DOES THE FEDERAL GOVERNMENT OWN THE PORE SPACE UNDER PRIVATE LANDS IN THE WEST? IMPLICATIONS OF THE STOCK-RAISING HOMESTEAD ACT OF 1916 FOR GEOLOGIC STORAGE OF CARBON DIOXIDE

BY

KEVIN L. DORAN* AND ANGELA M. CIFOR**

This Article establishes that pursuant to the mineral reservation contained in the Stock-Raising Homestead Act of 1916 (SRHA), as well as U.S. Supreme Court jurisprudence that has further defined the scope of that reservation, the federal government likely holds title to some 70 million acres of subsurface pore space located under private land in the West. In addressing the issue of pore space ownership, scholars and regulators have focused on the question of who owns the pore space when the mineral estate has been severed from the surface estate. This approach, however, overlooks the critical fact that for the approximately 70 million acres of land patented under the SRHA, the United States government held the original fee simple absolute, and conveyed the land while retaining "all the coal and other minerals in the lands." In 1983 in Watt v. Western Nuclear, Inc.*, the Supreme Court delineated a four-part test for determining if something falls within the scope of the SRHA's mineral reservation—a test that was further explicated by the Court's decision in 2004 in* BedRoc Limited, Inc. v. United States*. This Article analyzes this jurisprudence vis-à-vis the question of whether or not pore space falls within the scope of the SRHA's mineral reservation. Based on a detailed analysis of the history of the SRHA and relevant jurisprudence by the Supreme Court and other federal and state courts, we conclude that the federal government likely owns the pore space for those lands patented under the SRHA. This conclusion has far reaching policy implications. For instance, states that have statutorily determined that ownership of the pore space is vested in the surface owner are now confronted by the*

* Institute Fellow and Assistant Research Professor, Renewable and Sustainable Energy Institute, United States National Renewable Energy Laboratory (NREL) and the University of Colorado at Boulder (UCB); Managing Director, Carbon Management Center, Colorado School of Mines, Colorado State University, NREL, and UCB. The authors would like to thank Jason Deardorff, Mike Knotek, Elizabeth Lokey, Adam Reed, George Sherk, and Charles Wilkinson for their helpful comments.

** J.D. Candidate 2012, University of Colorado Law School.

prospect that these statutes are preempted by federal law when dealing with land originally conveyed by the SRHA. Moreover, given the significant acreage covered by the SRHA, federal ownership of pore space could arguably reduce the transaction costs associated with project development, thereby facilitating the rapid scaling of commercial geologic carbon storage projects.

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I. INTRODUCTION

There is really only one reason to take on the technically challenging, legally tortured, and economically cloudy task of storing carbon dioxide (CO_2) deep within the earth where it will—hopefully—remain indefinitely, trapped within the microscopic voids and fractures of rock known as pore space or transformed into solid carbonates over many years through the process of mineralization.[1] That reason, of course, is climate change. Storing CO_2 deep underground is widely viewed as an integral component of a larger United States and global strategy for reducing net emissions of greenhouse gases (GHGs),[2] which will consequently help to stabilize atmospheric concentrations of GHGs.

For geologic carbon storage to play this important role, however, a whole lot of CO_2 will need to be stored underground; and, consequently, a whole lot of underground space will be needed to store it.[3] According to several recent estimates, achieving a significant impact on stabilizing

[1] *See* Sally M. Benson & David R. Cole, *CO_2 Sequestration in Deep Sedimentary Formations*, 4 ELEMENTS 325, 325 (2008) (discussing the various physical and geochemical processes whereby CO_2 is sequestered); *see also* Eric H. Oelkers et al., *Mineral Carbonation of CO_2*, 4 ELEMENTS 333, 333 (2008) (discussing the process of mineral carbonation, whereby CO_2 becomes fixed as a stable carbonate mineral).

[2] *See* NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, DOE/NETL CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP 5 (2010), *available at* http://www.netl.doe.gov/technologies/carbon_seq/refshelf/CCSRoadmap.pdf.

[3] *See infra* text accompanying notes 6–11.

atmospheric CO_2 concentrations will require, *at a minimum*, a 90% reduction in CO_2 emissions from fossil fuel power plants.[4] Attaining reductions of this magnitude will almost certainly require a relatively large contribution from carbon capture and storage (CCS).[5] As a result, the sheer volume of CO_2 that will need to be geologically sequestered is enormous.

One large, coal-fired power plant releases about 8 million tons of CO_2 per year into the atmosphere.[6] According to Benson and Cole, "[S]equestering the CO_2 emissions from a power plant with a 50-year lifetime would require a volume of about 500 [million cubic meters (Mm^3)]."[7] To put this into perspective, the total volume of the Great Pyramid of Giza is thought to be around 2.5 Mm^3.[8] Putting 500 Mm^3 of CO_2 into the subsurface over a fifty-year span is the equivalent of putting four Great Pyramids of Giza consisting entirely of CO_2 into the subsurface every year for fifty years—and this is just for one power plant. In terms of the geographic footprint this would require, one such plant could need between 300 to 11,000 km^2 (186 to 6835 m^2) of pore space in which to store its CO_2 for thirty years.[9]

Let us assume there are about 315 large (one gigawatt (GW)-size) coal-fired power plants in the United States, each emitting a volume of about 10 Mm^3 of CO_2 per year.[10] Every year this would require the subsurface storage of about 1260 Great Pyramids of Giza. Over fifty years, this would equal the storage of some 63,000 Great Pyramids. The aggregate volume of all these

4 *See* NAT'L ENERGY TECH. LAB., *supra* note 2, at 5 (noting that "[r]ecent studies of potential GHG mitigation strategies conducted by Princeton, Electric Power Research Institute (EPRI), and others found that a minimum of 90 percent CO_2 reduction from fossil fuel power plants is required to make a significant impact on stabilizing atmospheric CO_2 levels").

5 *Id.*

6 Benson & Cole, *supra* note 1, at 325.

7 *Id.* (noting that for a single large coal-fired power plant, and at "the pressures and temperatures expected for sequestration reservoirs, the volume required to sequester CO_2 as a supercritical fluid is about 10 million cubic meters (Mm^3) per year").

8 JANEY LEVY, THE GREAT PYRAMID OF GIZA: MEASURING LENGTH, AREA, VOLUME, AND ANGLES 15 (2007).

9 ELIZABETH LOKEY ALDRICH ET AL., THE ENERGY POLICY INST., ANALYSIS OF EXISTING AND POSSIBLE REGIMES FOR CARBON CAPTURE AND SEQUESTRATION: A REVIEW FOR POLICYMAKERS 15 (2011) (noting that "the huge discrepancy in these numbers is due to the depth of the formation and its ability to sequester CO2"); R. Lee Gresham et al., *Implications of Compensating Property Owners for Geologic Sequestration of CO_2*, 44 ENVTL. SCI. & TECH. 2897, 2900 (2010), *available at* http://epi.boisestate.edu/media/6079/epi%20ccs%20pore%20space%20regimes.pdf; *see also* E.J. Wilson, *Subsurface Property Rights: Implications for Geologic CO_2 Sequestration*, *in* 52 DEVELOPMENTS IN WATER SCIENCE, UNDERGROUND INJECTION SCIENCE AND TECHNOLOGY 681, 681 (Chin-Fu Tsang & John A. Apps eds., 2005) (predicting a one GW capacity coal-burning power plant will necessitate approximately 100 km^2 of pore space to store the CO_2 from this plant for 30 years). Wilson's figure is a highly generalized estimate; CO_2 plume size can vary significantly based on site-specific structural features and geological characteristics.

10 According to U.S. Energy Information Administration data, the average of the United States 2009 net summer capacity from coal and the net winter capacity for coal is 315.3 GW. *See* ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2009, at 17 tbl.1.2 (2011), *available at* http://www.eia.gov/electricity/annual/archive/03482009.pdf. If we assume that coal-fired plants of approximately one GW in size provide this capacity, then we have approximately 315 one GW-size plants.

pyramids would be roughly equivalent to 63 million Olympic-sized swimming pools.[11]

So clearly, a great deal of subsurface space is needed to store all of this CO_2. Fortuitously, it appears there is plenty of potential subsurface storage space for the CO_2, even given the massive quantities that will need to be stored. According to the most recent estimate by the U.S Department of Energy (DOE), which includes estimates for off-shore storage capacity, there could be as much as 1800 billion to more than 20,000 billion metric tons of CO_2 storage capacity throughout the United States and portions of Canada.[12] At current emission rates, this potentially represents the availability of 500 to 5700 years of storage capacity for the United States and portions of Canada.[13] Much of this storage capacity is concentrated in the western United States. For the low-end of DOE's estimate for onshore storage capacity, ten western states—Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Utah, Washington, and Wyoming—represent 35.6% of this total; for the high-end estimate, these same states represent 36.5% of the total onshore storage capacity.[14]

For our purposes, here is where the story gets interesting. As vast amounts of CO_2 are injected deep underground, much of it will end up residing in pore space—the microscopic voids within rocks that are unoccupied by solid material. Naturally, this raises the question of who owns the subsurface pore space; in the United States, geologic carbon storage projects must first obtain permission from the relevant property owners in order to utilize the pore space for the storage of injected CO_2. In this Article, we endeavor to answer the question of pore space ownership from a novel, important, but essentially overlooked perspective—one which takes into account the implications of the Stock-Raising Homestead Act of 1916

11 Sixty three thousand pyramids multiplied by 2.5 Mm^3 equal approximately 157.5 billion metric cubic meters. The volume of an Olympic-sized swimming pool without starting blocks is 2500 m^3. *See* Fédération Internationale de Natation, *FINA Facilities Rules 2009–2013*, http://www.fina.org/project/index.php?option=com_content&task=view&id=51&Itemid=119 (last visited Apr. 7, 2012).

12 NAT'L ENERGY TECH. LAB., U.S. DEP'T OF ENERGY, 2010 CARBON SEQUESTRATION ATLAS OF THE UNITED STATES AND CANADA 155 (3d ed. 2010). Total offshore storage capacity is estimated at 509,220 to 6,776,230 million metric tons (MMT). *Id.*

13 *See id.* at 154–55 (dividing the total CO_2 emissions per year—3467 MMT—with the low estimate (1,854,260 MMT) and high estimate (20,473,110 MMT) for total storage resources). *See also* Press Release, Nat'l Energy Tech. Lab., U.S. Dep't of Energy, Third Carbon Sequestration Atlas Estimates up to 5,700 years of CO_2 Storage Potential in U.S. and Portions of Canada (Dec. 1, 2010), http://www.netl.doe.gov/publications/press/2010/10058-Third_Edition_of_Carbon_Sequestrat.html (last visited Apr. 7, 2012) (describing the available storage potential for CO_2 in geologic formations). *But see*, Michael L. Szulczewski et al., *Lifetime of Carbon Capture and Storage as a Climate-Change Mitigation Technology*, 109 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCE (2012) (estimating that there is sufficient capacity in the United States to store at least a century's worth of carbon dioxide emissions from all United States coal-fired power plants). The key innovation of Szulczewski et al. is in the inclusion of the fluid dynamics of CO_2 as it moves through rocks in the subsurface—a factor not included in previous modeling efforts.

14 NAT'L ENERGY TECH. LAB., *supra* note 12, at 155.

(SRHA)[15] and its capacious mineral reservation for the ownership of pore space.

In evaluating the issue of pore space ownership, scholars and regulators have focused primarily on the question of who owns the pore space when the mineral estate has been severed from the surface estate.[16] This approach, however, overlooks the critical fact that for the approximately 70 million acres of land patented under the SRHA,[17] the United States federal government held the original fee simple absolute, and conveyed the land while retaining "all the coal and other minerals in the lands."[18] In *Watt v. Western Nuclear, Inc.*,[19] the Supreme Court delineated a four-part test for determining if something falls within the scope of the SRHA's mineral reservation[20]—a test that was further explicated by the Court's decision in *BedRoc Limited, LLC v. United States* (*BedRoc*).[21] This Article analyzes this jurisprudence vis-à-vis the question of whether or not pore space falls within the scope of the SRHA's mineral reservation. Based on a detailed analysis of the history of the SRHA and relevant jurisprudence by the Supreme Court and other federal and state courts, we conclude that the federal government likely owns the pore space for those lands patented under the SRHA.

This conclusion has far-reaching policy implications. For instance, states that have statutorily determined that ownership of the pore space is vested in the surface owner are now confronted by the prospect that these statutes are preempted by federal law when dealing with land originally conveyed by the SRHA.[22] Moreover, given the significant acreage covered by the SRHA, federal ownership of pore space could arguably reduce the transaction costs associated with project development, thereby facilitating the rapid scaling of commercial geologic carbon storage projects.[23]

This Article proceeds in four parts. Part II describes the historical origins of the SRHA, focusing on the Congressional intent underlying the statute. Part III provides an analysis of Supreme Court and other federal and

15 Pub. L. No. 64-290, ch. 9, 39 Stat. 862 (codified as amended at 43 U.S.C. §§ 291–302 (2006)) (repealed in part 1976).

16 Owen L. Anderson, *Subsurface "Trespass": A Man's Subsurface Is Not His Castle*, 49 WASHBURN L.J. 247, 247–48 (2010); Owen L. Anderson, *Geologic CO_2 Sequestration: Who Owns the Pore Space?*, 9 WYO. L. REV. 97, 99 (2009) [hereinafter Anderson, *Geologic*]; Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change, Carbon Sequestration, and Property Rights*, 2010 U. ILL. L. REV. 363, 365 (2010); Christopher J. Miller, *Carbon Capture and Sequestration in Texas: Navigating the Legal Challenges Related to Pore Space Ownership*, 6 TEX. J. OIL GAS & ENERGY L. 399, 401 (2010–2011); Blayne N. Grave, Comment, *Carbon Capture and Storage in South Dakota: The Need for a Clear Designation of Pore Space Ownership*, 55 S.D. L. REV. 72, 73 (2010); Elizabeth J. Wilson & Mark A. de Figueiredo, *Geologic Carbon Dioxide Sequestration: An Analysis of Subsurface Property Law*, [2006] 36 Envtl. L. Rep. (Envtl. Law Inst.) 10,114, 10,115, *available at* http://www.elr.info/articles/vol36/36.10114.pdf.

17 *See* discussion *infra* note 60.

18 43 U.S.C. § 299(a) (2006).

19 462 U.S. 36 (1983).

20 *Id.* at 53.

21 541 U.S. 176, 182 (2004).

22 *See* 43 U.S.C. § 299(i)(1) (2006).

23 *Cf. infra* Part V (discussing problems with pooling and unitization—concerns that are avoided if federal ownership of pore space is established).

state case law interpreting the mineral reservation of the SRHA. In Part IV, we raise a number of straw arguments against the notion that pore space can legitimately be considered within the ambit of the SRHA's mineral reservation. We then consider these straw arguments in the context of the jurisprudence covered in Part III. We apply that jurisprudence to the concept of pore space and assess the extent to which the straw argument prevails. Finding that pore space is indeed likely within the scope of the SRHA's mineral reservation, Part V offers a brief, preliminary assessment of the implications of this finding for federal and state policy, as well as the development of CCS projects.

II. HISTORICAL ORIGINS OF THE STOCK-RAISING HOMESTEAD ACT OF 1916

In order to encourage settlement and development of the West in the second half of the nineteenth century, the United States federal government embarked on a mission to convey vast amounts of public land to homesteaders.[24] Congress provided aspiring settlers with land in fee simple absolute—free of charge—so long as the land was entered and cultivated for a particular number of years.[25] Settlement proceeded at a rapid rate, and by 1900 the government had allocated nearly 80 million acres of public land to private hands.[26]

To carry out its goal of settling the West, Congress employed a binary classification system that categorized tracts of land as either mineral or nonmineral.[27] Under this system, tracts were assigned to one category or the other—never both—based on entrymen affidavits asserting the land to be either mineral or nonmineral in character.[28] The federal government retained ownership of mineral lands and encouraged miners to exploit their underlying minerals[29]—subject to congressional mining laws.[30] Lands

24 Aulston v. United States, 915 F.2d 584, 585 (10th Cir. 1990).

25 Amoco Prod. Co. v. S. Ute Indian Tribe, 526 U.S. 865, 868 (1999); *see also* Act of May 20, 1862, ch. 75, § 2, 12 Stat. 392, 392 (providing settlers with land, and in exchange, homesteaders were required to be 21 years of age, pay a $10 filing fee, and reside on the land continuously for five years).

26 Library of Cong., *Primary Documents in American History: Homestead Act*, http://www.loc.gov/rr/program/bib/ourdocs/Homestead.html#American (last visited Apr. 7, 2012).

27 Watt v. W. Nuclear, Inc., 462 U.S. 36, 47 (1983).

28 *See, e.g.*, Act of June 21, 1866, ch. 127, 14 Stat. 66, 67; Act of July 2, 1864, ch. 217, § 3, 13 Stat. 365, 367; Act of July 2, 1862, ch. 130, 12 Stat. 503; *see also* United States v. Sweet, 245 U.S. 563, 567 (1918) (describing Congress's practice to assign property based on distinction between mineral and other lands); Act of July 1, 1862, ch. 120, 12 Stat. 489, 492; Deffeback v. Hawke, 115 U.S. 392, 400–01 (1885) (tracing the history of congressional acts reserving land with minerals); United States v. Union Oil Co. of Cal., 549 F.2d 1271, 1274 (9th Cir. 1977) (stating that the purpose of these acts was to retain mineral rights).

29 *Watt*, 462 U.S. at 47.

30 *See id.* at 50–51 ("The general mining laws were the most important of the 'mineral land laws' in existence when the SRHA was enacted. Those laws, which have remained basically unchanged through the present day, provide an incentive for individuals to locate claims to federal land containing 'valuable mineral deposits.'" (quoting 30 U.S.C. § 22 (2006))).

classified as nonmineral were conveyed to private homesteaders for the exclusive purposes of farming and raising livestock.[31]

In theory, this land classification system was supposed to function as an efficient mechanism for determining each tract's intrinsic purpose—farming or mineral exploitation—as evidenced by its mineral or nonmineral characteristics.[32] In practice, however, the system proved highly amenable to fraud.[33] Because the entryman affidavit was the exclusive means by which tracts were classified, entrymen would often falsely misclassify land as nonmineral in order to receive title from the government to the entirety of the estate, only to be pleasantly "surprised" when minerals were subsequently discovered on the land.[34] All the more troubling was that, in the classification phase, the government struggled to determine whether a given tract of land was more valuable for its minerals or for its agricultural use.[35] Lands misclassified as nonmineral in this context generally remained undeveloped, even when they did in fact possess mineral resources, because it was left wholly to the unincentivized homesteader to exploit them.[36] Ultimately, the government's parallel goals of promoting settlement and allowing for resource exploitation were too often foiled by an overly simplistic system designed to ignore the fact that lands often straddled both sides of the conceptual divide, and by the government's inability to effectively supervise the implementation of that flawed system.[37]

From the 1890s through the 1920s, the Progressive Era[38] ushered in a more pragmatic approach to public land distribution. A growing concern arose that the system for classifying and conveying land was too vulnerable to fraud, and that the valuable mineral resources underlying western lands

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31 *Id.* at 47–48.

32 *Id.*

33 *Id.* at 48 & n.9.

34 *Id.* at 48 n.9; *see, e.g.*, George Otis Smith et al., *The Classification of the Public Lands*, 537 U.S. GEOLOGICAL SURV. BULL. 17, 38–39 (1913); Laura D. Windsor, Amoco Production Company v. Southern Ute Indian Tribe*: A Final Resolution to the Battle over Ownership of Coalbed Methane Gas?*, 17 GA. ST. U. L. REV. 893, 895 (2001); Anita Starchman Bryant, Case Note, Amoco Production Co. v. Southern Ute Indian Tribe, 27 ECOLOGY L.Q. 799, 800–01 (2000); Katina L. Francis, Note, *Mining Law—Ownership of Coalbed Methane—A Judicial Step Toward Efficient CBM and Coal Development.* Southern Ute Indian Tribe v. Amoco Production Company, *119 F.3d 816 (10th Cir. 1997)*, 33 LAND & WATER L. REV. 469, 470 (1998).

35 *Watt*, 462 U.S. at 48 n.9.

36 *Id.*

37 *See, e.g.*, *Watt*, 462 U.S. at 48 n.9 ("If land was erroneously classified as nonmineral and conveyed under a land-grant statute, the patentee received title to the entire land, including any subsequently discovered minerals. . . . Absent proof of fraud, the Government had no recourse once title passed." (citations omitted)).

38 Library of Cong., *Progressive Era to New Era, 1900–1929: Conservation in the Progressive Era*, http://www.loc.gov/teachers/classroommaterials/presentationsandactivities/presentations/timeline/progress/conserve (last visited Apr. 7, 2012). The Progressive Era, which took place from the 1890s to the 1920s, was an American reform and social movement to cleanse the government of inefficiencies and abuse. In response to the previous era's wasteful exploitation of natural resources, the Progressive Era's conservationalists insisted upon federal intervention and supervision of the nation's resources. *See id.*

should remain within the public domain.[39] The federal government's desire to avoid imprudent development, add to public revenues, and avert the threat of monopolization informed this mindset.[40] In 1906, President Theodore Roosevelt, aware of the land classification system's unchecked inefficiencies and abuses, addressed the mounting need to conserve mineral fuels.[41] He called attention to the fact that many tracts of land were valuable for both agriculture and their underlying mineral resources, and argued that the binary classification system frustrated their simultaneous use.[42] A few years later, the Secretary of Interior recommended a solution to the problem: "[Separate] the right to mine from the title to the soil."[43]

Congress responded to these observations by shifting from a system of *land classification* to a system of *mineral reservation*.[44] It did so by enacting statutes that reserved particular minerals underlying western lands to the federal government while continuing to grant homesteaders title to the surface.[45] At their core, these statutes attempted to facilitate concurrent use,[46] a land grant concept that provided private homesteaders with unfettered access to the surface of a tract of land while the federal government concomitantly controlled the tract's underlying minerals.[47]

The shift from land classification to mineral reservation culminated in 1916 when Congress enacted the SRHA,[48] which reserved to the United States title to "all the coal and other minerals" in lands patented under the statute.[49] Unlike previous statutes containing mineral reservations, the SRHA reservation did not qualify the word "mineral" and instead reserved every mineral to the federal government.[50] The Department of Interior, endorsing the SRHA bill, stated that "[a]ll mineral[s] within the lands are reserved to

39 *See, e.g.*, Aulston v. United States, 915 F.2d 584, 585–86 (10th Cir. 1990).

40 *Id.* at 585.

41 *See Watt*, 462 U.S. at 48–49; United States v. Union Oil Co. of Cal., 549 F.2d 1271, 1274–75 (9th Cir. 1977).

42 *Union Oil*, 549 F.2d at 1274–75; *Watt*, 462 U.S. at 49.

43 *Union Oil*, 549 F.2d at 1275.

44 *Watt*, 462 U.S. at 49.

45 *See Watt*, 462 U.S. at 49; *see, e.g.*, Act of Mar. 3, 1877 (Desert Land Act), ch. 107, 19 Stat. 377 (codified as amended at 43 U.S.C. §§ 321–323 (2006)).

46 *See Watt*, 462 U.S. at 49 (quoting legislative discussions recognizing that "[s]uch a method permits the separation of the surface from the coal and the unhampered use of the surface for purposes to which it may be adapted" and "[r]ights to the surface of the public land . . . be separated from rights to forests upon it and to minerals beneath it, and these should be subject to separate disposal" (quoting H.R. DOC. NO. 60-5, at 15 (1907); Letter from President Theodre Roosevelt to the Senate and House Representatives (Jan. 22, 1909), http://www.presidency.ucsb.edu/ws/index.php?pid=69658&st=&st1=#axzz1rQUYoF55 (last visited Apr. 7, 2012)). *See* Aulston v. United States, 915 F.2d 584, 586 (10th Cir. 1990) (discussing the evolution of statutes passed by Congress to effectuate this purpose).

47 *See Union Oil*, 549 F.2d at 1275.

48 *Watt*, 462 U.S. at 49; *see also* Stock Raising Homestead Act of 1916, Pub. L. No. 64-290, ch. 9, 39 Stat. 862, 862–63 (codified as amended at 43 U.S.C. §§ 291–302) (repealed in part 1976) (granting 640 acres to support a family, provided the entryman resides on the land for three years and makes permanent improvements to the land so as to increase its value).

49 43 U.S.C. § 299(a) (2006).

50 *Watt*, 462 U.S. at 49.

the United States"[51] and emphasized the limited nature of the surface estate, for which the farmer–stockman has no desire to exploit its underlying minerals because such a pursuit does not fall within the realm of his expertise.[52] Similarly, the House of Representatives floor debate preceding the enactment of the SRHA elucidated Congress's intention to create an all-inclusive reservation.[53] Supporters of the bill underscored that the SRHA's land grants to homesteaders were limited in purpose and scope—for farming and raising livestock only—and "emphasized in the strongest terms that all minerals were retained by the United States."[54] Congressman Ferris,[55] a key architect of the SRHA bill, further explained that the mineral reservation of the SRHA "would cover every kind of mineral."[56]

The SRHA's language and legislative history provide palpable insight into Congress's general purpose for enacting the statute.[57] The SRHA's overriding intention was to promote concurrent use, such that each tract of land could be at once farmed by private landowners and mined freely by the government.[58] The SRHA's endorsement of concurrent use is a reflection of Congress's objective of retaining subsurface resources, "particularly sources of energy, for separate disposition and development in the public interest."[59]

III. ANALYSIS OF CASE LAW

The SRHA was responsible for the distribution of over 70 million acres of land primarily located in the western United States.[60] Given the capacious

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51 *Union Oil*, 549 F.2d at 1277 (quoting H.R. REP. NO. 64-35, at 5 (1916)).

52 *Id.*; *see also Watt*, 462 U.S. at 47.

53 *Union Oil*, 549 F.2d at 1277 (discussing the House floor debate over SRHA).

54 *Id.* (quoting 53 CONG. REC. 1171 (1916)).

55 Congressman Ferris was the floor manager of the SRHA bill and a House representative of the 64th Congress, 1st Sess, in 1916. *Id.* at 1277–78.

56 *Id.* (quoting 53 CONG. REC. 1171 (1916)).

57 *See id.* at 1274.

58 *See id.* at 1279.

59 Rosette, Inc. v. United States, 64 F. Supp. 2d 1116, 1120 (D.N.M. 1999), *aff'd*, 141 F.3d 1394 (10th Cir. 1998). We should also note that the federal courts have interpreted the land grant statutes' mineral reservations to grant the subsurface owner the dominant estate. *See* Harris v. Chas. Pfizer & Co., 385 F.2d 766 (8th Cir. 1967); McDonnell v. Capital Co., 130 F.2d 311 (9th Cir. 1942); Occidental Geothermal v. Simmons, 543 F. Supp. 870, 876–87 (N.D. Cal. 1982) (citing Transwestern Pipeline Co. v. Kerr-McGee Corp., 492 F.2d 878 (10th Cir. 1974)). For example, the Supreme Court determined that the Act of 1914 provided the subsurface owner the unrestrained right to extract and remove oil and gas, irrespective of any damage such behavior might cause to the surface owner's property. *Occidental Geothermal*, 543 F. Supp. at 876 (citing Kinney-Coastal Oil Co. v. Kieffer, 277 U.S. 488 (1928)). This premise was true of every agricultural entry law. When it passed these statutes, Congress did not contemplate any additional rights for the surface owners—such as royalty payments or the right to exclude—when it passed these statutes. *Id.* at 876–77 ("This result may seem harsh, but it is no more so than the results in cases arising under both federal statutes and under state law in which the mineral estate's surface rights by implication predominated over—and to a very great extent obliterated—those of the fee owners of the lands."). Rather, Congress only regarded adverse consequences to the surface owner's rights in the context of crop damage. *Id.* at 877.

60 *E.g.*, W. Nuclear, Inc. v. Andrus, 475 F. Supp. 654, 658 (D. Wyo. 1979); Matthew L. King, *Prospectors' Access to Stock-Raising Homestead Act Lands*, 20 COLO. LAW. 247, 247 (1991);

nature of the SRHA mineral reservation,[61] the underlying legislative history,[62] and the federal jurisprudence interpreting the reservation, it is our contention that the SRHA's mineral reservation likely includes the subsurface pore space underlying these 70 million acres.

While at least one commentator has argued that pore space does not fall within the ambit of the SRHA's mineral reservation,[63] United States case law appears to tell another story. The Supreme Court has yet to speak on the matter of CCS and pore space ownership specifically, although it—along with many of the federal courts—has interpreted the SRHA mineral reservation on a number of occasions.[64] These interpretations are what guide our view that pore space ownership falls within the purview of the SRHA mineral reservation.

In 1983, the Supreme Court decided the landmark case, *Watt v. Western Nuclear, Inc.*[65] There, the Court determined that gravel found on lands patented under the SRHA is a mineral reserved to the United States government.[66] For the surface owner, the Court reasoned, the SRHA conveyed land for the exclusive purposes of stock raising and farming forage crops,[67] and Congress therefore could not have intended to convey the right to extract gravel to the surface owner, as doing so does nothing to facilitate those purposes.[68] Additionally, the Court employed an often-cited canon of statutory construction, which states "land grants are construed favorably to the Government . . . and that if there are doubts they are resolved for the Government, not against it."[69] While some federal case law has questioned

Lawrence G. McBride, *Mining: 2004 Annual Report*, *in* AM. BAR ASS'N, ENV'T, ENERGY, & RESOURCES L.: THE YEAR IN REV. 2004, at 227, 231 (2005). *But see, e.g.*, Edward A. Amestoy, Note, *Is Gravel a Mineral? The Impact of Western Nuclear on Lands Patented Under the Stock Raising Homestead Act*, 5 PUB. LAND L. REV. 171, 171 (1984) (stating that the SRHA affected more than 33 million acres).

61 *See supra* text accompanying note 51.

62 *See supra* text accompanying notes 53–56.

63 *See* Anderson, *Geologic*, *supra* note 16, at 138 ("Although this statement of legislative intent is broad enough to encompass federal ownership of subsurface pore spaces, the Congressional focus of the [SRHA] was on reserving minerals, not pore spaces. Thus, I would argue that the SRHA does not vest ownership of pore spaces in the federal government.").

64 *See BedRoc*, 541 U.S. 176, 186 (2004); *Watt*, 462 U.S. 36, 47 (1983); Sunrise Valley, LLC v. Kempthorne, 528 F.3d 1251, 1258 (10th Cir. 2008); Rosette, Inc. v. United States, 277 F.3d 1222, 1234–35 (10th Cir. 2002); United States v. Union Oil Co. of Cal., 549 F.2d 1271, 1280–81 (9th Cir. 1977); *Rosette*, 64 F. Supp. 2d 1116, 1125 (D.N.M. 1999), *aff'd*, 141 F.3d 1394 (10th Cir. 1998); *Occidental Geothermal*, 543 F.Supp. 870, 877–78 (N.D. Cal. 1982).

65 462 U.S. 36 (1983).

66 *Id.* at 56, 59.

67 *Id.* at 53; *see also Rosette*, 277 F.3d at 1234 (characterizing forage as "vegetable food . . . for domestic animals").

68 *Watt*, 462 U.S. at 56.

69 *Id.* at 59 (quoting United States v. Union Pac. R.R. Co., 353 U.S. 112, 116 (1957)); *see also Occidental Geothermal*, 543 F. Supp. at 877; W. Nuclear, Inc. v. Andrus, 475 F. Supp. 654, 656 (D. Wyo. 1979), *rev'd*, 664 F.2d 234 (10th Cir. 1981), *aff'd sub nom.* Watt v. W. Nuclear, Inc., 462 U.S. 36; Scott Dasovich, Case Comment, BedRoc Ltd. v. United States, 28 HARV. ENVTL. L. REV. 561, 565 (2004) ("The premise of strict construction underlying this canon—that the government grants only what is necessary to fulfill the surface use specified in the land-grant—permeates public land-grant jurisprudence."); Steven R. McNutt, Case Note, Rosette Inc. v. United States*: Is*

the strength of this canon, such jurisprudence has failed to invalidate its relevancy.[70]

Significantly, and most important for our purposes, the Supreme Court established a four-part test to determine which minerals fall within the SRHA reservation. Under the *Watt* test, the SRHA mineral reservation includes "substances that are [1] mineral in character (*i.e.*, that are inorganic), [2] that can be removed from the soil, [3] that can be used for commercial purposes, and [4] that there is no reason to suppose were intended to be included in the surface estate."[71]

Prior to *Watt*, the Ninth Circuit decided *United States v. Union Oil Co. of California*[72] in 1977. There, the court held that the mineral reservation of the SRHA includes geothermal resources, particularly geothermal steam.[73] In reaching this holding, the court was not persuaded by the argument that Congress was not aware of geothermal power when it enacted the SRHA in 1916 and therefore could not have intended to include geothermal resources in the reservation.[74] The court instead looked to the purpose of the statute, which was to transfer land to homesteaders for agricultural use while reserving subsurface resources to the federal government.[75] Through the mineral reservation, Congress intended to retain subsurface resources, particularly sources of energy, for development in the public interest.[76] The court rationalized that this purpose was furthered by interpreting the SRHA reservation to encompass geothermal resources.[77]

Notably, the Ninth Circuit in *Union Oil* considered the SRHA mineral reservation to have an extensive reach. When it arrived at its decision, the court stated that "[a]ll of the elements of a geothermal system—magma, *porous rock strata*, even water itself—may be classified as 'minerals.'"[78] That the Ninth Circuit regarded rock strata, or pore space, as "mineral" such that it is encompassed by the SRHA reservation is significant, especially given that the Supreme Court has never expressly disavowed this supposition.

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the United States Full of Hot Air When It Comes to Reservation of Geothermal Resources as a "Mineral?", 8 GREAT PLAINS NAT. RESOURCES J. 44, 54 (2003) ("Virtually every case that had been decided prior to Rosette [in 2002] was decided in favor of the United States vesting title to the government in subsurface resources."). *But see* Leo Sheep Co. v. United States, 440 U.S. 668, 682 (1979) (noting that "this Court long ago declined to apply this canon in its full vigor to grants under the railroad Acts").

70 *See Leo Sheep*, 440 U.S. at 682–83 ("It is undoubtedly . . . the well-settled rule of this court that public grants are construed strictly against the grantees, but they are not to be so construed as to defeat the intent of the legislature . . . ." (quoting United States v. Denver & Rio Grande Ry. Co., 150 U.S. 1, 14 (1893)). For our purposes, all *Leo Sheep* says is that one must look to Congress's intent in 1916 when the SRHA was enacted. *See* discussion *infra* Part IV (noting that our argument is sustained regardless of whether one analyzes Congress's intent in 1916 or 2011).

71 *Watt*, 462 U.S. at 53.

72 549 F.2d 1271 (9th Cir. 1977).

73 *Id.* at 1272, 1279.

74 *Id.* at 1279.

75 *Id.* at 1274.

76 *Id.*

77 *Id.*

78 *Id.* at 1273–74 (emphasis added) (footnote omitted).

The Supreme Court indirectly addressed the SRHA mineral reservation again in 2004. In *BedRoc*, the Supreme Court held that sand and gravel are not "valuable minerals" reserved to the federal government in land grants issued under the Pittman Underground Water Act of 1919 (Pittman Act).[79] The Pittman Act served to promote development and population growth in Nevada, where a lack of surface water encumbered any incentive to invest in agricultural efforts.[80] Rather than incur the costs of underground water exploration in Nevada, which were likely to be expensive and fruitless, Congress instead granted tracts of "nonmineral" land to settlers who could successfully demonstrate that the tract could irrigate at least twenty acres of crops.[81]

The Court's decision to confer sand and gravel to the surface estate occurred for reasons unique to the Pittman Act and independent of its SRHA counterpart. In 1919, sand and gravel were not commonly regarded as "valuable minerals" in Nevada.[82] The Court reasoned that because Congress textually narrowed the scope of "minerals" by using the modifier "valuable," Congress must have intended to distinguish the Pittman Act's reservation from that of the SRHA and the Court's subsequent interpretation of it in *Watt*.[83] Because the Pittman Act applied exclusively in that state,[84] and because the Court found that the common conceptualization of sand and gravel in Nevada in 1919 was that it possessed no intrinsic value due to its abundance throughout the state, the Supreme Court determined that sand and gravel were not reserved to the federal government for that particular statute.[85]

BedRoc is relevant to the instant analysis for two principal reasons. First, the Supreme Court in *BedRoc* explicitly refused to overrule the precedential value of *Watt*, leaving its holding undisturbed.[86] Secondly, the Court referenced the commercial value prong of the *Watt* test, noting that "the minimal inquiry into whether a substance might at some point have separate value from the soil and might, in the abstract, be susceptible of commercial use is a far different inquiry from whether the substance is a 'valuable mineral' as Congress used the term in 1919."[87] Here, the Court characterizes the commercial value prong of the *Watt* test as a "minimal

79 *BedRoc*, 541 U.S. 176, 178 (2004); Act of Oct. 22, 1919, Pub. L. No. 66-60, ch. 77, 41 Stat. 293 (1919) (codified at 43 U.S.C. §§ 351–355 (1958)) (repealed 1964).

80 *BedRoc*, 541 U.S. at 178–79.

81 *See id.* at 179.

82 *Id.* at 184.

83 *Id.* at 183–84.

84 *Id.* at 184; ch. 77, 41 Stat. at 293; *see also BedRoc*, 541 U.S. at 181 ("Unlike the Pittman Act, the SRHA was not limited to Nevada; it applied to any 'public lands' the Secretary of the Interior designated as 'stock-raising lands.'" (quoting 43 U.S.C. § 291 (1976), *repealed by* Act of Oct. 21, 1976, Pub. L. 94-579, § 702, 90 Stat. 2743, 2787 (1976))).

85 *BedRoc*, 541 U.S. at 184.

86 *Id.* at 183; *see also Sunrise Valley*, 528 F.3d 1251, 1253–54 (10th Cir. 2008) ("Although the petitioners in *BedRoc* asked the Supreme Court to overrule [*Watt v.*] *Western Nuclear*, the plurality refused this request . . . .").

87 *BedRoc*, 541 U.S. at 183 n.5.

inquiry."[88] Thus, it appears that commercial value in the context of the SRHA mineral reservation did not need to be present when the original language was adopted in 1916, but merely "at some point" and "in the abstract."[89]

Generally speaking, courts that have been confronted with SRHA litigation have interpreted the statute's mineral reservation broadly.[90] The Ninth Circuit in *Union Oil* emphasized the dominance of the subsurface estate over the surface estate and determined that the SRHA's mineral reservation "is to be read broadly in light of the agricultural purpose of the grant itself, and in light of Congress's equally clear purpose to retain subsurface resources."[91] The Supreme Court validated this view in *Amoco Production Co. v. Southern Ute Indian Tribe*, where it cited the SRHA as an example of a land grant statute that possessed a broad mineral reservation.[92] There, the Court distinguished earlier land grant statutes from the SRHA by underscoring the limited nature of the early laws, which reserved only those minerals enumerated in the statute.[93] The SRHA's reservation, on the other hand, did not delineate specific minerals and instead reserved every kind of mineral to the federal government.[94]

Unsurprisingly, surface owners have criticized the broad reach of the SRHA mineral reservation for being impractical and inequitable.[95] Regardless of these arguments, however, the legal support for the supremacy of the subsurface estate is overwhelming.[96] Initially, opponents to the SRHA argued that the 640-acre homestead patent was too large for a single family.[97] Congress defended the tract size by noting how the 640-acre grant—while capacious in acreage—was still limited in the ways in which it could be utilized, while the subsurface reservation to the federal government would include every kind of mineral underlying those 640 acres and the uninhibited right to exploit them.[98] This was especially relevant for the Tenth Circuit in *Rosette*, which determined that "the question is not what Congress intended to reserve, but rather what Congress intended to give away in its grant to the

88 *Id.*

89 *Id.*

90 *See Amoco Prod.*, 526 U.S. 865, 878 (1999); *Watt*, 462 U.S. 36, 56 (1983); *Sunrise Valley*, 528 F.3d at 1258; *Union Oil*, 549 F.2d 1271, 1279 (9th Cir. 1977); *Rosette*, 64 F. Supp. 2d 1116, 1121 (D.N.M. 1999), *aff'd*, 141 F.3d 1394 (10th Cir. 1998); *Occidental Geothermal*, 543 F. Supp. 870, 876 (N.D. Cal. 1982).

91 *Union Oil*, 549 F.2d at 1279.

92 *Amoco Prod.*, 526 U.S. at 878.

93 *Id.*

94 *Id.*

95 *See id.*; Hector Lareau, *Rights of Surface Owners on Federally Patented Lands*, 10 J. NAT. RESOURCES & ENVTL. L. 13, 14–15 (1994); King, *supra* note 60, at 247–48.

96 *See Amoco Prod.*, 526 U.S. at 878; *Union Oil*, 549 F.2d at 1277; cases cited *supra* note 90.

97 *See Rosette*, 277 F.3d 1222, 1227 (10th Cir. 2002); *Union Oil*, 549 F.2d at 1277.

98 *Rosette*, 277 F.3d at 1226–27; *see also Union Oil*, 549 F.2d at 1278 ("[W]ithout a broad mineral reservation the grant would be unjustifiable . . . ."); *Occidental Geothermal*, 543 F. Supp. 870, 877 (N.D. Cal. 1982) ("[T]he court notes the existence of a 1916 Congressional 'purpose to retain subsurface resources, particularly sources of energy, for separate disposition and development in the public interest' rather than to create an additional windfall for stock-raising homesteaders, who were already being granted surface rights on favorable terms." (quoting *Union Oil*, 549 F.2d at 1279)).

landholder in the SRHA."[99] It is clear from United States jurisprudence that Congress intended to give away only those resources relevant for farming and raising livestock, leaving the rest of the estate to the federal government.

IV. APPLYING THE *WATT* TEST TO PORE SPACE

In order to determine whether pore space falls within the scope of the SRHA mineral reservation while comporting with relevant case law, the most appropriate judicial standard to apply clearly comes from *Watt*. Pore space ownership is a novel concept, and consequently federal and state jurisprudence have never specifically addressed pore space in this or in any other context. Notwithstanding this novelty, however, the *Watt* test functions as the controlling rule for delineating the scope of the SRHA's mineral reservation. For this reason, in the following discussion, we analyze pore space by applying *Watt*'s four-part test.[100]

A. Arguments that Pore Space Fails the Watt *Test*

There are a number of cogent arguments as to why pore space could not legitimately be understood as falling within the scope of the SRHA's mineral reservation. For starters, pore space is not a mineral—even within the capacious bounds of the Court's definition. Indeed, it is not anything at all; rather it is the *absence* of something. In grappling with the question of whether gravel, geothermal steam, magma, porous rock strata, water, or sand fall within the scope of the SRHA's mineral reservation, courts have dealt with the question only insofar as it relates to a physical substance—a thing that can be physically held and possessed. Given this foundational, conceptual distinction, we might reasonably view the relationship between "minerals" and pore space as far too attenuated to satisfy the first prong of the *Watt* test. As a compilation of voids, pore space simply is not "mineral in character."

Second and relatedly, Congress most certainly understood SRHA minerals to mean something capable of being extracted from the subsurface.[101] As the conceptual embodiment of nothing, pore space is hardly

99 *Rosette*, 277 F.3d at 1229.

100 *See supra* Part III (analyzing the *Watt* case, and the influence of its analysis in the context of land grants). *Cf.* Anderson, *Geologic*, *supra* note 16, at 137–38 (noting the broad interpretation federal courts have given the SRHA mineral reservation provision, but arguing nonetheless that the SRHA should not reserve pore spaces).

101 Congress has defined "minerals" as including "all minerals and mineral fuels including oil, gas, coal, oil shale and uranium" and in the same section described the policy surrounding minerals as "foster[ing] and encourag[ing] private enterprise in . . . economically sound and stable domestic mining, minerals, metal and mineral reclamation industries, . . . economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs." National Mining and Minerals Policy, 30 U.S.C. § 21a (2006). The policy focuses specifically on minerals that can actually be extracted for economic use.

something one can remove from the ground.[102] On this basis, we again might conclude that pore space rather miserably fails the *Watt* test's second prong.

Also on this basis, we might conclude that the third and fourth prongs of the Watt test are simply inapplicable as they proceed from the concepts of "mineral in nature" and "can be removed." This line of reasoning posits that "commercial" should be construed as an attribute of something that is "mineral in nature" and which "can be removed" from the subsurface. Similarly, the question of whether or not something was intended to be included in the surface estate should be asked only of things that are "mineral in nature," "capable of being removed" and amendable to "commercial use." Put simply, the *Watt* test should be read as an integrated whole; and as pore space can satisfy neither of the two initial thresholds, it simply makes no sense to even apply the next two criteria—or so this argument goes.

B. Meeting the Watt *Test: Why Pore Space Is an SRHA Mineral*

1. Mineral in Character

We have already noted that pore space is clearly not a mineral, but is rather the absence of something—a void constituted by surrounding structures. But while pore space is itself nothing, that which encapsulates the pore space is. This is an essential distinction. The matrices that create pore space and give it form—such as dolomite, limestone, lignite, and sandstone—are certainly mineral in character.[103] Without these minerals, the pore space would not exist.

So while the rocks to which pore space owes its form and existence are clearly mineral in nature and meet the "non-organic" threshold of *Watt*, the question then becomes: Is the pore space within these rocks encompassed in the mineral reservation? If we answer "yes" to this question, then we satisfy the first prong of *Watt*. Consider, however, the implications of answering "no" to this question. An answer of "no" would mean that the pore space would not fall within the scope of the SRHA's mineral reservation, and as a result would belong to the holder of the remaining estate, likely the surface owner. We would, in effect, be saying that while the gravel beneath your feet on SHRA lands belongs to the federal government, you nonetheless own the empty space formed by minerals that belong to the federal government several thousand feet beneath you.

An additional absurdity would also arise if we consider pore space to be a discrete property interest capable of being separated from its mineral structure because then every substance treated as a mineral—and therefore reserved to the federal government—could not be extracted without

102 While pore space is merely the space created by surrounding structures, this space is never truly empty. Common inhabitants include brine, oil, water, and air.

103 CONCISE ENCYCLOPEDIA OF MINERAL RESOURCES 4, 41, 64–65, 103 (Donald D. Carr & Norman Herz eds., 1989) (describing mineral composition and uses for dolomite, lignite, sandstone, and limestone).

destroying the nonreserved property interest in pore space. Alternatively, if pore space is treated as inseparable from the matrices that create it, then we confront the possibility that every mineral—which largely consists of space (i.e., pore space)—is outside the scope of the SRHA's mineral reservation. Quite obviously, this was not Congress's intention when it enacted land grant statutes that reserved minerals to the United States.[104]

Given the absurdities noted above, as well as the plain fact that the matrices that give rise to pore space clearly are "mineral in nature," we think it clear that pore space is part of "the coal and other minerals" included in the SRHA's mineral reservation.

Our view finds support outside of *Watt*—particularly with the Ninth Circuit in *Union Oil* and the Tenth Circuit in *Rosette*. In both instances, the federal appellate courts interpreted the SRHA's mineral reservation in the broadest possible sense in order to effectuate the purpose of the statute.[105] When analyzing the first *Watt* factor for geothermal resources, the Tenth Circuit in *Rosette* reasoned that "geothermal resources are not isolated substances and are dependent upon heat from magma being transmitted to water contained in porous rock strata."[106] The court went on to determine that magma and rock strata are both inorganic in character.[107] From this, the court concluded that geothermal resources are mineral in character by proxy, and therefore meet the first *Watt* factor, because the geothermal process as a whole is inorganic.[108]

2. Removable from the Soil

Can pore space be removed from the soil? As we noted above, pore space is the conceptual embodiment of nothing. It is defined by that which creates it. Outside of that generative structure, it does not exist. So clearly, it cannot be moved as a discrete entity—or even really conceptualized as one. To move it, without destroying it, requires moving the mineral resources that create it. And these most certainly can be removed from the ground. If we view pore space as a conceptual entity that cannot exist without its mineral matrices, federal case law provides strong support for viewing both as a single, insuperable entity.[109] And since this mineral structure can be removed from the subsurface, the second element of the *Watt* test should be *formally* satisfied.

We offer the proviso of "formally" because for our purposes—or rather, for the purpose of CCS—taking something out of the soil is the opposite of what is actually desired. In the context of CO_2 storage, the whole point is to put something into the subsurface, and keep it there for a very long time

104 *See supra* note 59 and accompanying text.

105 *Union Oil*, 549 F.2d 1271, 1279 (9th Cir. 1977); *Rosette*, 277 F.3d 1222, 1228 (10th Cir. 2002).

106 *Rosette*, 277 F.3d at 1228.

107 *Id.*

108 *Id.*

109 *See id.*; *Union Oil*, 549 F.2d at 1273–74.

(i.e., permanently). While we can argue that dolomite, for example, can be removed from the subsurface along with its resident pore space, thereby satisfying the third prong of the *Watt* test, this reduces the standard of this prong to an exercise in abstract speculation—very akin to what the Supreme Court approbated in *BedRoc* for the third prong of *Watt*. This prong of the *Watt* test is, for the purposes of our argument, perhaps the most problematic. Conceptually, pore space does not function in an entirely suitable manner within the confines of the *Watt* removability framework. A slight counter to this concern can be found in the fact that construing pore space to be part of the SRHA's mineral reservation would further Congress's intent to facilitate energy development and subsurface exploitation, and thereby also support the SRHA's goal of concurrent use.[110]

Finally, it is worth noting the triviality of this *Watt* factor. In *Sunrise Valley, LLC v. Kempthorne*,[111] the Tenth Circuit noted how the Supreme Court in *Watt* "devoted only a single line in its opinion to the removability issue."[112]

3. Commercial Value

Does pore space have commercial value? For our purposes, pore space can be used for the geological storage of CO_2. Even more, the minerals that create pore space can be used for valuable purposes. Dolomite, limestone, lignite, and sandstone all have commercial value today, thereby meeting the more lenient *Watt* and *Union Oil* commercial value standard.[113]

Even more, these substances were commercially valuable in 1916, and thus satisfy the more rigorous *BedRoc* standard, which stipulates that Congress must have contemplated the mineral in 1916 in order for it to be included in the SRHA reservation.[114] According to *Yearbook of the Bureau of Mines 1916*, lignite was valued for the crude tar derived from it, which was used in a variety of important products in 1916.[115] The *Yearbook* further identifies limestone as a commercially valuable mineral in 1916, when it was specially adapted for cement manufacture and soil amendment.[116] *Metallurgical & Chemical Engineering* references dolomite and its many valuable chemical, agricultural, and building purposes in the United States in

110 *See supra* notes 57–59 and accompanying text (discussing Congress's intent in enacting the SRHA and case law discussing land grants).

111 528 F.3d 1251 (10th Cir. 2008).

112 *Id.* at 1255 (citing Watt v. W. Nuclear, Inc., 462 U.S. 36, 55 (1983)).

113 *See* U.S. GEOLOGICAL SURVEY, MINERAL COMMODITY SUMMARIES 2011, at 152 (2011), *available at* http://minerals.usgs.gov/minerals/pubs/mcs/2011/mcs2011.pdf (discussing the value of dolomite, limestone, and sandstone in crushed stone); Michail Samouhos et al., *Microwave Reduction of Copper(II) Oxide & Malachite Concentrate*, 24 MIN. ENGINEERING 903, 912 (2011) (describing lignite as the most efficient agent to satisfactorily reduce malachite concentrate).

114 *BedRoc*, 541 U.S. 176, 184 (2004) ("[T]he proper inquiry focuses on the ordinary meaning of the reservation at the time Congress enacted it.").

115 VAN H. MANNING, YEARBOOK OF THE BUREAU OF MINES 1916, at 87 (1917).

116 *Id.* at 111.

1916.[117] Finally, over fifty-five sandstone quarries were present in 1916 and examined by the Bureau of Mines, as indicated by the *Yearbook*.[118] Accordingly, the minerals that form the pore space were commercially valuable in 1916 and meet the more stringent *BedRoc* standard. It is important to note, however, that *BedRoc* merely necessitates a "minimal inquiry" into whether these minerals had separate value from the soil "at some point" and are "susceptible of commercial use" "in the abstract."[119] With this standard in mind, these four minerals unquestionably meet the commercial value prong of the *Watt* test.

4. Benefit to the Surface Estate

Finally, is there any reason to suppose that Congress intended to include pore space in the surface estate? Here, the answer is unequivocally no. Congress was not explicitly aware of pore space in 1916 and could not have conceived of it as an aspect of surface ownership.[120] Furthermore, every judicial interpretation of the SRHA has hinged on the purposes underlying Congress's land grant statutes.[121] As discussed above, the SRHA was enacted to facilitate concurrent use of the land, such that surface owners could have the freedom to raise crops and livestock while ownership of valuable mineral resources was left with the federal government.[122] Pore space does nothing to further the agricultural and ranching purposes of SRHA land patents and it follows that Congress could not have intended it to be part of the surface estate.

While interpreting the SRHA reservation to include pore space would certainly seem to Congress's intent to promote concurrent use and accordingly retain subsurface resources for the public benefit, there are additional justifications supporting the supposition that the federal government owns the pore space pursuant to the SRHA mineral reservation. The canon of statutory construction referred to by the Supreme Court in *Watt* maintains that any discrepancies over land grant ownership are to be construed in favor of the federal government.[123] This indicates that even if one were to harbor any doubt that the SRHA reservation encompasses pore space, the interest in deferring to the federal government should override that doubt. In addition, if the SRHA mineral reservation confers ownership of sand and gravel just below the surface estate to the federal government,

117 Eugene A. Smith, *Mineral Resources of Alabama of Chemical and Metallurgical Importance*, 18 METALLURGICAL & CHEMICAL ENGINEERING 449, 450 (1918).

118 MANNING, *supra* note 115, at 114.

119 *BedRoc*, 541 U.S. at 183 n.5.

120 Had Congress been aware, it would have expressly mentioned it. There is no source to indicate that Congress knew of pore space in 1916.

121 *Watt*, 462 U.S. 36, 47–48 (1983); *Sunrise Valley*, 528 F.3d 1251, 1257 (10th Cir. 2008); *Rosette*, 277 F.3d 1222, 1226–27 (10th Cir. 2002); *Union Oil*, 549 F.2d 1271, 1274 (9th Cir. 1977); *Occidental Geothermal*, 543 F. Supp. 870, 875 (N.D. Cal. 1982).

122 *See supra* notes 58–59 and accompanying text.

123 *Watt*, 462 U.S. at 59; *see supra* note 69 and accompanying text. *But see supra* note 70 and accompanying text.

as the Supreme Court concluded in *Watt*,[124] then it would be illogical to exclude pore space—which exists thousands of feet below the surface[125]—from this ownership bundle. Ultimately, because there is no perfect metric for determining pore space ownership, the *Watt* analysis, federal jurisprudence, and elastic logic of legal reasoning guide the conclusion that pore space is reserved to the federal government through the SRHA.

V. IMPLICATIONS FOR CCS

For a CCS project to be realistically implemented in the United States, project developers should obtain permission from the relevant right holders for the injected CO_2 to reside within and traverse throughout the subsurface.[126] Given the sheer volume of CO_2 that will need to be injected to store the CO_2 from even a single coal-fired power plant, as well as the relative buoyancy and high mobility of CO_2 in the subsurface, CCS projects will likely involve CO_2 plumes extending hundreds of miles, at a minimum, throughout the subsurface.[127] In many instances, this will mean that subsurface sinks for CO_2 will be owned by hundreds or even thousands of individual right holders, each possessing plenary ownership rights to their fractional portion of the needed pore space.

At first blush, replacing this welter of pore space owners—some of whom would undoubtedly prove recalcitrant and impervious to the siren call of hypothetical cash (or even real cash, if CO_2 were to have a market value)—with a single owner such as the federal government might seem helpful in accelerating the growth of CCS as a technological solution. In the following discussion we problematize that assessment, but we first begin with a brief overview of how interacting (from a developer's perspective) with a pooling and unitization regime might seem to be—but perhaps is not—a superior alternative to a scenario wherein the federal government is the sole or primary owner of the pore space for a contemplated CO_2 sink.

Assume, *arguendo*, that our assessment of the SRHA's mineral reservation is wrong, and that even on SRHA lands CCS developers will need to negotiate with individual landowners and other subsurface right holders to acquire rights to access and occupy the needed pore space. To deal with a recalcitrant interest, a developer could turn to a legal concept from oil and gas law—namely, the use of pooling and unitization as a means of compulsorily aggregating and utilizing these subsurface interests—a concept

124 *See Watt*, 462 U.S. at 56–59.

125 Jan Martin Nordbotten et al., *Injection and Storage of CO_2 in Deep Saline Aquifers: Analytical Solution for CO_2 Plume Evolution During Injection*, 58 TRANSPORT POROUS MEDIA 339, 342 (2005) (discussing injecting carbon dioxide into pore spaces 1000 to 3000 meters below the surface for purposes of carbon sequestration).

126 *See* Christopher Bidlack, *Regulating the Inevitable: Understanding the Legal Consequences of and Providing for the Regulation of the Geologic Sequestration of Carbon Dioxide*, 30 J. LAND RESOURCES & ENVTL. L. 199, 222 (2010) (remarking on the Department of Energy Interstate Oil and Gas Compact Commission's recommendation that developers acquire storage rights of pore space before commencing a CCS project).

127 *See id.*

that a number of states have statutorily embraced in the context of CCS.[128] But consider, again, the sheer geospatial magnitude of employing a pooling and unitization scheme to aggregate subsurface interests for the purpose of CCS—a daunting procedural and legal task that would likely involve substantial transaction costs.[129] To even determine, as a first order issue, who owns the pore space would involve a nontrivial investment of time and financing.[130] Further complicating this approach is the reality that pooling and unitization regimes, which are based in state law, comprise an inconsistent mix of state regulatory systems.[131] Based on these infirmities, we might conclude that pooling and unitization schemes for CCS will prove inoperable in practical terms, and that a preferred alternative would be to interact with a single (or very large) subsurface owner such as the federal government.

Things are not that simple, though. Three key points militate against a quick assumption that vesting the federal government with large swaths of pore space ownership in the western United States is a useful—in terms of scaling CCS—idea. First, as we noted above, not only must a developer acquire permission from relevant right holders to store CO_2 in the subsurface, but also, *regardless* of whether the pore space is deemed to be part of the SRHA's mineral reservation, the developer must first identify *who owns* the pore space in question. While an initial and tentative identification of who owns the needed pore space can be based on property tax records, to definitively ascertain who owns the pore space requires a detailed title search. This is not necessarily a daunting task. But consider that if our assessment of the SRHA's mineral reservation is correct, for every parcel of privately owned land in the West, developers will now need to determine—*definitively*—whether or not that parcel was originally patented under the SRHA (which will also determine, in some instances, whether or not state law is preempted). Put differently, rather than simply relying on a cursory examination of tax records to determine the relevant ownership interests, CCS developers will need to ensure that for every implicated property interest, title is traced back to the receding yesteryear of 1916, thereby answering the question of whether or not the interest ultimately traces its

128 *See, e.g.*, Victor B. Flatt, *Paving the Legal Path for Carbon Sequestration from Coal*, 19 DUKE ENVTL. L. & POL'Y F. 211, 231–32 (2009) (stating that field unitization is especially applicable to regulation of CCS because of the uncertainty of where CO_2 will travel after it is injected); Philip M. Marston & Patricia A. Moore, *From EOR to CCS: The Evolving Legal and Regulatory Framework for Carbon Capture and Storage*, 29 ENERGY L.J. 421, 481–82 (2008) (explaining use of a Unit Operating Agreement to aggregate surface and mineral owners in managing CCS storage underground).

129 *See* James Robert Zadick, Note, *The Public Pore Space: Enabling Carbon Capture and Sequestration by Reconceptualizing Subsurface Property Rights*, 36 WM. & MARY ENVTL. L. & POL'Y REV. 257, 273 & n.126 (2011) (describing the economic burden of unitizing thousands of pore space estates belonging to different owners and noting that even leasing pore space would cost more than $13 million per year).

130 *See id.* at 272–73 & n.126.

131 *See* Bruce M. Kramer, *Compulsory Pooling and Unitization: State Options in Dealing with Uncooperative Owners*, 7 J. ENERGY L. & POL'Y 255, 259 (1986) (noting the disparity among state pooling and unitization statutes).

origin back to a land patent issued under the SRHA. Transaction costs will abound.

Second—and really as an extension to the first—Congress, in authorizing lands to be patented under the SRHA, did not designate a specific geographic delimitation as "SRHA Lands," but rather authorized that public lands, so defined, could be patented by meeting the SRHA's requirements.[132] The practical import of this fact is that SRHA lands are like handfuls of thick confetti strewn across the West. They are to be found pretty much everywhere, but there is no way (as of yet) to systematically or easily determine their locations. Positing that the federal government owns the pore space underlying some 70 million acres of private lands in the West is one thing, but figuring out where it is all located is quite another. Thus, more transaction costs abound.

Third (and most certainly not last), putting aside the transaction costs of engaging in exhaustive title searches going back to 1916 for hundreds or thousands of property interests, we might assume that federal ownership of large areas of pore space might prove more amendable to CCS development, simply on the basis that it presents an alternative to the expensive reality in which a multiplicity of property owners must consent to allowing CO_2 to occupy their subsurface interests. Again, a rush to judgment is not (necessarily) warranted. While interacting with a single large subsurface owner, like the Bureau of Land Management (BLM)—with 70 million acres of SRHA pore space—might be preferable to negotiating with individual pore space owners, BLM (as with virtually all federal agencies) is saddled with the mercurial constraints of a political zeitgeist that are hardly conducive to attracting serious and sustained private investment. Perhaps of equal or greater relevance, unlike an individual property owner—who might be enticed by the prospect of some rent for allowing his pore space to be used for CO_2 storage—the federal government (as instantiated by individual agents acting as regulatory decision makers), is often an inherently risk-averse entity, prone to lengthy deliberative processes that clash with the timelines of potential project developers and investors.[133] Regulatory indecision, delays, and uncertainty regarding the rules of the game can easily prove anathema to private investment.

In the end, it remains to be seen whether the putatively high transaction costs of pooling and unitization outweigh any reduced transaction costs that occur as a result of federal ownership of pore space.

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[132] *See Watt*, 462 U.S. 36, 38 (1983) (defining SRHA lands as those designated by the Secretary of Interior, who relied on a particular set of criteria—not based on geographical location—in making that determination).

[133] *See, e.g.*, Mark G. Stewart et al., *Homeland Security: A Case Study in Risk Aversion for Public Decision-making*, 15 INT'L J. RISK ASSESSMENT & MGMT., 367, 367–86 (employing utility theory to reflect the risk-averse nature of federal agencies for low probability, high consequence events).

VI. CONCLUSION

The legislative history and jurisprudence surrounding the SHRA's mineral reservation strongly suggest that the federal government owns the pore space underlying some 70 million acres of privately owned land in the West. If this proposition proves correct, it will have significant ramifications for the development of a United States CCS industry—though for better or worse remains to be seen. To achieve United States or international goals for mitigating climate change, CCS will almost certainly need to be part of the mix. This Article has focused on one fraction of one aspect of CCS deployment. But that fraction may prove to be of significant near-term importance for the development of a United States CCS industry.