure of the resource, and social preferences that value the discovery and development of fossil resources. Yet, the system is also adaptive (Rose, 2005). The increasing fragmentation and regulation of land, diminished social and economic dominance of fossil fuel development, and development of new technologies have irrevocably shifted the yardsticks of reasonableness, due regard, and necessity. In response, courts and legislatures have altered the scope and nature of the implied easement to protect the interests of the servient estate. In areas with small parcels and intensive surface uses, the surface estate has become indomitable.

V. A Liberal Commons Ad Coelum

The dominant and servient ordering of surface and mineral estates falsely supposes that prioritization and coordination conflicts between overlapping estates can only be reconciled through a binary and hierarchical ordering. These estates however were always interrelated and codependent, but the law governing the relationship between them has treated them as immutably separate. Though once a rule of convenience and necessity, as applied to modern development the result is both inefficient and inequitable, creating an anticommons where both surface and mineral resources may be underdeveloped. Although falling short of requiring unanimity among surface and mineral owners, both are limited by coordination challenges and the rights of use and occupation of the other. Thus neither can derive full utility from the land (Bradshaw & Lueck, 2014).

Just as the mineral owner's enjoyment of its mineral property is dependent on the management of the limited commons of the reservoir community (Pierce, 2011), it also relies on access to and through the shared surface property. That surface property also exists within broader resource communities: the neighborhood, watershed, migration corridors, and ecosystem. The conflicts between surface and mineral owners can thus be understood as resource management problems that transect hybrids of private and limited-commons regimes and which have been exacerbated by land fragmentation and changing production techniques. These shifts have expanded the community of owners that must be coordinated for management into a broader and more heterogeneous group, some whom do not have a voice in private or public governance mechanisms (Spence, 2014; Wiseman, in press). Further, the creation of new property and new uses have initiated temporal transitions in owners and resource use, thus stressing the established property for management of split-estates.

By making the commons more "porous" (Rose, 2014), liberal commons principals which provide for democratic governance between and among split-estates may address the limitations and inequities permitted by the dominant-servient ordering. Dagan and Heller, (2001) suggest that cooperation in limited commons scenarios can be enhanced through greater democratization of internal governance mechanisms which promote individual autonomy, collective decision making over resource use, and "cooperation-enhancing exit." Liberal commons institutions are more adaptable, promote customization, and engender trust and cooperation among members. Already, oil and gas governance institutions incorporate liberal commons principals relative to management of split-estates; the separation of two estates and dominance of the mineral estate promote individual dominion; the reasonableness and due regard requirements inherent to the implied easement provide flexibility while preserving autonomy; and, the institutional coordination required by split-estate statutes demand cooperation and private ordering. Yet, the liberal aims of this structure are constrained by adherence to a vertical boundary-based adjudication that fails to conceive of split-estates as co-existing within both private and commons regimes (Rose, 2000), thus precluding economic gains from aggregating resources. Moreover, cooperation regarding resource management decisions is temporally limited to the time immediately preceding mineral development, thus producing inefficiencies in resource allocation, trade-offs, and management. Finally, two-dimensional and bilateral rules reduce opportunities for exit, creating equitable concerns, limiting trust, discouraging cooperation.

[6] For instance, a proposed setback measure in Colorado would have significantly affected state and local tax receipts, see, e.g., Chris Brown and Zhao Chang, *Increasing the Oil and Gas Setback Requirement to 2,500 Feet in Colorado: The Economic and Fiscal Impacts*, REMI Partnership (July 2018).

Future split-estate conflicts can be limited by encouraging early, democratic cooperation between surface and mineral owners. In most states, surface and mineral owners interface only in the limited time between when a well is first proposed and the time when it is plugged and abandoned. The mineral estate may be severed for a century before requiring any communication or coordination between the surface and mineral owners. During this time, the surface estate may be subdivided and developed, limiting the geography within which subsequent mineral development can occur and setting the stage for future resource conflicts. Earlier coordination between surface and mineral owners can mitigate conflicts, allowing development of the surface while preserving the opportunity for exploitation of the minerals. The Texas Subdivision Act, for example, creates a cooperative process through which surface and mineral owners and state agencies set aside future locations for mineral development when undeveloped land is subdivided (Tex. Nat. Res. Codes Ann. §92 (2020)). Rather than applying a dominant-servient property rule that allows the mineral developer to later destroy surface developments which cannot be accommodated, this process limits future land use conflicts through early-stage collaboration between agencies and private actors over shared resources. The mutual vulnerability of this process begets early cooperation over resource use decisions (Singleton & Taylor, 1992) and could support the transition of depleted reservoirs for new purposes (Schremmer, in press).

Governance institutions can further enhance coordination among split-estate owners by creating formal processes for landscape scale resource management. Already, oil and gas reservoirs are large scale resources that can be managed to maximize economic good through pooling and coordinated resource development (Bradshaw and Lueck, 2015; Pierce, 2009). Unitization laws provide for voluntary or compulsory aggregation of mineral property through majority consent processes (Libecap & Wiggins, 1985; *see, e.g.*, Wyo. Stat. Ann. §30-5-110 (2020)). Similarly, a number of states have enacted unitization statutes to assemble pore space resources for carbon storage (Righetti, 2017). Unitization statutes acknowledge that while reservoirs are comprised of individual property interests, they can only be enjoyed and exploited as a community. It recognizes that mineral development is dispersed, and temporal, and thus that boundary line analyses are artificially limiting. Thus, by allowing combination of minerals and surface within a very large area, unitization allows placement of wells to maximize recovery and minimize surface conflicts.

However, the governance of production units is mismatched to their purpose and the scope of interests they control. Unitization modifies the property and contractual interests of owners in the unit including changing allocations of production and expenses among mineral, royalty, and operating rights holders (Kramer & Martin, 2019). As a result, oil and gas conservation statutes define mineral owners, royalty owners, and the holders of mineral leases or operating rights as interested parties (Kramer and Martin, 2019, §§11.02, 18.02; *see, e.g.*, Wyo. Stat. §30-5-110 [2020]). These limited definitions exclude surface owners, environmental interests, and local governments, despite the fact that consolidated development within units may render significant impacts on these groups. Although courts have found that unitization does not expand the scope or intensity of the implied easement from which the dominant-servient ordering is derived (Kramer and Martin, 2019 §20.06), exclusionary and compulsory processes may not result in pareto improvements for all participants (Libecap & Smith, 2001). In these conditions, alternative organizational structures which encourage negotiated consensus arrangements between stakeholders may offer improvements.

Already, some state oil and gas conservation statutes have challenged antiquated jurisdictional boundary norms and engaged in community centric, multi-lateral and adaptive resource planning processes. Revised conservation law statutes recognize rights of entrance (Peñalver, 2005) to the reservoir community as associated with the property interests of surface owner and administrative and municipal associations. For instance, Colorado's Oil and Gas Conservation Act (2019) provides oil and gas developers with an option to engage in a comprehensive drilling plan processes that involves participation by landowners, local governments, environmental regulators, and public comment. This process allows developers to pool surface and mineral interests over large areas for the purpose of orderly and efficient development and preservation of surface resources, thus maximizing economic and social benefits. Collaborative land planning processes not only promise to enhance local democratic institutions and offer legitimacy to decision-making processes (Camacho, 2005), but may provide increased adaptability within bilateral negotiations among surface and mineral owners.

Developing institutions that promote cooperation across shared resources also presents new opportunities for exit. Landscape scale planning processes promote aggregation of surface and subsurface resources through private governance mechanisms at efficient management scales (Bradshaw & Leonard, in press). These mechanisms could include opportunities for alienation such as mineral conservation easements that would secure non-development of certain mineral properties (Jackson, 2017) or land exchanges. Doctrinal changes that recognize mineral and surface owners as cotenants rather than may also permit equitable

dissolution through partition, thus reunifying severed surface and mineral interests.[7] Cooperative processes would thus promote usability among surface and mineral estates by overcoming current barriers to transacting, including high information costs and power imbalances in default rules.

VI. Conclusion

Technological and social changes have strained the normative ordering between severed surface and mineral estates. A binary focus on priority diminishes opportunities for cooperation and exit, resulting in inequities and inefficient resource use. The current illiberal framework leads us to accept as normative that development must happen within subdivisions and sensitive environmental areas and that inequities are unavoidable in a system where there can be either surface or mineral use. This article suggests that democratized public governance mechanisms can facilitate resolution of coordination and exit issues related to vertical boundaries. Liberalizing split-estates through a more porous, common resource framework provides opportunities for generative solutions to the environmental, energy, and economic challenges of the energy revolution.

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Competing Interests

The author has no competing interests to declare.

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[7] Partition is not customarily available to severed surface and mineral estates since they are not considered cotenants in the property. (*See, e.g.* Wolf, 2020, §50.07).

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