Robert Macfarlane’s new book Underland: A Deep Time Journey (2019) takes readers on an extraordinary tour of the world beneath our feet. Stops on Macfarlane’s subterranean and submarine tour include a cave that served as a burial site, a mine used as a source of potash and a location to study the universe’s dark matter, an underground city, and an offshore oilfield on the continental shelf. Macfarlane acknowledges that there are “many reasons we tend to turn away from what lies beneath.” But, he argues, “now more than ever we need to understand the underland” and “see more deeply.”

This issue of Natural Resources & Environment also takes readers on a journey “underland” by exploring terrestrial and ocean mining from a legal perspective. Our goal is to broaden the perspective of practitioners and scholars regarding what lies below our planet’s surface. The feature articles respond to the call to “see more deeply” in two ways. First, authors look into the deep by examining the physical and ecological aspects of mines that are often overlooked as we focus on the earth’s air, water, forests, farms, cities, and mountains. Second, the articles encourage a more in-depth understanding by offering fresh insights into legal issues and regulatory regimes that govern human approaches to exploring, mining, and reclaiming the underland.

We begin our journey at the bottom of the ocean with an exploration of the regulatory and technological challenges of mining submarine deposits of metal sulfides. We then come ashore for two articles that offer insights on terrestrial mining from a regional perspective. The first examines tribal opposition to mining in the upper Midwest; the second explores the regulatory landscape for addressing the produced water that emerges during the extraction of natural gas from the Marcellus and Utica shale plays in Ohio, Pennsylvania, and West Virginia. Returning to the ocean, we are invited to consider the establishment of a regulatory framework for deep seabed mining that incorporates aspects of the Clean Water Act and the Surface Mining Control and Reclamation Act. Next, two authors present a new approach to the regulation of mining—specifically, using ecological augmentation to address mining contamination under Superfund.

Our final oceanic stop takes us to the Arctic to consider emerging legal issues related to seabed resources on the continental shelf and the region beyond national jurisdiction as well as the role of the United Nations Convention on the Law of the Sea. Continuing the move to an international perspective, two authors note the absence of international law as they examine domestic regulations governing the closure of underground gas storage facilities in three European countries. We travel back across the Atlantic to consider lessons learned from the Brumadinho Mining Disaster in Brazil and contemplate what will happen to the remains of fracking that are stored in waste impoundments. Finally, a trio of writers explores new technologies that can be brought to bear on revegetation at reclaimed mining sites.

If this issue of Natural Resources & Environment achieves its goal, it will have provided readers with a guidebook for looking into the deep and for understanding the legal contours of the mining landscape and seascape.

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Seafloor Massive Sulfides Mining

Andrew C. Lillie

On the lightless bottom of the Western Pacific Ocean, tiny volcanoes jet extraordinarily hot fluids into icy water. These “smokers,” as geologists coined them, emerge from hydrothermal vents, and are either “white” or “black” depending on the chemicals they emit. Some pour rumbling, acrobatic clouds of metals such as copper, zinc, and gold, combined with sulfur, into the heavy seawater. Fine particles of metal sulfides then precipitate, or fall out, forming “chimneys” of intricate geometries on the seabed. These can be three meters tall and evoke images of stalagmites on a cavern floor.

Whole ecosystems exist in and around fields of these chimneys of seafloor massive sulfides (SMS), including extremophiles—microorganisms evolved to thrive in harsh environments by generating energy from hydrogen sulfide rather than photosynthesizing glucose from carbon and sunlight like most living things. These are the progenitors of astrobiology, sparking speculation that life could have begun near these hydrothermal vents as hot inorganic molecules blended in just the right way. Such peculiar life might exist on Mars and other planets with otherwise-hostile atmospheres.

But this article concerns a more down-to-earth premise arising from these submarine SMS deposits: that one day your child’s mobile phone (or perhaps your grandchild’s cerebral implant) could contain circuit boards engineered from elements vacuumed from the bottom of the sea.

The saltshaker on the table, your mountain bike, your sister’s fleece puffy coat, cars, trains, buses, and aircraft, the building whose roof is above you, the computer on which I write this: most fundamental objects are tools designed to facilitate human life. What is obvious but easily overlooked is that every tangible object we have is made from some resource on this planet. Long before recorded history, Homo sapiens and their ancestors began yanking materials from the Earth and putting them to use. As you read this article in 2019 and beyond, the most visionary human minds seem capable of almost anything. Juxtapose that against another self-evident fact propounded for decades by keen observers in science, engineering, energy, manufacturing, and environmental circles, and now abundantly plain to anyone paying attention: resources are severely limited. We are especially challenged in our ability to find them, engineer their extraction, and market them economically, all without destroying the planet. This is especially true, of course, for non-renewables like oil and gas, coal, and hard-rock minerals. And it is why doing what once was considered the stuff of science fiction—like landing on asteroids to assess their rare metals or mining the moon—is now soberly debated. See, e.g., Scot W. Anderson et al., The Development of Natural Resources in Outer Space, 37 J. Energy & Nat. Resources L. 227–58 (2019).

Although space was the “new frontier” of the last century, it has now in many ways been eclipsed by the deep sea, an uncultivated wilderness full of promise. The ocean remains infused with mystery, even as the 300 quintillion gallons of seawater are our constant companion, ubiquitous, manifest, more often than not taken for granted. In this present age of human population growth that drives an unparalleled demand for resources, it is hardly surprising that an entrepreneurial urge is upon us: to take a gigantic deep breath and dive to the ocean floor in search of the stuff we need to make new gadgets. In this article we discuss how that impulse created SMS mining, and how governments, investors, and the legal community have reacted.

A Brief History of Undersea Mineral Exploration

Although deep-sea mining depends on cutting-edge technologies honed to the demands of a largely unexplored world, it is not a new endeavor. For one thing, extracting some kinds of submarine resources is commonplace: offshore drilling for oil and gas became an industry standard in the 1900s, and now fossil-fuel companies regularly withdraw petroleum from ocean depths as great as 2,700 meters. World Ocean Review, Oil and Gas from the Sea (2014), https://worldoceanreview.com/en/wor-3/oil-and-gas/. Such production is one-third of all that occurs worldwide. Id. Underwater resource extraction is not limited to oil and gas. De Beers and other companies take diamonds from the seabed off the coast of Namibia, for example. And minerals like cobalt are targets in the Clarion-Clipperton Zone, or CCZ, located in the Pacific Ocean east of Hawaii.

The concept of deep-sea, hard-rock mineral extraction arose in the 1870s, around the time when the HMS Challenger, a British research vessel, embarked on a scientific enterprise to circumnavigate the globe and study the ocean, including locating mineral deposits. The Economist, Race to the Bottom (Mar. 8, 2018), www.economist.com/technology-quarterly/2018/03/19/race-to-the-bottom. SMS deposits likewise are not recent objects of exploration. Although SMS are found in oceanic crust, this same mix of compounds also exists on land, where the ancient Greeks mined it, followed by many others. John W. Jamieson et al., Seafloor Massive Sulfide Resources 1 (2017). In the 1960s, mining engineers and resource companies began to visualize exploiting marine SMS deposits as a viable commercial pursuit. Now, profitable deep-sea SMS extraction is beginning to look more like reality as technology opens the hatch to opportunities miles below the ocean’s surface.

Discovery of Seafloor Massive Sulfide Deposit Fields

SMS deposits occur where one tectonic plate moves under another, in “subduction zones,” and where tectonic plates pull
Engineering Challenges Presented by Deep-Sea Mineral Extraction

Extracting minerals from SMS deposits presents a bevy of technological challenges. SMS deposits are often found 2,000 meters below the surface of the ocean, in heated seawater that approaches 400 degrees Celsius (but ironically is accessible only by traveling through frigid ocean), in the pitch dark, under pressures reaching a bone-crushing 3,000 pounds per square inch. Kristi Birney et al., Potential Deep-Sea Mining of Seafloor Massive Sulfides: A Case Study in Papua New Guinea v, vi, 22–30 (2006). All the tools required to drill for samples, extract sediments, separate ore, transport it to waiting ships, and process the SMS have to be customized to overcome these obstacles, either through new developments or by adapting equipment from oil and gas production or other industries.

Fortunately, mining companies generally excel at engineering economically beneficial solutions to complex problems, and the same clariion call for human ingenuity sounds at over 300 fathoms below the surface. Glencore’s Onaping Depth Mine in Ontario, Canada (albeit on land), exemplifies the steady advance of mineral-extraction engineering. The Onaping Depth Mine accesses an ultra-deep nickel-copper-platinum-group-elements deposit 2,500 meters below the Sudbury Basin. The find is highly valuable, but its depth makes ventilating the site prohibitive. Rather than walk away, Glencore is creating an electric-vehicles fleet for the mine. Admittedly, upfront costs will be higher than traditional diesel. But Glencore expects that its electric fleet will cut expenditures on ventilation and refrigeration by half. International Institute for Sustainable Development. Innovation in Mining: Report to the 2018 International Mines Ministers Summit (Mar. 2018), www.iisd.org/library/innovation-mining-report-2018-international-mines-ministers-summit.

Similar to solving for the extremes of the Onaping Depth Mine, undersea mining requires innovative solutions to overcome novel, complicated problems. Nautilus, for instance, has been working on an integrated system for seafloor extraction and production. It involves using several specialized vehicles to prepare the rugged seafloor, cut and gather the SMS deposits, and then collect the broken material in seawater slurry that would be pumped to a ship uniquely designed for dewatering, storage, and shipment to shore. Nautilus Minerals, Technology Overview, www.nautilusminerals.com/irm/content/technology-overview.aspx?RID=329 (last visited July 17, 2019).

Jurisdiction Stumbling Blocks in the Race to the Bottom of the Ocean

The physics of deep-water mining of SMS present challenges, but the law also poses significant hurdles. Not surprisingly, companies bent on excavating the seafloor also must navigate jurisdictional problems. The United Nations Convention on the Law of the Sea (UNCLOS), which became effective in 1994 with its ratification by 60 nations, divides the ocean into legal zones. The “territorial sea,” extending up to 12 nautical miles from coastlines, is the sovereign territory of each coastal nation. UNCLOS, Dec. 10, 1982, 1833 U.N.T.S. 397, art. 2–3. The “exclusive economic zone” (EEZ) extends beyond the territorial sea up to 200 nautical miles from the coastline and gives coastal states sovereign rights and jurisdiction for exploring, exploiting, managing, and conserving natural resources here, in waters of what geologists call the continental shelf. Id. at art. 55–57. Coastal states “have the exclusive right to authorize and regulate drilling on the continental shelf for all purposes.” Id. at art. 81. Papua New Guinea, Sudan, and Saudi Arabia have already issued permits and licenses to exploit minerals in the seabed below their EEZs. Kathryn A. Miller et al., An Overview of Seabed Mining Including the Current State of Development, Environmental Impacts, and Knowledge Gaps (Jan. 10, 2018), at 7. But emerging regulatory frameworks for deep-sea mining near certain states, along with pushback from local communities and nongovernmental organizations (NGOs) raising environmental and other concerns, have disrupted some EEZ mining plans.

Beyond the EEZs extend the seemingly infinite high seas and, under their crushing weight, the seabed known in UNCLOS as “the Area,” “the common heritage of mankind” over which no state may claim sovereignty. Id. at art. 136–37. The International Seabed Authority (ISA), an autonomous international organization established by UNCLOS, governs resources development in the Area. The ISA considers applications to mine deep-sea resources located within the Area, and it has approved 29 15-year contracts for exploration of polymetallic nodules, polymetallic sulfides, and cobalt-rich ferromanganese crusts. International Seabed Authority, Deep Seabed Minerals Contractors, www.isa.org.jm/deep-seabed-miners-contractors (last visited July 17, 2019). But states that have not ratified UNCLOS, such as the United States, may not apply to the ISA for deep-sea mining permits. Such states thus find themselves at a comparative disadvantage in what will inevitably become a competition to explore for and extract minerals from the seafloor.

Environmental Considerations

Although mining SMS deposits will occur only where the metal-sulfide chimneys are “dead”—i.e., otherwise finished producing SMS and often collapsed in heaps on the seafloor—mining nonetheless will take place in the proximity of active vents and their dynamic living systems, creating obvious environmental implications. Birney et al., supra at v, 23. Recall the ubiquitous front-page news of the Deepwater Horizon oil spill that began with an explosion on April 20, 2010. Equipment malfunctions, high pressure, deep water, volatile heavy machinery, and human error all led to the catastrophe that spread quickly through the churning seas and coated the Gulf Coast with oil, leaving lasting physical and biological impacts, and leading to years of costly litigation resulting
in some of the largest damages settlements in history. Concerns here are not dissimilar. For example, mining SMS could lead to silt and sediment plumes (some toxic), and destruction of delicate (often rare) marine ecosystems. Interference with light availability (natural or anthropogenic), increased noise, changes in temperature, and other pollution, along with damage to the seafloor itself, would all play a role. Compounding these issues are numerous problems already impacting the ocean: climate change, acidification, overfishing, and large-scale pollution by plastics and other contaminants. Perhaps of greater concern is what makes the ocean a mysterious frontier in the first place: all that we do not know and could harm as a result. Current assessments of potential environmental impacts cannot account for our general ignorance of the deep sea as humankind continues to discover flora and fauna—85 percent of which are considered endemic—living near hydrothermal vents at a rate of two new species each month. Miller et al., supra at 11–18.

Other Controversies
Environmental issues are not the only controversies. Competing interests from other industries, along with fights over resource availability and access, also present substantial challenges. In New Zealand, for example, Trans-Tasman Resources’ (TTR) plan to extract seabed iron sands has been suspended following legal challenges from both local and international entities. In 2017, the New Zealand Environmental Protection Authority approved TTR’s proposal to mine in New Zealand’s EEZ. Trans-Tasman Resources Appeals High Court Decision on Seabed Mining, New Zealand Herald (Sept. 24, 2018), www.nzherald.co.nz/environment/news/article.cfm?c_id=39&objectid=12130799. Several groups, including international NGOs like Greenpeace, local environmental groups such as Kiwis Against Seabed Mining, and commercial fishing interests all challenged that decision. Taranaki Seabed Iron Sand Mining Decision Reversed, Stuff (Apr. 19, 2018), www.stuff.co.nz/business/103221820/taranaki-seabed-iron-sand-mining-decision-reserved. An increasing number of NGOs are focused exclusively on seabed mining. The Deep Sea Mining Campaign (DSMC) (www.deepseaminingoutofdepth.org/), for instance—an association of NGOs and citizens from the Pacific Islands, Australia, Canada, and the United States—combines grassroots community development and science-based advocacy to fight it. DSMC’s active opposition against commercial extraction of SMS off the Papua New Guinea coast demonstrates just how potent and focused legal resistance can be.

Nautilus Minerals Saga
Such resistance, along with a host of other obstructions, has plagued Nautilus Minerals. Its venture into SMS mining is a cautionary tale for deep-sea miners of all kinds, but especially for those seeking to explore for and extract SMS under license in a state’s territorial waters.

Nautilus, a Canadian underwater, mineral-exploration company, holds itself out as the first commercial operation to consider seriously mining seafloor SMS. Nautilus tried to adapt offshore oil-and-gas technologies to do so. Although the company initially focused on SMS deposits near Papua New Guinea and Tonga in the Southwest Pacific, it expanded to explore the CCZ in Central Pacific international waters, where researchers discovered substantial deposits of poly-metallic manganese nodules. Nautilus Minerals, CCZ, www.nautilusminerals.com/irm/content/ccz.aspx?RID=261 (last visited July 17, 2019).


But the tide quickly turned. In June 2012, Nautilus reported a dispute with the Papua New Guinea government over the investment agreement, asserting that the country had exercised its option to acquire a 30 percent interest in the project but was claiming Nautilus had not satisfied certain conditions precedent. Press Release, Nautilus Minerals Inc., Nautilus Dispute with the State of PNG (June 1, 2012). The company’s stock price crashed and Nautilus was forced to delay the project. An arbitrator ultimately ruled for Nautilus, finding that Papua New Guinea breached the option agreement by failing to complete the purchase of its interest. Nautilus received $113 million released from escrow in December 2014. Peter Koven, Nautilus Minerals Inc Says It’s Poised to Begin Undersea Mining Following Dispute Settlement, Financial Post (June 25, 2014).

But the company never fully recovered from the setback. In 2017, nearby community members, represented by the non-profit environmental and human rights organization Centre for Environmental Law and Community Rights Inc., complained to the government of Papua New Guinea about environmental concerns related to Nautilus’s project, seeking permitting documents, environmental studies, and agreements between the government and Nautilus. In May 2018, Anglo American divested from Nautilus, leaving the company with few key investors. By December 2018, Nautilus appeared to have lost the nearly completed custom-built ship it had chartered when MAC Goliath, which was overseeing the ship’s construction, defaulted on a payment and Nautilus was unable to step in to make up for it. The shipyard then sold the ship to a subsidiary of MDL Energy, an Indian shipping-investment
company. Nautilus likely cannot replace the ship, designed specifically to extract SMS deposits in the Southwest Pacific. Nautilus’s future in SMS exploration and extraction is uncertain. On February 21, 2019, the company filed for and was granted creditor protection under the Canadian Companies’ Creditors Arrangement Act. Subsequently, on April 3, 2019, Nautilus was delisted from the Toronto Stock Exchange. The company reports that it remains in control of its business, but it is exploring recapitalization options, including the sale of its SMS business unit. Nautilus Delisted from Toronto Exchange, Papua New Guinea Post-Courier (Apr. 2, 2019), https://post-courier.com.pg/nautilus-delisted-toronto-exchange/. Deep-sea mining companies may find themselves caught in a web of unclear regulations and corporate uncertainty, trying to find a foothold in a shifting legal and political landscape. Nautilus is perhaps an extreme example of this, but one that companies should not overlook as they consider their options for SMS exploration and development.

**Underwater Hard-Rock Mineral Mining in the Future**

The need for metals will only increase as more people inhabit the planet, living new-tech lives. Just one of the elements entrained in SMS—copper—is used to generate and transmit power, make industrial machinery, and manufacture vehicles of all kinds. Heating, cooling, telecommunications, and car parts depend on copper, every ounce of which we have taken from terrestrial mines. Mining on land will continue, of course, but likely will experience tougher regulation, more resistance in various forms (whether due to environmental consequences, land-use conflicts, or political controversies), and market variations that will significantly affect economic incentives to continue operating current mines or open new ones.

Although many of these factors are associated with seafloor mining as well, they have different connotations underwater. Because industrial-scale seafloor mining has not yet been attempted, and because the scientific, economic, and legal challenges facing this nascent industry are just emerging, it is difficult to predict the future of the business. One thing seems certain, however: when demand for the metals that are also found on the seafloor exceeds the ability of land-based mining interests to supply those elements, the major mining companies will be swift to follow the entrepreneurial pluck of their upstart and intrepid deep-ocean counterparts.

New efforts at deep-sea mining will take place against a backdrop of laws, regulations, guidelines, and even general “best practices” that are fledgling, moving targets. Even the terms vary—what may be a lease or a permit in one jurisdiction could be a contract or a charter in another. Indeed, the legal infrastructure is as turbid and unstable as the windswept high seas.

What seems clear, however, is that the International Seabed Authority is critical to the future of deep-sea SMS extraction. Exploration and exploitation in the Area can only happen by contract with the ISA, and the draft rules addressing exploration for deep-sea deposits pursuant to these contracts were first promulgated in 2007. The draft rules mimic, at least in part, some of the United States’ (and other countries’) environmental laws and regulations. For example, they require an environmental impact assessment to precede mining activity. Miller et al., supra at 7. Finalizing these rules has stalled, however. This is due to a lacuna of scientific research on deep-sea marine habitats, combined with quickly advancing deep-sea mining technologies. A draft “Regulations on Exploitation of Mineral Resources in the Area” was published on March 25, 2019. ISA Release Draft Proposal of Exploitation Regulations for Deep Sea Mining, ECO Magazine, www.ecomagazine.com/news/regulation/isa-release-draft-proposal-of-exploitation-regulations-for-deep-sea-mining. But shortly thereafter, the ISA announced in a “Proposal of Draft Exploitation Regulations Released by ISA Legal and Technical Commission” that the draft rules would be reviewed again in July 2019.

Numerous nonprofits and NGOs have voiced strong opinions on—and objections to—the ISA’s draft rules, including the DSMC, the International Union for Conservation of Nature, the International Marine Minerals Society, and The Ocean Foundation. Although NGOs such as the DSMC radically oppose SMS mining, others take a more nuanced approach, asking for more transparency into the ISA’s regulations and discussions and for an ISA environmental committee.

Regional nonbinding guidelines and best practices also contribute to the global governance of deep-sea mining. These include the MIN-Guide initiative for the European Union’s member states, and the Deep Sea Minerals Projects for the larger Pacific Ocean region (which promulgated in 2012 a Regional Legislative and Regulatory Framework). Miller et al., supra at 7–9. Deep-sea SMS extraction within the Area is truly the new legal Wild West of the mining world, and leaves much to be resolved.

**Looking Forward**

Those who are willing to tackle seafloor mining can be de facto first movers in this embryonic market, and the draw of reserving the most lucrative mineral deposits and securing valuable patents will continue to lure investors willing to accept the physical, environmental, economic, and legal risks. Undoubtedly, seafloor mining is not obviously better, easier, or more attractive than mining on land. For example, the cost of removing tons of overburden to access ores on land is met by the expense of negotiating miles-deep saltwater to get to otherwise unburdened deposits on the seafloor. And, along with project-crippling environmental litigation, an undefined regulatory structure, and unknown technical challenges, there are many reasons to hold back from digging in the sea. But there is hardly a doubt that a market will emerge to make it worthwhile. It is almost certain that private companies will not be the only players, either. Spurred by the prospect of greater resource independence, nation-states with large budgets will have a strong incentive to tap into seabed resources, and actively participate as well.

Whether or not mining companies or governments can successfully realize the benefits of SMS mining depends on the creation and impact of future regulations, an increased understanding of environmental issues and how to mine SMS sustainably, and, most importantly, humanity’s future demand for metals weighed against the costs of extracting them. That demand created this burgeoning industry in the first place, and it very likely will overcome today’s numerous challenges to drive seabed mining into the future. 🌊
Tension with indigenous populations arising from the use and allocation of natural resources, and the level of protection and preservation to which those resources are entitled, has been constant in North America since the arrival of European explorers. In the recent past, these tensions manifested in conflicts over tribal treaty rights to fish in ceded territories in Wisconsin, Michigan, and Minnesota. These conflicts—which would collectively come to be called the “Walleye War,” reached their peak in the 1980s and 1990s and played out in courthouses, at public boat landings, and on bodies of water throughout the upper Midwest.

Against this backdrop of contentious battles over treaty fishing rights, Native and non-Native people in the upper Midwest have come together several times over the past few decades to successfully halt mining operations that posed threats to water resources, wetlands, fisheries, and wild rice. Tribes have employed a variety of tactics from blocking trains carrying toxic substances from entering their land to invoking off-reservation treaty rights and developing stringent tribal water and air quality standards. Non-tribal partners have led grassroots efforts, implemented local ordinances, and joined with the tribes in seeking more stringent state laws and federal oversight. These efforts have built up the relationships and strategies developed in the Walleye War, which had its origins in a series of nineteenth-century treaties between tribes in the upper Midwest and the United States.

Throughout the 1800s, tribes in the Great Lakes basin ceded millions of acres in a series of treaties with the U.S. government. Beginning with the Treaty of Sault St. Marie in 1820, the Chippewa (Ojibwe) and Ottawa tribes reserved perpetual rights to fish, hunt, and gather in ceded territories in an effort to preserve and protect traditional lifeways and subsistence practices. See Treaty with the Chippewa at Sault Ste. Marie, Art. 3, June 16, 1820, 7 Stat. 206. However, a significant decline in tribal exercise of these treaty rights occurred in the late 1800s and early 1900s, bolstered by federal policy and by state court decisions such as Wisconsin v. Morrin, 136 Wis. 532 (1908), affirming a tribal member’s conviction for fishing with a gill net on the theory that Wisconsin’s admission into the Union abrogated the tribe’s treaty rights; and People v. Chosa, 252 Mich. 154 (1930), affirming a tribal member’s conviction for illegally possessing a lake trout on the theory that state sovereignty over game laws should not be abrogated by federal laws, and that tribal members, as U.S. citizens, were subject to state law.

A rise of activism and intentional assertion of treaty rights by tribal members came about in the 1960s and 1970s in conjunction with the broader civil rights movement. Tribal members exercised off-reservation fishing rights guaranteed under the treaties in order to be prosecuted and gain standing to challenge the old cases. In the following decades, tribes in the upper Midwest brought dozens of cases in state and federal courts and began piling up significant legal victories. In Wisconsin v. Gurnoe, 53 Wis. 2d 390 (1972), members of the Red Cliff and Bad River Bands of the Chippewa successfully appealed circuit court orders restricting tribal fishing rights on Lake Superior. In Michigan v. LeBlanc, 399 Mich. 31 (1976), the Michigan Supreme Court overturned the conviction of a Bay Mills Band tribal member for commercial fishing without a license based on the treaty fishing rights reserved in the 1837 Treaty of St. Peters. The 1983 case Lac Courte Oreilles Band of Lake Superior Chippewa Indians v. Voigt, 700 F.2d 341 (7th Cir. 1983) was the first in a series of Seventh Circuit cases that upheld the treaty rights granted in 1837 and 1842 throughout Michigan, Wisconsin, and Minnesota. Finally, the U.S. Supreme Court affirmed in 1999 that the tribes’ off-reservation usufructuary rights contained in the 1837 treaty had not been extinguished. Minnesota v. Mille Lacs Band of Chippewa Indians, 526 U.S. 72 (1999).

In the face of these legal victories, pervasive backlash erupted against tribal members by non-Indians who formed anti-treaty groups such as Equal Rights for Everyone, Protect Americans’ Rights and Resources, Stop Treaty Abuse, and Proper Economic Resource Management. These groups not only believed that the courts had unfairly bestowed special privileges to tribal members that were not available to others, but also maintained that tribal exercise of treaty rights would deplete the fisheries, resulting in economic impacts such as loss of tourism and reduction in property values. Many of the groups’ activities and publications were aggressively racist—slogans such as “save a fish, spear an Indian” were widespread. Patty Loew & James Thannum, After the Storm: Ojibwe Treaty Rights Twenty-Five Years after the Voigt Decision, 35 Am. Indian Q., 161, 171–73 (2011). In addition, harassment, threats, and outright violence ensued at multiple public boat landings where non-Indians blocked access, threw rocks and bottles, and actively harassed tribal fishermen. However, the Native fishermen continued to exercise their rights to fish off reservation in ceded territory, which had been guaranteed by treaty and now was upheld in state and federal courts.

At the heart of the conflict was the desire to protect access to common natural resources—the game and fish—that always had been central to the indigenous peoples’ way of life and now had become central to the way of life for the region’s non-Native population. The fisheries were valued for subsistence,
economic, and cultural reasons by Native and non-Native populations alike. Both sides felt the need to protect their own access to the resources, to have a voice in their management and regulation, and to preserve the resources for the future. In addition, there was a healthy dose of mistrust and anger.

Buoyed by the success of the efforts to regain recognition of their off-reservation treaty rights, the Bad River Band, along with Native and non-Native allies, organized a blockade in the summer of 1996 on the portion of the railroad that traversed the reservation.

In the early 1990s, the conflicts over tribal treaty rights in the upper Midwest began to subside. The state of Wisconsin determined it would no longer appeal the court decisions related to off-reservation treaty rights, and a permanent injunction was issued that largely stopped the violent activities by anti-treaty protestors at boat landings and lakes. *Lac de Flambeau Band v. Stop Treaty Abuse-Wisconsin*, 759 F. Supp. 1339 (W.D. Wis. 1991). Though not without further incident, the upper Midwest tribes and states developed cooperative relationships to comanage fish and game. The Great Lakes Indian Fish & Wildlife Commission (GLIFWC) formed in 1984 to represent the 11 Ojibwe tribes in Minnesota, Wisconsin, and Michigan with respect to reserved hunting, fishing, and gathering rights, and the Chippewa Ottawa Resource Authority (CORA) formed in 2000 to represent several tribes in Michigan. Both groups now work with state game agencies to comanage and regulate fisheries. In addition, conservation efforts were bolstered by tribal gaming revenue, and the non-Indian populations shared in the economic boost to the surrounding communities from tribal economic development. As these relationships between Native and non-Native communities strengthened, they helped to build a framework that would be used in efforts to protect the shared resources at issue in the Walleye War—water, fish, and game—from the effects of a long-standing source of revenue and development in the upper Midwest: mining.

**Early Mining in the Upper Midwest**

In addition to fishing, hunting, and other outdoor activities that are part of the social and economic fabric of the upper Midwest, mining has long been a cultural and economic mainstay. Indigenous people mined copper in Upper Michigan’s Keweenaw Peninsula, lead in Wisconsin, and quarried pipestone, or catlinite, in Minnesota for thousands of years. These metallic elements and rocks were used for tools, utensils, pipes, weapons, and ornaments. In the 1800s, interest by non-Indians in Upper Michigan’s copper and iron (beginning in the 1840s); Wisconsin’s lead, zinc, and iron (beginning in the 1820s); and Minnesota’s iron and taconite (beginning in the 1880s) fueled boomtowns and became major economic drivers for the entire region. However, these interests also fueled violence—notably the Winnebago War of 1827 and the Black Hawk War of 1832. Both conflicts resulted in further reduction of tribal land and natural resources, including the minerals mined over the next century and a half. By the mid-1990s, the region’s mines had long been on the wane, and only a few operating mines remained.

**Grassroots Opposition to Mines**

The White Pine copper mine, located in Michigan’s Upper Peninsula approximately six miles south of Lake Superior, began operations in 1953 and ceased conventional mining in 1995, resulting in mass layoffs and devastating the local economy. David Fettig, *Western U.P. Mine Closes, Locals Look to Keep Workers at Home*, Fed Gazette, Oct. 1, 1995. In an effort to revive the mine, a pilot project was proposed—mass recycling of sulfuric acid into the copper ore underground to dissolve the copper and recover it by pumping the acid solution out, a process known as leach mining. The massive amounts of sulfuric acid needed for the project would be transported through the Bad River Band’s reservation in Wisconsin to White Pine in Michigan’s Upper Peninsula. The Michigan Department of Environmental Quality (DEQ) issued a permit for the pilot project, which included interstate shipment via railroad of large volumes of sulfuric acid, for which the Environmental Protection Agency (EPA) did not require a hearing or environmental impact statement. See *Michigan DEQ, Permit M00942: Authorization to Operate an Underground Solution Mining Facility in the State of Michigan, May 1996*. This proposal caused widespread tension about potential environmental effects. The Bad River Band, in particular, was concerned that a spill of sulfuric acid would poison the reservation, and that the leach mining process would contaminate groundwater in lands where the Band held usufructuary rights.

Buoyed by the success of the efforts to regain recognition of their off-reservation treaty rights, the Bad River Band, along with Native and non-Native allies, organized a blockade in the summer of 1996 on the portion of the railroad that traversed the reservation. The Band refused to allow rail cars carrying sulfuric acid to pass through, demanding an Environmental Analysis, an emergency response plan, and safety documentation for the roads, bridges, and rails over which the materials would pass. Wisconsin Central Railroad representatives demanded that the Ashland County Sheriff’s office arrest the protestors, but the officers responding to the blockade refused to act, citing a lack of jurisdiction on the reservation. Robert Imrie, *Tram Protesters Hung Down*, Daily Globe (Ironwood, Mich.), July 31, 1996, at 1. Eventually, a federal investigation into the safety of the rails was initiated, and the blockade allowed all trains not containing sulfuric acid to pass. Following further negotiations, including over the lack of tribal consultation prior to approving the project, EPA agreed to conduct an environmental analysis. The following year, citing costs associated with the delay, Inmet, the Toronto-based mining operation that had proposed the pilot project, withdrew.

In Wisconsin, a long-running and well-known saga involving tribal opposition to mining interests occurred near the town of Crandon, Wisconsin. In 1975, Exxon discovered large zinc/copper deposits upstream of the pristine Wolf River and the reservations of the Mole Lake Band of Lake Superior Chippewa, the Forest County Potawatomi, the Menominee Indian Tribe, and Stockbridge-Munsee Band of Mohican Indians. Over the next 28 years, the proposed project was bought and sold by various mining companies, including Nicolet Minerals Company, Rio Algom, and BHP Billiton. Out of concerns related to the potential devastation of the wild rice beds, fisheries, and other natural resources in the vicinity of the proposed project site, both on and off reservation, tribes and their non-tribal allies employed increasingly sophisticated measures to prevent the mine from going forward. Other local concerns centered on impacts from the toxic mining waste, reduction of groundwater, damage to the fisheries, loss of property values, and impacts to tourism. See Zoltan Grossman & Al Gedicks, Native Resistance to Multinational Mining Corporations in Wisconsin, 25 Cultural Survival Quarterly 9–11 (2001).

Initially, strong local opposition to the project, combined with low metal prices, resulted in Exxon’s withdrawal from the project in the mid-1980s. However, in 1993, with Canadian mining company Rio Algom as a partner, Exxon revived the mining project proposal. The four nearby tribes formed the Nii Win Intertribal Council and, along with GLIFWC, immediately began compiling legal and technical information to challenge the mine permit application. Id. Other nearby tribes and non-Native allies participated in the opposition efforts. For example, the Wolf Watershed Education Project conducted a 12-day speaking tour to educate local communities on the issue of metallic sulfide mining and staged well-attended anti-mining rallies, including in the state capital.

Immediately downstream, the Mole Lake Band (now the Sokaagon Chippewa Community) sought Treatment as a State (TAS) under section 518(e) of the Clean Water Act (CWA), 33 U.S.C. § 1377(e), a provision by which qualifying tribes may be delegated federal authority to develop and implement water quality standards in the same manner as a state—that is, to develop and implement tribal water quality standards that would apply to upstream sources. Just a few years earlier, in 1991, EPA had promulgated the water quality standards TAS rule, setting the criteria that Tribes must meet to obtain approval for TAS. 56 Fed. Reg. 64,876 (Dec. 12, 1991). In 1995, in direct response to the threat of mining impacts to their waters, fisheries, and wild rice beds, the Mole Lake Band became the first tribe to obtain TAS under the CWA.

One week later, the state of Wisconsin sued EPA. Throughout the Band’s application process, Wisconsin had consistently voiced its opposition, arguing that it was sovereign over all the navigable waters in the state, including those on the Mole Lake Reservation, and that its sovereignty precluded any tribal regulation of those waters. In its lawsuit, which the Crandon Mining Company (later, Nicolet Minerals) supported as amicus curiae, Wisconsin sought revocation of EPA’s grant of authority to the Band. In 1999, the U.S. District Court for Wisconsin upheld the Band’s right to regulate all water within the reservation. Wisconsin then appealed to the Seventh Circuit, arguing that the tribe did not have authority over the water resources on the reservation because the state owns the underlying lake beds—an argument that had been successful in an earlier case relating to tribal authority to regulate hunting and fishing on reservation waters. See Wisconsin v. Baker, 698 F.2d 1323 (7th Cir. 1983). However, the Seventh Circuit rejected the state’s reasoning, holding that the CWA’s TAS provision constituted an explicit grant of federal authority over waters within the borders of the reservation regardless of ownership. Wisconsin v. EPA, 266 F.3d 741 (7th Cir. 2001), cert. den. 535 U.S. 1121 (2002). The U.S. Supreme Court declined to hear the case in 2002.

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Concurrently, the Forest County Potawatomi, whose land base consists of multiple non-contiguous plots east of the proposed Crandon project, advised EPA that it would seek redesignation of certain reservation lands from Class II to Class I under section 164 of the Clean Air Act (CAA), 42 U.S.C. § 7474. A Class I designation provides greater protection for air resources by decreasing the amount of pollutants that nearby sources may emit. The Forest County Potawatomi sought the redesignation to impose more stringent requirements to protect the reservation’s air quality should the potential project go forward. Both Michigan and Wisconsin objected to the proposal, triggering an EPA dispute resolution process. The dispute with Wisconsin was resolved in 1999; however, the dispute with Michigan dragged on for years. Finally, in 2008, more than 14 years after submitting its application to EPA, the Forest County Potawatomi obtained an Air Quality Class I Designation. 73 Fed. Reg. 23,107 (April 29, 2008). Michigan then challenged EPA’s redesignation in the U.S. Court of Appeals for the Seventh Circuit, but the court dismissed the challenge. Michigan v. EPA, No. 08-2582 (7th Cir. 2009).

In addition to tribal environmental regulation development, non-Indians opposed to mining launched a concerted effort to strengthen state laws on sulfide mining in Wisconsin. These well-coordinated efforts resulted in the 1998 adoption, with strong bipartisan support, of Wisconsin’s “Prove It First”
law. Wis. Stat § 293.50 (1998). The law, which would come to be known as the “Mining Moratorium,” imposed a requirement that a metallic mining permit applicant must provide an example of a metallic sulfide mine in the United States or Canada that had been in operation for 10 years without polluting groundwater or surface water, and a mine that had been closed for 10 years without causing any water pollution. Previously, the Wisconsin Natural Resources Board, a state agency charged with conserving and managing Wisconsin’s natural resources, had sought examples of metallic sulfide mines that had not negatively impacted the environment. In response to this inquiry, the Wisconsin Department of Natural Resources (WDNR) drafted a report on mining waste management that stated, “There are no ideal metallic mineral mining sites which can be pointed to as the model approach in preventing acidic drainage industry-wide.” An Overview of Mining Waste Management Issues in Wisconsin, Report to the Natural Resources Board by Wisconsin DNR Bureau of Solid and Hazardous Waste Management, July 1995, updated Oct. 1997.

Environmental concerns about activities that threaten common values and lifeways, such as hunting and fishing, have resulted in what were once unlikely alliances.

When the mining company presented an example of a mine that allegedly had not polluted—the Sacaton mine in Arizona—the example was rejected by the WDNR as proof that such mining could be conducted safely in Wisconsin. Joe Tarr, To Mine or Not to Mine? Lifting the Mining Moratorium Could Change the Face of Wisconsin, Isthmus, Dec. 13, 2002; see also Foley and Lardner, Wis. stats. 293.50 Supplemental Compliance Demonstration Report (Sacaton Mine, Pinal Co., AZ) Cran- don, Wisc.: Nicolet Minerals Co., 2003, http://digital.library.wisc.edu/1711.dl/EcoNatRes.WISstats03. Subsequently, in the face of the concerted efforts by Native and non-Native activists alike, including more than 30 organizations, such as fishing groups, tourism groups, economic development organizations, and local governments, the 28-year fight to stop the Crandon mine ended in 2003 with the mining project abandoned. Nicolet Minerals (a subsidiary of BHP Billiton) sold the proposed project site to the Mole Lake Sokaogon Band and Forest County Potawatomi for $16.5 million. The Forest County Potawatomi paid cash for their half of the payment, while the Sokaogon Band paid an $8 million mortgage from BHP. Upon receipt of the final mortgage payment in 2006, BHP Billiton gifted back the $8 million to a trust fund to be used by the Band for the restoration and conservation of the Crandon mine site. Robert Imrie, Mining Firm Gives $8m Back to Tribe; Gift Ends Crandon Mine Saga, The Capital Times, May 31, 2006, at 10.

Little more than an hour’s drive west of Crandon, an ore deposit discovered by Canadian mining company Noranda in 1990 became the proposed site of the Lynne mine in Oneida County, the heart of the territory that had seen some of the most vocal anti-treaty activities during the Walleye War. Thirty miles south of the Lac du Flambeau Band of Lake Supe- rior Chippewa, the proposed Lynne mine site sat just upstream of the Willow Flowage—a 4,200-acre lake surrounded by wetlands and prized by locals for its outstanding fishing and minimal development. Virulent—and unexpected—opposition from both the Lac du Flambeau Chippewa and local non-Indians, including hunting and fishing groups, resulted in withdrawal of the mining permit application in 1993. In 1997, the Wisconsin Natural Resources Board designated the Willow Flowage as an Outstanding Resource Water, and subsequent additions to the Willow Flowage Scenic Water Area have resulted in an almost 35,000-acre public resource.

Nevertheless, in 2009, Tamerlane Ventures pushed again for a mine at Lynne. And again, Lac du Flambeau members and non-Indian residents—including many seasonal residents—voiced their opposition. In 2012, the Oneida County Board voted to end any consideration of a mine on the county-owned property overlying the ore deposit. Oneida County Mining Ordinance Could Go to Voters, WSAU.com, June 18, 2018, https://wsau.com/news/articles/2018/jun/18/oneida-county-mining-ordinance-could-go-to-voters/. However, the issue remains alive. In 2018, a mining referendum placed on the Oneida County ballot was rejected when more than 19,000 people in the rural county turned out to vote, spurred by the conflict surrounding the proposed mine and the public meetings, reports, and radio and television commercials in both support and opposition.

In 2010, in the Penokee Hills of Wisconsin, south of Lake Superior and 20 miles upstream of the Bad River Band’s reservation, Gogebic Taconite proposed what would be the largest open pit iron-ore mine in the world at the headwaters of the Bad River, which flows through the reservation to Lake Supe- rior. The Bad River Band opposed the project, due to the project’s threat to its extensive wild rice beds and threatened and endangered species habitat, pointing out that the Bad River Reservation hosts approximately 40 percent of the coastal wet- lands within the Lake Superior Basin. See generally Bad River Band Mining Update at www.badriver-nsn.gov/tribal-news/ mining-update. All 10 other tribes in Wisconsin also voiced their opposition to the project. The Bad River Band, which had been granted TAS under the CWA in 2009, promptly developed water quality standards, approved by EPA in 2011. Id.

In response to the proposed mine, Wisconsin’s Ashland County implemented a strict zoning ordinance and Metallic Mineral Mining Impact Ordinance, requiring a special use permit from the county for any mining operations, imposing financial penalties for pollution caused by mining, and requiring establishment of a Well Damage Trust Account for payment to citizens whose wells are impacted by mining activity. Ashland County Ordinance 006-2013-78 & -79. Nearby Iron County in Michigan’s Upper Peninsula also implemented a requirement for county approval of metallic mines in its zoning ordinance. Iron County Code of Ordinances, § 9.7.3. Despite support for the project from Wisconsin’s governor, and the imposition of new, looser mining laws in Wisconsin in 2013, Gogebic Taconite withdrew its mining permit application in 2015, citing concerns related to the number of wetlands at the proposed project site. Letter from Timothy J. Myers on behalf of Gogebic Taconite to Ann Coakley,
Working together, tribal and non-tribal people have been able to successfully resist proposed mining operations in the upper Midwest. Environmental concerns about activities that threaten common values and lifeways, such as hunting and fishing, have resulted in what were once unlikely alliances. Greater awareness of mining’s potential impacts, and wariness surrounding the boom-and-bust mining economy, have continued to fuel local resistance to a mining resurgence.

Current and Potential Future Mining Projects

Changes to state laws and the level of federal oversight add additional variables to mining projects’ long and hotly contested permitting processes and recently have bolstered the progress of some proposed mines. For example, in 2018, Wisconsin repealed its Mining Moratorium; also in 2018, Michigan amended its non-ferrous metallic mining statute to allow for review of permit decisions by a panel of industry experts; and federal agencies recently have granted renewal of mineral leases that previously were delayed for additional environmental review. See 2017 Wisconsin Act 134 (Dec. 11, 2017); Michigan Public Act No. 268 (June 29, 2018); and DOI-BLM-Eastern States-0030-2018-0002-EA (Addition of Terms and Conditions for Removal of Hardrock Leases, MNES 001352 and MNES 001353) (May 15, 2019).

The Eagle Mine, a nickel and copper mine located northeast of Marquette, began construction in 2010 and is the first new mine in Michigan’s Upper Peninsula in decades. Local opposition included community groups, environmental groups, and the Keweenaw Bay Indian Community, which fought together to preserve the pristine and remote Yellow Dog Plains, and Eagle Rock, an ancient place of worship for the Keweenaw Bay Indians, from the impacts of mining. A decade of opposition, including several administrative and state court appeals, resulted in approval of the project, which the Michigan Court of Appeals affirmed in 2014. Nat’l Wildlife Fed’n v. Dept’ of Envtl. Quality, 306 Mich. App. 336 (2014).


Also, in Minnesota, PolyMet Mining has been pursuing a copper mine near Hoyt Lakes, north of Duluth, for more than 10 years. Minnesota Ojibwe Bands holding treaty rights to ceded territory have objected to the mine through the state’s environmental impact statement process and voiced objections to a land exchange of over 6,500 acres of federal land that is necessary for the project to move forward. The Minnesota Pollution Control Agency issued an air emission permit, water quality permit, and CWA section 401 certification for the project in 2018. The project still lacks a federal wetlands permit and is facing lawsuits related to the environmental review process and land exchange. In addition, environmental groups and the Fond du Lac Band of Lake Superior Chippewa have called for renewed review of the proposed tailings dam for the project following the failure of a similarly designed tailings dam in Brazil earlier this year that killed dozens and resulted in environmental devastation. Marshall Helmerberger, Groups Seek DNR Stay on PolyMet Dam Permit, The Timberjay, Feb. 13, 2019, at 8.

The Back Forty Project is a proposed open-pit sulfide mine west of Stephenson, Michigan, on the east bank of the Menominee River, which forms the border between the Upper Peninsula of Michigan and Wisconsin. Local opposition groups have argued that the mine would negatively impact water quality, tourism, and property values. Concerned citizen groups from both Michigan and Wisconsin, as well as multiple local governments, have pointed to potential impacts to the fishery—including valuable lake sturgeon habitat—which is comanaged by Michigan and Wisconsin. Perhaps the most intense opposition to the project has come from the Menominee Indian Tribe of Wisconsin, who originated from the mouth of the Menominee River and whose ancestral burial grounds and village sites lay within the footprint of the proposed project. The Menominee Tribe sued EPA and the U.S. Army Corps of Engineers in federal court over their failure to exercise jurisdiction over wetlands permitting and are contesting the project’s state-issued permits through Michigan’s administrative processes. See, e.g., Menominee Indian Tribe of Wisconsin v. EPA and U.S. Army Corps of Engineers, Case No. 18-C-108 (E.D. Wis. Dec. 19, 2018).

The push for new mines in a region marked by passionate defense of its natural resources yet in search of new economic opportunities has again stirred debate between those who would welcome mining and those who see the potential environmental impacts as a threat to their way of life and the robust outdoor recreation and tourism economies. In addition, the upper Midwest is home to dozens of tribes that have formed alliances, strengthened their own environmental regulations, and have gone to court to protect their natural resources and long-standing off-reservation treaty rights. Where tribal and local governments favor greater levels of environmental protection than state governments, alliances between Natives and non-Natives have been, and may continue to be, effective in resisting proposed mining projects in the upper Midwest. ©
Smarter Produced Water Management Options: Can the Regulatory Landscape Keep Pace?

Gary Steinbauer and Kevin Garber

Unconventional natural gas development in the Marcellus and Utica shale plays has seen unprecedented growth since 2012. Ohio, Pennsylvania, and West Virginia are now among the top gas-producing states, with Pennsylvania emerging as the second-largest natural gas producer in 2018, behind Texas. U.S. Energy Information Administration, Natural Gas Marketed Production, www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_VGM_mmcf_a.htm (last visited Aug. 8, 2019). The historic rise in production comes with increased volumes of produced water and waste streams that must be managed by natural gas operators. Produced water is naturally occurring brine brought up to the surface from the hydrocarbon reservoir during extraction of natural gas. Although the volume of produced water varies by well and formation, produced water is by far the largest water source by volume generated in the gas production process. U.S. Environmental Protection Agency (EPA), Management of Exploration, Development and Production Wastes: Factors Informing a Decision on the Need for Regulatory Action (Apr. 2019), at 3–11, www.epa.gov/sites/production/files/2019-04/documents/management_of_exploration_development_and_production_wastes_4-23-19.pdf. Many unconventional natural gas operators treat, reuse, and recycle produced water to increase their water usage efficiency, cut down on the costs of disposal, and recover valuable materials.

Implementing the most effective strategy for produced water management requires compliance with a complex web of interrelated federal and state laws, which include state oil and gas-related laws, local laws and ordinances, and environmental laws. This article explores the most commonly used management strategies for produced water in the Marcellus and Utica shale plays in these three states and analyzes the federal and state environmental regulatory regimes governing such management alternatives. It begins by examining the chemical characteristics and volume of produced water from an unconventional natural gas well. It then analyzes the federal and state environmental regulatory landscape for the most common ways that produced water is managed: (1) reuse or recycling within or outside the gas field; (2) disposal in underground injection wells; and (3) treatment at commercial treatment facilities, some of which discharge pretreated effluent to publicly owned treatment works (POTWs). While the natural gas industry increasingly searches for ways to harness the full value of produced water, the environmental regulatory landscape for produced water in the Marcellus and Utica shale plays is evolving. It is unclear whether this evolution will keep pace with innovative solutions and technological advances that are being used to maximize produced water’s value.

Volumes and Chemical Composition of Produced Water in Appalachia

Understanding the complexities of produced water management options and their regulatory underpinnings would not be possible without first understanding the volumes and chemical composition of produced water. Since 2009, the volumes of produced water generated have increased considerably. In Pennsylvania alone, produced water volumes from unconventional operations have increased from roughly 10 to more than 50 million barrels per year. Lee Ann L. Hill et al., Temporal and Spatial Trends of Conventional and Unconventional Oil and Gas Waste Management in Pennsylvania, 1991-2017, 674 Sci. of the Total Env’t 623, 626 (2019).

Scientists often refer to produced water as being hypersaline, with some analyses showing total dissolved solids concentrations of more than 200,000 milligrams per liter for a well in the Marcellus Shale play. Hill et al., supra, at 624. These dissolved constituents primarily consist of sodium and calcium, but barium, strontium, and bromide have also been detected in produced water. Id. Naturally occurring radioactive material, particularly radium, can also be found in produced water from unconventional gas wells in the Marcellus and Utica shale plays. Id.

Produced water often shares the chemical characteristics of the brine located in the geologic formation from which natural gas is produced. While many contend that its chemical composition may be influenced by chemical additives used in the hydraulic fracturing process, a recent scientific study suggests that most of the injected water and chemical additives remain within the shale formations and the return flow consists primarily of naturally occurring brines. Andrew J. Kondash et al., Quantity of Flowback and Produced Waters from Unconventional Oil and Gas Exploration, 574 Sci. of the Total Env’t 314, 317 (2017).

Current technologies like crystallization can remove the various dissolved constituents in produced water, and the resulting salts have been sold commercially. Nonetheless,

Produced water management strategies in the Marcellus and Utica shale plays vary based on the location of the well proximity to available treatment and disposal facilities, market forces, and operator preference. For underground injection and reuse or recycling of produced water, the governing environmental regulatory requirements are significantly different depending on the state. EPA is currently evaluating its existing rules concerning the discharge of treated produced water to surface waters and expected to announce any potential changes to the existing federal regulatory requirements in the summer of 2019. Below, we explore the applicable federal and state regulatory requirements for each of the most commonly utilized produced water management strategies and explain why the paradigm for produced water management appears to be trending away from disposal and toward reuse and recycling.

**Disposal in Underground Injection Wells**

At the beginning of the Appalachian natural gas boom, disposal in underground injection wells was the most common produced water management option. These wells are regulated under the Class II Underground Injection Control (UIC) program established by the Safe Drinking Water Act. 42 U.S.C. § 300h. EPA can delegate the authority to administer the UIC program to states, and Ohio and West Virginia have delegated authority to implement the Class II UIC program for brine or produced water disposal wells. 40 C.F.R. § 147.1800; see 40 C.F.R. § 147.2453. On the other hand, Pennsylvania has opted not to seek delegation to administer the UIC program. Therefore, EPA administers the UIC program, including the issuance of permits for Class II UIC wells, within Pennsylvania. 40 C.F.R. §§ 144.1(e), 147.1951(a).

Pennsylvania’s lack of implementation authority for the Class II UIC program and its relatively unique geology, have resulted in significantly fewer produced water disposal wells as compared to those located in Ohio and West Virginia. Ohio has the greatest number of active produced water disposal wells at 223. Ohio Dep’t of Nat. Resources, Class II Brine Injection Wells of Ohio, http://oilandgas.ohiodnr.gov/portals/oilgas/pdf/Class_II_Map/Class%20II%20Brine%20Injection%20Wells%20of%20Ohio%2007082019.pdf (last visited Aug. 8, 2019), almost four times as many as West Virginia, where there are 59 active Class II disposal wells. Groundwater Protection Council, State of West Virginia Class II UIC Program Fee Review (GWPC WV) (Nov. 2017), at 15. Comparatively, Pennsylvania has roughly ten Class II disposal wells, only one of which is a commercial UIC well. Pa. Dep’t of Envtl. Prot., Underground Injection Control Wells, www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/Pages/Underground-Injection-Wells.aspx (last visited Aug. 8, 2019).

Understanding the complexities of produced water management options and their regulatory underpinnings would not be possible without first understanding the volumes and chemical composition of produced water.

The regulatory process for permitting such wells changes drastically from state to state. As noted, EPA administers the Class II UIC well program in Pennsylvania, meaning that it is responsible for drafting permits, completing the public participation process on such permits, and issuing the permits. See 40 C.F.R. Part 124, Subpart A. Challenges to EPA-issued Class II UIC disposal well permits in Pennsylvania are heard by EPA’s Environmental Appeals Board, 40 C.F.R. § 124.19(a), which has, at times, scrutinized EPA regional offices for failing to address fully induced seismicity issues during the permitting process for Class II produced water wells. See, e.g., In re West Bay Exploration Co., 17 E.A.D. 204 (EAB 2016). In addition to an EPA permit, Class II UIC disposal wells in Pennsylvania require a separate permit from the Pennsylvania Department of Environmental Protection. 25 Pa. Code § 91.52. The dual federal-state permitting requirements for Class II disposal wells in Pennsylvania, in addition to obtaining the necessary and sometimes numerous local approvals needed to construct such a well, provide several avenues for third parties to oppose disposal wells.

Similarly, Class II UIC disposal wells in West Virginia require two separate permits, although both are issued by the Office of Oil and Gas in West Virginia’s Department of Environmental Protection (WVDEP). W. Va. Code, Ch. 22; W.Va. Code R. §§ 47-13, 35-4. In addition, WVDEP distinguishes between “commercial” and “noncommercial” UIC disposal wells. A commercial Class II disposal well is any permitted operating facility that accepts fluids produced by another oil or gas operator. WVDEP, Underground Injection Control Class 2 and 3 UIC Wells, Permit Application Package Instructions and Guidance, http://dep.wv.gov/oil-and-gas/GI/Forms/Documents/UIC%20APPLICATION%20PACKAGE%2006-25-2014.pdf. Commercial UIC disposal wells in West Virginia often are subject to additional permitting requirements,
such as analytical testing, manifesting requirements, and increased security measures. *Id.* There are 14 active commercial and 45 active noncommercial UIC disposal wells in West Virginia. GWPC WY, at 15.

Ohio’s Class II UIC disposal program is unique for several reasons. By statute, the Ohio legislature has vested authority for permitting and implementing a specific regulatory program for produced water (i.e., brine) injection wells, known in Ohio as “saltwater injection wells,” in the Ohio Department of Natural Resources (ODNR), the same state agency that also is responsible for issuing permits for unconventional natural gas wells. Ohio Admin. Code § 1501:9-3. Ohio’s regulatory program requires disposal well operators to use state-of-the-art technology. As an example, each produced water disposal well in Ohio must be equipped with an automatic shut-off device that terminates operations if the maximum allowable surface injection pressure on the injection pump is exceeded. Ohio Admin. Code § 1509-9-3-07(G). Similarly, adapting to recent instances where oil and gas-related wells are believed to have caused seismic activity, the ODNR has the authority to require a disposal well operator to conduct a geologic investigation near the injection well, including the completion of seismic surveys. Ohio Admin. Code § 1501:9-3-06(C)(2)-(3). Recent permits issued by ODNR for produced water disposal wells require monitoring for “microseismicity” prior to injection and throughout the well’s operation. Williams Disposal LLC, API Well Number 34-121-2-4636-00-00 (Aug. 8, 2018).

The reported decline in the use and reliance on disposal wells has coincided with repeated and louder calls by natural gas producers, state regulatory agencies, and others to “rebrand” produced water as a valuable resource.

The prevalence of available disposal wells gives natural gas producers in Ohio and the nearby counties of Pennsylvania and West Virginia a cost-effective means of managing produced water and other wastes generated in the natural gas production process. More recently, however, evidence shows that producers increasingly are turning to other management options, at least in Pennsylvania. Hill et al., supra, at 628. Transportation of produced water to disposal wells can drive up costs to the point where this management option is no longer viable. Transportation to UIC wells also comes with risks of spills and accidental discharges, increased traffic, and air emissions. EPA May 2019, at 19. Concerns over induced seismicity caused by underground injection and disposal wells becoming over-pressurized can pose challenges to siting new disposal wells. *Id.* at 20.

*Reuse or Recycling In and Outside the Gas Field*

The reported decline in the use and reliance on disposal wells has coincided with repeated and louder calls by natural gas producers, state regulatory agencies, and others to “rebrand” produced water as a valuable resource. *Id.* at 19. Reusing and recycling produced water in and outside of the gas field can take on many different forms, from simply storing and reusing produced water to stimulate production in another nearby natural gas well to utilizing treatment technology to produce distilled water and other usable products. The environmental regulatory requirements vary, ranging from relatively straightforward for simple storage and reuse to complex and nuanced for advanced treatment and reuse facilities.

Viewed from a federal waste management perspective, Congress temporarily exempted produced water from natural gas wells from the hazardous waste management requirements of the Resource Conservation and Recovery Act (RCRA) in 1980. 42 U.S.C. § 6921(b)(2)(A). At that time, Congress required EPA to conduct a study and publish a regulatory determination on whether produced water and other oil and gas exploration and production-related wastes require regulation under RCRA Subtitle C. EPA published its regulatory determination in 1982, concluding that regulation under RCRA Subtitle C was not warranted because existing federal and state laws were adequate to regulate, among other things, produced water. Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes, 53 Fed. Reg. 25,447 (July 6, 1988). In 2019, following a lawsuit filed by environmental groups, EPA completed a more recent study and arrived at the same conclusion: produced water would remain exempt from RCRA’s nonhazardous waste program. EPA May 2019, at 9-4 to 9-5. Therefore, operators in the Marcellus and Utica shale plays are subject to state solid waste management programs and regulations regarding the management of produced water. These programs differ substantially among the states.

Pennsylvania has perhaps the most comprehensive set of regulations governing storage, treatment, and transportation of produced water. Even when it is being reused or recycled, Pennsylvania treats produced water as a waste under its solid waste program. Consequently, temporary storage or processing of produced water in Pennsylvania requires a solid waste permit and facilities engaging in these activities are considered solid waste transfer facilities. Produced water destined to be used to complete wells is regulated as a residual waste until the moment it is placed down-hole, unless the produced water meets stringent quality standards. The Pennsylvania Department of Environmental Protection (PA DEP) has issued a beneficial reuse general permit for facilities that transfer, process, and use produced water to hydraulically fracture gas wells, known as WMGR123. The current version of the WMGR123 permit expires in October 2020, unless PA DEP renews it.

In addition to undergoing a comprehensive process to obtain coverage under the WMGR123 general permit, operators of produced water management facilities must then comply with the permit’s strict mandates. In addition to requiring compliance with the major Pennsylvania statutes for air pollution, water pollution, and solid waste management, WMGR123 requires operators to comply with (1) various requirements related to storage, including a one-year limitation on storage absent written approval that is based on
proportional rates of accumulation and reuse; (2) a prohibition of a point or nonpoint source discharge or runoff from staging, processing, and storage areas to a water of the Commonwealth; (3) a prohibition on mixing beneficially reused produced water with other waste; (4) management requirements for produced water that is not beneficially reused as solid waste, including proper treatment or disposal; (5) a prohibition to secure the estimated costs of cleanup; and (6) comprehensive cleanup and closure requirements. Recordkeeping requirements, similar to RCRA’s hazardous waste cradle-to-grave requirements, are also required under WMGR123.

WMGR123 also covers scenarios where the produced water facilities are processing or treating the liquid. Produced water ceases its status as a “waste” under WMGR123 when (1) it is transported to a well site, the owner or operator of the well site meets specific requirements, and it is beneficially reused to hydraulically fracture a gas well; or (2) it is treated so that the concentrations of nearly 40 separate parameters are below established levels and stored in an impoundment or other facility designed to hold water. Any facility or operator unable to exempt produced water from classification as a residual waste or unable to meet WMGR123 must apply for and obtain an individual solid waste permit from the PA DEP.

In Ohio, storage, recycling, treatment, and processing of produced water is subject to statutory requirements implemented by the state’s natural resources agency, ODNR. Ohio’s legislature granted ODNR exclusive authority to regulate the storage, recycling, treatment, and processing of brine or produced water. Ohio Rev. Code § 1509.22(C). ODNR has the authority to issue regulations that govern each of these activities, including procedures related to issuing permits. Id. However, to date, ODNR has not promulgated implementing regulations. Instead, it has been authorizing the storage, recycling, treatment, and processing of produced water through administrative orders for “temporary authorization” to manage produced water.

ODNR has issued more than 35 such orders, each of which temporarily authorize some combination of produced water storage, recycling, treatment, or processing. These orders require each facility to operate in accordance with Ohio Revised Code Chapter 1509. ODNR also typically incorporates regulations at Ohio Administrative Code § 1501:9, which contain various requirements for temporary storage of produced water in pits and tanks. Ohio Admin. Code § 1501:9-3-08. The Ohio Supreme Court recently affirmed a judgment in favor of ODNR in an environmental group’s lawsuit seeking to require ODNR to promulgate regulations governing produced water management, effectively allowing ODNR to continue issuing orders temporarily authorizing the storage, recycling, treatment, and processing of produced water for the time being. State ex rel. Food & Water Watch v. Ohio, 153 Ohio St. 3d 1 (Ohio S. Ct. 2018).

West Virginia explicitly allows the use of produced water for hydraulic fracturing. W. Va. Code R. § 35-8.5-6.f. West Virginia allows produced water to be brought to another well location, as long as the produced water is stored “in pits or tanks or centralized pit facilities” at the new location. Id. Centralized pits or impoundments are regulated in West Virginia based on whether they are included within a specific well work permit for an unconventional gas well and their capacity. Off-site centralized pits or impoundments are subject to more stringent requirements. See W. Va. Code R. §§ 35-8-16, 35-8-17. Siting restrictions, synthetic liner requirements, leak detection systems, groundwater and surface water monitoring requirements, and several related operational requirements are required for centralized pits and impoundments. Id.

The most controversial produced water management option is the discharge of produced water, treated or otherwise.

Temporary storage of produced water in tanks is regulated under West Virginia’s Aboveground Storage Tank (AST) Act, W. Va. Code § 22-30, which was enacted following a 2014 chemical spill into the Elk River. West Virginia promulgated implementing regulations in August 2016. W. Va. Code R. § 47-63. Notably, tanks holding less than 210 barrels of produced water that are not located in a “zone of critical concern” and wastewater process tanks are excluded from the AST Act requirements. Finally, a non-disposal solid waste permit is required to store and treat produced water in West Virginia. W. Va. Code R. § 33-1-3.5a.

Discharge Options for Produced Water
The most controversial produced water management option is the discharge of produced water, treated or otherwise. Any discharge to surface waters would be covered under the Clean Water Act’s National Pollutant Discharge Elimination System (NPDES) permit program. Ohio, Pennsylvania, and West Virginia are each delegated the responsibility to implement the NPDES permit program within their borders. The controversy over discharge options for produced water has centered primarily over two federal effluent limitation guidelines (ELGs) promulgated under the Clean Water Act.

For onshore gas development, EPA prohibited direct discharges of produced water when it revised the ELGs for the Oil and Gas Extraction Wastewater Point Source Category in 2016. 40 C.F.R. Part 435. EPA has imposed a zero-discharge requirement for oil and gas extraction wastewaters, including produced water, from onshore oil and gas activities. 40 C.F.R. § 435.32. When EPA revised these ELGs in 2016, it then prohibited indirect discharges of produced water to POTWs. 40 C.F.R. § 435.33(a)(1). Following a petition for reconsideration filed by the Pennsylvania Grade Crude Oil Coalition in the U.S. Court of Appeals for the Third Circuit in November 2016, EPA extended the deadline of the prohibition until August 29, 2019. Effluent Limitations Guidelines and Standards for the Oil and Gas Extraction Point Source Category—Implementation Date Extension, 81 Fed. Reg. 88,126 (Dec. 7, 2016). On July 5, EPA published notice of its decision to not revise its 2016 rule imposing a zero-discharge requirement for wastewaters from onshore unconventional oil and gas extraction facilities. Decision on Supplemental Information on the Effluent Limitations Guidelines and Standards for the
Produced water management will continue to be an issue for natural gas producers as natural gas production in the Marcellus and Utica shale plays continues to increase, especially if the pace of drilling and completing new wells does not keep up with generation of produced water from producing wells.

Although 40 C.F.R. Part 435 prohibits direct discharges of produced water to surface water and indirect discharges to POTWs, the ELGs for Centralized Waste Treatment (CWT) facilities at 40 C.F.R. Part 437 provide an avenue to treat and discharge produced water. The CWT ELGs were last revised in 2003, several years before the proliferation of unconventional natural gas production in the Marcellus and Utica shale plays. However, the unconventional gas industry does not fit well within the current structure of these ELGs. The present subcategories of the CWT ELGs regulate wastewater from metals treatment and recovery, oils treatment and recovery, organics treatment and recovery, and multiple waste streams. 40 C.F.R. §§ 437.10–437.47. Produced water from unconventional natural gas operations does not fit into any of these subcategories as currently defined. That has caused uncertainty and often the excessively stringent application of the ELGs by state agencies as they develop NPDES for CWTs, which in turn has limited the number of CWTs available to accept produced water for treatment. As an example, one state agency has selected the most stringent effluent limits from the various CWT subcategories and included those in a draft NPDES permit. 47 Pa. Bull. 3995 (July 22, 2017) (publishing notice of a draft NPDES permit and the proposed effluent limits for the FRS Kingsley Facility).

Divergent opinions have emerged on whether additional discharge options should be available for produced water. Industry, some state agencies, and some NGOs generally supported increased opportunities for produced water discharge alternatives, while environmental NGOs and academics have raised concerns. In late 2018, EPA began a comprehensive review to evaluate the management of oil and gas onshore facilities and to determine whether there is a need for additional discharge options under the CWA. As discussed above, EPA released a draft Study of Oil and Gas Extraction Wastewater Management under the Clean Water Act on May 15. This study was designed to evaluate “produced water generation, management, and disposal options at regional, state, and local levels for both conventional and unconventional onshore oil and gas extraction.” EPA May 2019, at 1. EPA reviewed various produced water management strategies, assessed various treatment technologies, and solicited input from a variety of stakeholders related to produced water management and whether additional discharge options were warranted under the CWA. The public comment period EPA provided for the study was open through July 1, and EPA encouraged interested parties to provide input on (1) nonregulatory steps EPA could take to encourage the reuse and recycling of produced water, (2) whether it should revise 40 C.F.R. Part 435 to allow for discharge of produced water considering the cost of transporting and treating produced water, and (3) the steps EPA could take to incentivize the reuse of produced water within and outside the gas field. EPA will use the information in the study and comments received to determine the appropriate course of action, with the goal of announcing any next steps later in 2019.

Produced water management will continue to be an issue for natural gas producers as natural gas production in the Marcellus and Utica shale plays continues to increase, especially if the pace of drilling and completing new wells does not keep up with generation of produced water from producing wells. The paradigm for produced water management appears to be shifting from disposal toward a recognition that produced water is a potentially valuable resource. Efforts to make reuse and recycling options more readily available, and even increasing the availability of discharge options, would be welcomed by unconventional natural gas operators and could prove to be environmentally beneficial. Market drivers, however, will only shift the outlook for increased produced water management options so much. Federal and state regulatory regimes must keep pace with the available science and technological advancements.
Contemplating a Domestic Regulatory and Enforcement Framework for Deep Seabed Mining

Kartik S. Madiraju

Demand for basic and rare-earth minerals is expected to increase substantially in the coming decades, both domestically in the United States, and around the globe. Some estimates predict that global mineral demand will be 60 percent higher in 2050 than it is today. For more traditional minerals such as copper and nickel, demand could triple in that time. The United States relies heavily on imports for its rare-earth mineral resources—these minerals include yttrium, scandium, and neodymium. Between 2014 and 2017, the United States obtained a staggering 80 percent of its rare-earth mineral resources from China. Globally, China has about one-quarter of the world’s land-based deposits of rare-earth minerals and supplies nearly all the world’s rare-earth minerals. See Jessica Aldred, The Future of Deep Seabed Mining, The Maritime Executive, Mar. 1, 2019; Rare Earth Mineral Commodity Summary, National Minerals Information Center, U.S. Geological Survey (2019); Doug Struck, Treasures of the Deep: Tapping a Mineral-Rich Ocean Floor, Trust Magazine, Aug. 13, 2018. These minerals are used in technologies ranging from wind turbine magnets to LED screens to guided missile technology. While the United States’ need for these minerals to revolutionize its energy, high-tech, and defense industries cannot be understated, continuing to rely on a single trading partner for these minerals is proving increasingly untenable.

Deep seabed mining (DSM)—the use of mining technology to harvest minerals deposited on the crust or just above the surface of the seafloor—is an industry that could provide the United States with access to vast deposits of various minerals without needing to rely on trading partners. DSM employs a variety of methods to access polymetallic nodules (clusters of minerals embedded in the mud of the seafloor), polymetallic sulfides (sulfide deposits found in hydrothermal vents and near seafloor volcanoes), and cobalt crusts (concentrated mineral deposits found up to a foot underground near underwater mountains). Previously thought to be economically unfeasible and unnecessary given the supply of land minerals, DSM is now an economically viable and attractive option.

The seafloor is thought to contain billions of tons of mineral deposits. One rough estimate calculated that a small portion of the sea floor, the Clarion-Clipperton Zone (CCZ), contained 6,000 times more titanium than all land reserves combined. Other areas were calculated to have several times more cobalt, yttrium, and significant amounts of copper, lithium, and manganese. A 2012 European Commission Report estimated that as much as 10 percent of the world’s mineral requirements could come from DSM by 2030. See, e.g., James R. Hein et al., Deep-Ocean Mineral Deposits as a Source of Critical Metals for High- and Green-Technology Applications: Comparison with Land-Based Resources, 51 Ore Geology Rev. 1 (2013); Blue Growth: Opportunities for Marine and Maritime Sustainable Growth, European Commission (2012); see also Paul A.J. Luston and Bramley J. Murton, Deep-Ocean Mineral Deposits: Metal Resources and Windows into Earth Processes, 14 Elements 301 (2018). As a result, deep seabed mining of sulfide deposits could compete economically with land mining of sulfides. Indeed, hundreds of millions of dollars are being invested in DSM, and a cost-benefit analysis of DSM found that nodule recovery was profitable, to the tune of $2.2 billion dollars a year. Other analyses also have suggested that DSM is profitable in other parts of the world. See Jessica Aldred, The Future of Deep Seabed Mining, Chinadialogue Ocean, Feb. 25, 2019; Rahul Sharma, Deep-Sea Mining: Economic, Technical, Technological and Environmental Considerations for Sustainable Development, 45 Mar. Technol. Soc. J. 28 (2011); Cardno, An Assessment of the Costs and Benefits of Mining Deep-sea Minerals in the Pacific Island Region, Pacific Community, Suva, Fiji (2016).

It comes as no surprise then, that the International Seabed Authority is providing exploration contracts to several member states, with expiry dates in the next decade. Although the United States is not an International Seabed Authority member and therefore cannot apply for exploratory contracts in international waters, the United States National Oceanic and Atmospheric Administration (NOAA) has already granted two exploratory licenses to companies planning to engage in DSM in U.S. waters. See Notice of Extension of Deep Seabed Hard Mineral Exploration Licenses, 82 Fed. Reg. 42,327 (Sept. 7, 2017).

Deep seabed mining, therefore, is not a far-off futuristic dream, but rather an economically feasible and technologically practical concept that is poised to become a large industry in the near future. However, as is the case with many if not all industries, the expansion of DSM comes with various environmental risks. Although the seafloor covers more than half the world’s surface, little is known about the ecosystems and natural phenomena that exist in the abyss. There is widespread agreement that DSM will necessarily impact the seafloor, the water above it, and surrounding areas. Environmental groups point to the potential destruction of habitats, the loss of as yet undiscovered species, and the disruption caused by excavating...
the top crust as environmental impacts that have not been fully evaluated. The concern over environmental impacts has already led to a lawsuit filed by the Center for Biological Diversity over NOAA exploration permits issued to deep seabed mining companies. The complaint, since settled, alleged that insufficient analysis of the environmental impacts of DSM violates the National Environmental Policy Act, and therefore that the permits were invalid. See Complaint, Center for Biological Diversity v. Pritzker, No. 15-0723 (D.D.C. May 13, 2015).

The growing concern over environmental impacts highlights an even greater challenge: the lack of any clear regulatory regime to govern DSM, the actors, and the environmental impacts.

The growing concern over environmental impacts highlights an even greater challenge: the lack of any clear regulatory regime to govern DSM, the actors, and the environmental impacts. Because DSM has not been viewed as a full-fledged industry until now, the United States has not developed legal and regulatory infrastructure to deal with issues such as permitting and environmental impact analysis.

The only existing law related to DSM is the Deep Seabed Hard Mineral Resources Act (DSHMRA), which Congress enacted nearly 40 years ago. 30 U.S.C. § 1441 et seq. (1980). The DSHMRA has the makings of a robust regulatory regime. For example, the DSHMRA contemplated environmental impact statements, only provides for exploratory permits rather than extraction itself, and has a penalty provision for those who violate permitting requirements. See 30 U.S.C. § 1413(a) (permitting), § 1419 (protection of the environment), and §§ 1461–1467 (penalties and enforcement). But the fact that Congress explicitly wrote in sections 1401(b) and 1441(3) of the Act that the law was meant to be a placeholder for an eventual international treaty on DSM serves to highlight that the DSHMRA was not, and is not, equipped to regulate an entire industry. Id. §§ 1401(b), 1441(3). Forty years later, the United States is not a party to the International Seabed Authority, has not signed on to UNCLOS (United Nations Convention on the Law of the Sea), and does not appear to have any commitments to an international treaty on DSM in the future. That leaves the country with a barebones statute to contend with a multibillion-dollar industry at its doorstep. Also, the statute is silent on extraction itself, how DSM is to be conducted, how much of each mineral can be extracted under a given permit, what happens to regulated entities that pollute or over-extract, and how regulated entities can appeal permitting decisions or obtain recourse for adverse judgments. The DSHMRA also makes no mention of reclamation or cleanup, two crucial parts of statutes that regulate land-based mining.

Courts also have had no occasion to interpret the statute or adjudicate disputes between agencies and regulated entities, thus depriving this industry of a body of law that could be used as guidance and precedent. The lack of a regulatory framework for an industry that is now ready to take flight will lead to uncertainty for regulated entities, the inefficient allocation of resources for regulating bodies, and ultimately run the risk of ineffective extraction and widespread environmental damage. Fortunately, the DSHMRA does not exist in a vacuum—there are several comprehensive pieces of legislation that govern mining and water pollution, which can be used as a framework for a fully formed law on DSM.

The Role of Permitting and Point Sources in Deep Seabed Mining

DSM presents a unique challenge for comprehensive regulation because it involves not only mining, but waters of the United States as well. Any discharge of pollution, and other potential impacts caused by DSM, would necessarily have impacts on water quality, marine life, and other water resources crucial to the United States. Rather than start from scratch, taking inspiration from existing statutes that govern water quality, for example, could provide key elements of a regulatory framework applicable to DSM, and some cautionary tales as well.

The Clean Water Act (CWA), 33 U.S.C. § 1251, regulates pollution from mining-related activities, although the statute did not contemplate DSM as a form of mining specifically. Section 404 established a program regulating the discharge of “dredged” or “fill” material into waters of the United States (which, importantly, includes discharge into the coastal waters and the ocean, as detailed in section 403 of the CWA). 33 U.S.C. § 1344 (permits for dredged or fill material); see also 33 U.S.C. § 1343 (discharges into the oceans or coastal waters). While section 404 does not strictly fall under the National Pollutant Discharge Elimination System (NPDES) of the CWA, the permitting system is quite similar, and permits obtained for mining discharge still must comply with relevant regulations established by the NPDES program under section 402; thus the two permitting systems act in concert. See 33 U.S.C. §§ 1342 (establishing the national permitting system) and 1344 (establishing permitting for mining operations). Instead of the administrator of the Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers reviews applications for permits to discharge mining fill material into waterways and the ocean, in conjunction with guidelines established by the EPA. 33 U.S.C. § 1344(d). A plethora of existing regulations cover which materials can be discharged, in what quantity, and the requirements of permitting. See, e.g., 40 C.F.R. § 125.123 (ocean discharge permit requirements); 40 C.F.R. § 228.15 (location of ocean dumping sites); 33 C.F.R. § 323.2 (definitions).

The CWA’s regulation of point source discharges through permitting under section 402 has generally been a success, providing both regulatory certainty for businesses, and a simple way to target and measure sources of pollution. Applied to DSM, a permitting system that covers both exploration and extraction that mimics the NPDES system could be a cornerstone of regulating DSM. Since the DSHMRA already has permitting provisions, including sections for enforcement and monitoring, the statute could direct either the EPA
administrator, NOAA, or the U.S. Army Corps of Engineers to establish extraction criteria and pollutant discharge limits on DSM activities.

Importantly, DSM extraction methods that have been explored work naturally on a NPDES-like permitting system. Whether mining discharge or runoff is a point source largely depends on where one selects their starting point. For example, most scholars believe that the bulk of seabed minerals exist as “nodules”—tiny clumps of minerals that are strewn across the seafloor, or near thermal vents. Sections of seafloor, or each clump itself, could constitute a point source. Alternatively, the extraction methods currently developed involve using long pipes to essentially “vacuum” mineral deposits after excavating them. The CWA defines point sources as pipes, ditches, ships, or smokestacks. See 33 U.S.C. § 1362(14). This would seem to include any pipes conducting mining waste or fill material off-site. Those who engage in DSM need only monitor specific extraction points within their entire operation for emissions, making compliance more cost-effective and predictable.

In cases where DSM extraction generates readily dispersing pollutants, the measurement and monitoring of discharges becomes a challenge. Excavating the seafloor can raise sediments or release processing chemicals that will dissolve or disperse into the ocean during operations—here, the NPDES permitting system would probably fall short. Even if a certain DSM operation could not be treated as a point source, periodic stocktaking of biodiversity, the stability of thermal vents, and water quality could inform regulatory bodies. For example, if an extraction permit awarded to a certain mining entity covered a given surface area “parcel” of seafloor, the company could be held responsible for that parcel as a column of ocean extending from the seafloor to the surface. The company and regulatory bodies would monitor water quality and other indicators of environmental health periodically, and violations could be penalized.

Mining companies are already applying for exploratory permits from NOAA through the DSHMRA. These permits are merely to explore the seabed. Very soon, however, that exploration will result in discovery, and invariably, the prospect of extraction. The nature of deep seabed minerals as localized clumps, or around specific natural structures like thermal vents, coupled with the enclosed pipeline format of underwater excavation and extraction, make treating DSM activities under sections 402 or 404 of the CWA reasonable and effective regulatory choices.

The DSHMRA can provide regulatory coverage to a very large proportion of DSM by drawing from the CWA and implementing a permitting system that has emissions and effluent criteria, extraction limitations, and monitoring requirements or establishes limits on dredged materials. The permit itself will provide the clarity and predictability regulated entities require to engage in DSM while remaining compliant. Regulated entities can use the permit and reapply for expanded extraction periodically, thereby staggering the growth of DSM in lockstep with the ability to regulate and monitor properly. And, just as the CWA charges the EPA administrator with the authority and the responsibility to alter emission criteria and permit requirements as new information becomes available, scientific research that expands our knowledge of the impacts of DSM can inform permitting under the DSHMRA. The flexibility of the CWA would therefore address and protect the sensitivity of biodiversity or environmental systems to deep seabed mining as knowledge of DSM and its impact becomes more broadly available.

Regulatory Concepts from Mining Law

Although the CWA provides very useful templates for regulating DSM, it deals primarily with discharges and runoff—essentially by-products of mining, which are centered on the actual physical extraction of resources. For example, the CWA is not equipped to provide guidance on what constitutes a defined “mine” for DSM purposes; nor does the CWA provide any guidance on mine reclamation or cleanup. These key issues are central to DSM, and a complete regulatory framework under the DSHMRA would include a definition of a deep seabed mine, as well as a procedure for reclamation or cleanup of mined areas.

The nature of deep seabed minerals as localized clumps, or around specific natural structures like thermal vents, coupled with the enclosed pipeline format of underwater excavation and extraction, make treating DSM activities under sections 402 or 404 of the CWA reasonable and effective regulatory choices.

On land, the Surface Mining Control and Reclamation Act (SMCRA) is a comprehensive statute, enacted in 1977, primarily for the purpose of addressing the environmental impacts of coal mining in the United States. 30 U.S.C. § 1201. Because pre-WWII coal mining and strip mining created devastating environmental and public health impacts, the SMCRA has two main pillars: setting mine operating standards, and ensuring that mining sites are cleaned up or reclaimed. 30 U.S.C. § 1265 (environmental operating standards) and 30 U.S.C. § 1258 (reclamation plan requirements). Although these provisions focus almost entirely on coal mining, the principles are cross-applicable to other forms of mining. See 30 U.S.C. § 1201. For example, requiring mining companies to comply with air and water quality laws in each mining site is not dependent on the type of mining conducted, nor are provisions requiring mining companies to submit a reclamation or cleanup strategy along with their permit application.

The SMCRA issues five-year permits for coal mining on federal and non-federal lands. The permit application...
process and requirements, detailed in sections 1256 (permit requirements), 1257 (permit application process), and 1258 (reclamation plan requirements), are comprehensive and require mining companies to account for potential runoff; discharge into water streams; the direction of prevailing winds; and the impacts of mining activity on the land, flora, and fauna; as well as whether the mining activity will destabilize any geological formations. 30 U.S.C. §§ 1256–1258.

The CWA and the SMCRA are two treasure troves of regulatory examples that can be relied upon to address properly the dual challenge of DSM—regulating water and regulating mines. However, sometimes more important than what is regulated is who regulates and how.

Reclamation plans must identify the land subject to mining, its condition prior to mining, what type of use that land could support before mining, and what use is proposed for the land afterward. 30 U.S.C. § 1258(a)(1), (2), (3), and (5). Applicants for a mining permit are required to detail the potential economic output of such land and describe the restoration activities needed to return the land to useable condition after mining operations cease.

Working in tandem with reclamation is the requirement under the SMCRA that all permit applicants post sufficient bond as a guarantee against the costs of reclamation and cleanup, as well as pay into a Reclamation Fund from the profits of their activities. 30 U.S.C. § 1259. The bonding requirement, detailed in section 1259, backed up by the Reclamation Fund, provides a financial "safety net" in case mining companies are unable to pay for the full reclamation of a mining site.

The DSHMRA does not speak to reclamation or to financing cleanup of mining activities. However, both concepts are highly relevant to DSM. Because DSM is necessarily extractive, and its impacts are difficult to gauge, a thoughtful component of DSM regulation would require permit applicants to put forward a strategy for restoring deep seabed mining sites. For example, if a permit covered a certain square mileage area of the sea floor, the company could be made responsible for evaluating the biodiversity and soil and water quality of that area, and for ensuring that those conditions are restored once mining activity has ceased. Because the DSHMRA already has a permitting framework in place (albeit skeletal), 30 U.S.C. §§ 1413–1417, the conditions for permitting can be altered to include a reclamation plan requirement.

The Reclamation Fund and bonding requirement of the SMCRA are key provisions that can be adapted for deep seabed mines. Interestingly, although the DSHMRA did create a fund, that fund was created as a trust for money to be used toward the United States' obligations under a potential international treaty for DSM. 30 U.S.C. § 1472 (detailing the Deep Seabed Revenue Sharing Trust Fund). When the DSHMRA was enacted, Congress believed it to be a transitional statute that would eventually be displaced by an international treaty. Since then, it is increasingly clear that a treaty covering DSM is not going to be ratified in the short term. Therefore, the DSHMRA's provision on a treaty fund could be repurposed to invest funds for reclamation projects or cleanup of sites. Currently, the SMCRA obtains funds from a fee levied on the revenues of mining companies; the DSHMRA could do something similar, or invest funds from permit application fees, or appropriate funds from elsewhere.

Although the DSHMRA does not speak to bonding, this aspect of surface mining regulation can be easily grafted onto a DSM regulatory framework. The SMCRA's bonding provision has recently come under criticism from environmental advocates because it allowed then-profitable coal companies to rely solely on their financial strength as a guarantee for future ability to pay for reclamation. As history has shown, many of these companies then struggled, and eventually became insolvent. Environmental advocates have called for the elimination of this self-bonding option, to force mining companies to post bond, so that the risk of their insolvency does not prejudice the regulating agency's ability to carry out a cleanup in their stead. See The Alliance for Appalachia, Coal Mining Reclamation: Bonding Policy Recommendations (2018); Jayni Foley Hein et al., Self-Bonding in an Era of Coal Bankruptcy, Institute for Policy Integrity (2016). Applied to DSM, and especially considering the industry's infancy, excising the portion of bonding that allows for self-bonding might be a wise approach. It is possible that mining companies engaging in DSM, many of which may be start-ups, are taking on a financial risk. The DSHMRA would do well to shield the government from the possibility that a deep seabed mine site needs a costly cleanup, but no funds are available to conduct the reclamation.

The SMCRA, which regulates surface mining, addresses two key issues that are unique to all mining: conditioning permitting on a pledge to restore the site mined, and requiring a financial commitment to help fund that reclamation. DSM permits may define sites by surface area or otherwise, but within the confines of a deep seabed mine, there must be regulations in place that address cleanup, reclamation, and how those post-mining activities will be financed. Tasking mining companies with the financial responsibility and the logistical responsibilities of a cleanup encourages private actors to account for the financial risks their extractive activity poses. Additionally, the research these companies will conduct to develop their reclamation plan will aid regulating bodies in understanding how much would be required to reclaim a deep seabed mining site, whether the mining site's metes and bounds have been properly defined, and whether the permit applicant is adequately equipped to deal with the environmental consequences of DSM.
Who Should Regulate?
The CWA and the SMCRA are two treasure troves of regulatory examples that can be relied upon to address properly the dual challenge of DSM—regulating water and regulating mines. However, sometimes more important than what is regulated is who regulates and how. A vastly complex regulatory framework will do very little to provide certainty for regulated entities, and, if that framework is impossible to navigate, accomplish very little in the way of enforcement. Ideally, DSM will be regulated efficiently and transparently, and the authorities involved will not have conflicting jurisdictions that will cause monumental headaches for federal judges tasked with interpreting such regulations.

There are candidates for regulatory authority: the DSHMRA itself grants implementing authority to NOAA, and it is NOAA that was recently sued for issuing a permit. See 30 U.S.C. § 1403(14) (defining Administrator as the Administrator of NOAA); Center for Biodiversity v. Pritzker, No. 15-0723 (D.D.C. May 13, 2015). However, considering Congress’ stated intent that the DSHMRA was to be transitional, it is not clear whether a robust DSHMRA that actually does the job of regulating would be once again entrusted to NOAA for administration.

Provisions taken from the Clean Water Act involve the U.S. Army Corps of Engineers, which evaluates CWA permits for mining projects, and the EPA, which administers the overall permitting system for all industries. See Permit Program under CWA §§ 402 and 404, U.S. Environmental Protection Agency. Complicating matters further, provisions taken from the SMCRA involve the Department of the Interior, which decides where mines can be sited, how much can be extracted, and how reclamation must proceed. See 30 U.S.C. § 1 (establishing the U.S. Bureau of Mines within the authority of the Department of the Interior).

It is possible that one singular agency possesses the requisite expertise, funding, and enforcement power to deal with DSM as a whole. NOAA does not administer permit programs the way the EPA and the U.S. Army Corps of Engineers do; similarly, the EPA may not have as much institutional knowledge regarding coastal, ocean, and deep seabed issues as NOAA might. Tasking just one agency with regulating the entire DSM industry will prove challenging, and may require Congress to give additional powers to that agency, or may force an agency to promulgate wide-ranging rules. Such a move could prove contentious politically, and in the courts, as we have seen with the “Waters of the United States Rule” and the Clean Power Plan Rule.

The allure of creating another agency from scratch, to regulate only deep seabed issues, is arguably outweighed by the goal of not complicating regulation. Perhaps a middle-of-the-road option, one that contemplates a regulatory panel that has representation from the EPA, NOAA, the Department of the Interior, and the U.S. Army Corps of Engineers, would help build consensus around rulemaking and permitting, and would pool resources for monitoring and enforcement.

Developing domestic regulations and laws on DSM while concurrently stepping into the forum of international regulation of DSM will allow the United States to be ready for the industry at home, while shaping that industry globally. We cannot know if the United States will participate in a UN or International Seabed Authority treaty just yet. For now, however, we can look to existing domestic statutes to understand how we might regulate DSM at home. DSM is here, and will grow rapidly. We have the tools and examples to respond with a clear, effective, and environmentally aware regulatory framework—let us use them.

International Considerations
While contemplating a domestic regulatory framework for DSM, the United States will eventually need to make a decision on international DSM. The United Nations and the International Seabed Authority have proposed draft regulations governing DSM in international waters and are allowing nations to obtain exploration contracts and permits in areas such as the Clarion-Clipperton Zone near Hawaii. See Draft Regulations on Exploitation of Mineral Resources in the Area, International Seabed Authority, ISBA Doc. 24/LTC/WP.1/Rev.1 (July 9, 2018); Deep Seabed Minerals Contractors, International Seabed Authority (2019) (listing foreign nation permit holders to explore the Clarion-Clipperton Zone for minerals, including China, the United Kingdom, Belgium, and Germany). These areas of the ocean contain vast resources, resources in which the United States will have or already has a strategic interest.

Perhaps a middle-of-the-road option, one that contemplates a regulatory panel that has representation from the EPA, NOAA, the Department of the Interior, and the U.S. Army Corps of Engineers, would help build consensus around rulemaking and permitting, and would pool resources for monitoring and enforcement.

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How a New Ecological Augmentation Remedy Option Could Advance Superfund Site Closures at Mining-Impacted Sites

Amanda Halter and Ashleigh Acevedo

What to do about mining and metals-related contamination is an increasingly pronounced concern under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), i.e., Superfund, regardless of whether a mine is still in operation, has been closed, or is an orphan mine under the care of the federal government. Plagued by insufficient financing and facing complex risk assessments and remediation decision-making, many such mining sites linger for years without resolution. In addition to their association with several different industrial operations, metals are of course also both naturally occurring and pervasive, making for particularly protracted, complicated, and ambiguous risk assessments outside the Environmental Protection Agency’s (EPA) dominant domain of managing threats to human health.

The quandary is that although many mining-impacted and metals-contaminated sites present little or no real human health concerns that have not already been managed through emergency or interim actions, ecological risks of varying and unclear magnitudes can remain for many years. When it comes to remedy selection for these risks, Superfund practice favors removing or treating contaminants. Office of Solid Waste & Emergency Response, Envtl. Prot. Agency, A Guide to Selecting Superfund Remedial Actions, Directive 9355.0-27FS (Apr. 1990); see 42 U.S.C. § 9621(b)(1) (“Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.”). But in certain sites, these standard responses can be a suboptimal solution—impractical and costly in time, treasure, and environmental impact relative to their potential benefits. Thus, at mine and metals sites where human health risks have been or are otherwise being managed and ecological risk considerations will predominate remedial decision-making, it may be time to break out of the source-control default and consider an additional alternative: an ecological augmentation remedy.

An ecological augmentation remedy is one that focuses on addressing overall ecological health of the site by increasing habitat or ecosystem productivity, rather than by the physical removal or capping of contaminants. At mine and metals sites at which only ecological risks remain, ecological augmentation may present a superior solution to the overall environmental problem when analyzed through the framework of the National Contingency Plan’s (NCP) nine remedy selection criteria. 40 C.F.R. § 300.430(e)(9).

Yet despite the availability of well-established science to support ecological augmentation as a remedy, it is infrequently—if ever—invoked under Superfund, though a variant has been embraced in some state programs, such as Texas’ Risk Reduction rules under the heading of “restoration.” This article evaluates the ability of EPA to adopt a policy that would allow for ecological augmentation under the current remedy-selection framework within CERCLA and its supporting regulations, and thereby address ecological risks at certain mining-impacted and metals-contaminated sites with a more efficient, more environmentally protective alternative.

The purpose of the CERCLA Superfund program was to establish authority and provide a financial vehicle and liability allocation to directly and comprehensively address contamination at sites that pose a real risk to human health and the environment. 42 U.S.C. § 9601. Since its inception, CERCLA has provided the federal government with the authority (through the EPA) to respond to the release or substantial threat of a release of any pollutant or containment that may present an imminent and substantial danger to public health or welfare and respond to a release or substantial threat of a release of a hazardous substance into the environment. Id. § 9604. The overarching purpose of the CERCLA response authority and remedial action provisions is to ensure that human health and the environment are protected. 40 C.F.R. § 300.430(f)(1)(i)(A). CERCLA gives the president (and EPA by delegation) broad authority to do what is “necessary to protect public health or welfare or the environment” 42 U.S.C. § 9604(a)(1).

Thus, Congress had the foresight to provide not only the authority to address public health implications of hazardous substance releases, but also to protect the environment. Unsurprisingly, the context in which CERCLA was created influenced the trajectory of EPA’s response authority. CERCLA arose after the specter of Love Canal in Niagara Falls, New York, where a dream community and school were built over a poorly constructed landfill from which 21,000 tons of chemicals (including dioxins, a carcinogen) were released. In a worst-case scenario, storage drums came to the surface of the landfill, the neighborhood and school ground were filled with...
noxious fumes, and birth defects, illnesses, and elevated white blood cell counts were pervasive throughout the community. After a presidential state of emergency was declared, the community was evacuated. News Release, Env'tl. Prot. Agency, Love Canal Revealed a National Problem; Superfund Provided a Solution: EPA's Superfund Task Force Continues to Ensure Cleanups Remain a Top Priority (Aug. 6, 2019) (referencing the Aug. 7, 1978, presidential federal emergency declaration and May 21, 1980, presidential federal emergency declaration designating the Emergency Declaration area for evacuations). The incident focused the public’s attention on the threat to public health from contaminated sites and the need for a comprehensive system to address them. The threat was humanized. In response, Congress created CERCLA to provide EPA with the authority to investigate, select, and compel remedies primarily to protect humans.

Since the primary focus of CERCLA was human health, at least initially, remedies generally include capping, treating, or removing contaminants, as well as access restrictions, thereby eliminating or minimizing human exposure pathways. Such approaches make sense when the focus is protecting individual humans; however, the assumption that what protects humans can be applied wholesale to the environment is not only anthropocentric, it can also be terribly wrong. That is because invasive remedies like removal and capping can lead to further environmental degradation as habitat is disrupted or destroyed.

And, as the program has evolved, many of the worst sites or portions of sites—i.e., those that present serious human health concerns—have been cleaned up or contained. Thus, resources and focus are shifted to ecological risk. However, that focus shifted without sufficiently adapting perspectives or approaches on remediation alternatives.

Yet human health risk and ecological risk are fundamentally different: whereas, we routinely focus, and should focus, our human health policies on mitigating risks to people, the value of individual ecological resources, i.e., an individual bird, worm, etc., is not one we typically recognize. That is, while we may care deeply about the exposures of an individual person and make remedy decisions accordingly, the exposures of a worm, insect, or benthic macroinvertebrate are simply not, or should not be, decision drivers, at least not without a clearheaded understanding of the ecological trade-offs. Using a human health–focused paradigm to make decisions about ecological risk assessment and remediation has led to protracted assessment processes and invasive remediations that too often provide little, if any, environmental benefit relative to the time and transaction costs involved.

That is, however, to be expected. Unlike impacts to human health, ecological impacts can be far more complex—rather than dealing with one species in a human health analysis, a proper ecological analysis almost always necessitates considering multiple species with sensitivity to varying threshold concentrations. Within the inherent complexity of the food web, ecological impacts can be more difficult to assess and remedy. In that vein, in the early days of CERCLA, significant uncertainty existed as to whether and to what extent damaged natural resources could be restored through what was, at that time, unproven science, and whether public resources could be used for such a purpose.

Consequently, when Congress amended CERCLA with the Superfund Amendments and Reauthorization Act of 1986 (SARA), it cut off access to Superfund funds for assessment of natural resource impacts during damage assessments so that the newly designated Superfund trustees, which excludes EPA, could assess damages and injury to, as well as destruction of or loss of, natural resources and be responsible for the restoration of trust resources injured by an uncontrolled release of hazardous materials. Pub. L. No. 99-499, Oct. 17, 1986, 100 Stat. 1613; 42 U.S.C. §§ 9507(c), 9607. Notably, only funding for natural resource damages assessment was cut off; Congress did not curtail EPA’s mandate to respond in a way to protect both human health and the environment.

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Yet, cutting EPA out of Superfund monies for natural resource damages assessment effectively limited the holistic restoration perspective that more aptly fits ecological risk analysis. In effect, EPA was on one side of a dividing line, primarily focused on human health risks that necessitate cutting off exposures, and natural resource trustees were on the other, looking at ways to restore ecosystem-level damages. As a result, EPA’s purview has not meaningfully expanded to include innovative ecological augmentation-based solutions for minimally contaminated sites. Yet, where human health risks are absent or otherwise managed, such approaches can provide more holistic and efficient ecological risk management strategies than traditional remedies.

Ecological Augmentation Policy: A “New” Tool to Advance Site Remediation and Closure
What is proposed herein is that EPA can and should more holistically utilize ecological concepts and tools by adopting a policy that allows ecological augmentation as a remedy for site cleanup and closure. In some instances, where human health risks are either not present or have been addressed, the optimal response to contamination from an environmental perspective is not contaminant control or removal, but rather directly offsetting the ecological risks at issue through restoration.
or ecological augmentation that would counterbalance the decreases to ecological productivity or habitat degradation associated with the presence of the contaminants at issue.

Substantively, ecological augmentation is akin to restoration. The science of restoration has been well developed already by natural resource agencies in the years since Love Canal. The human-focused perspective on the impacts of hazardous substance releases expanded dramatically with the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. The public observed disturbing images of deceased and harmed wildlife and severely degraded habitat. In the face of public outcry, responsible parties, spent tremendous resources to quantify the damage to natural resources and meaningfully try to understand ecological risks and harms, thus launching modern restoration science. Since the Exxon Valdez incident, restoration has come into maturity as a viable science and methodology. In turn, parties have developed widely accepted eco-econometric tools to determine how much restoration would be required to mitigate a given ecological risk. 43 C.F.R. Part 11.

At certain sites, an ecological augmentation remedy could be a better-suited response action than traditional remediation or could complement traditional remediation in achieving maximum rehabilitation of a contaminated site by allowing, for example, the site to be put back to productive use, such as for fishing, camping, and other recreational opportunities, much more quickly than if a traditional remedy were selected, such as dredging.

EPA can and should utilize this science to identify and scale ecological augmentation remedies that directly address the ecological risks at issue for a given site. Embracing an ecological augmentation remedy policy would allow EPA to approach cleanup and closure at candidate sites more expeditiously and holistically. These sites are generally characterized as those in which the level and type of contamination is such that there is no danger to human health or such dangers have been addressed already; the only existing or remaining effects are to natural resources. The extent of the injury is a loss to productivity of certain receptions within the ecosystem or even to the overall productivity of the system, but the contaminants do not biomagnify such that contaminants are increasing in concentrations in the tissues of organisms as they move up the food chain. Such conditions may occur when human exposures to contaminants have been addressed through removal, treatment, capping, or institutional controls, but some contamination remains that leaves questions about more complex, subtle ecological impacts.

In such circumstances, directly increasing ecological productivity and habitat can be superior to traditional remediation (i.e., removing contaminants) by providing overall net environmental and human use benefits more expeditiously. In other words, at certain sites, an ecological augmentation remedy could be a better-suited response action than traditional remediation or could complement traditional remediation in achieving maximum rehabilitation of a contaminated site by allowing, for example, the site to be put back to productive use, such as for fishing, camping, and other recreational opportunities, much more quickly than if a traditional remedy were selected, such as dredging.

Ecological augmentation also supplants traditional remedial options that can cause further ecological harm. Traditional remediation can involve tremendously invasive and immediately destructive methods to remove contaminants. While these areas may recover ecologically over time, ecological augmentation, at a minimum, can maintain the existing productivity. But when human health risks are not at play and thus do not have to be prioritized, the health and productivity of the ecosystem can be made part of the remedy instead of defaulting to remedies that may be more harmful to the very natural resources intended to be protected than is the contamination itself.

For example, extensive dredging of a water body bottom to remove contaminants can destroy the benthic community, but that same community, or certain species therein, may be affected only marginally by the presence of low-grade contamination. In such instances, it should be considered whether it may be better to leave that contamination in the environment rather than destroy the benthic species residing there, and to instead explore ecological augmentation as a vehicle for offsetting productivity losses.

Moreover, ecological augmentation often offers a much greater value than traditional remediation practices. The return on the investment can be much greater: whereas traditional remediation at candidate sites would require time- and cost-intensive operations for relatively little (and sometimes negative) ecological benefit, an ecological augmentation remedy could be implemented at a much lower cost and much more quickly while enhancing ecosystem services and functionality.

In short, ecological augmentation can provide the following benefits: (1) allow faster cleanups and site closures; (2) return sites to beneficial use more quickly; (3) reduce total spending on CERCLA compliance while achieving similar results; (4) free up resources to be used at sites that pose an imminent threat to human health; (5) protect public health by limiting ecological augmentation to those sites, or portions thereof, that do not have unmanaged human health risks; and (6) shift the cleanup focus from reducing the volume of contaminants to increasing the net benefits to the environment.
Ecological Augmentation at Mining-Impacted and Metals-Contaminated Sites

Ecological augmentation is particularly well suited for mining-impacted and metals-contaminated sites. The reality is that the numerous unresolved mines and metals sites are not massive environmental disasters. They are not characterized by millions of gallons of toxic, yellow-orange wastewater flowing through the Animas River watershed following a mine blowout, as was the Gold King Mine in 2015. See Envtl. Prot. Agency, Emergency Response to August 2015 Release from Gold King Mine, www.epa.gov/goldkingmine. Many mine and metals sites, and sizeable portions thereof, have relatively low-level concentrations of contaminants that, though impactful, are not a threat to human health, or even direct threats to fish and wildlife. Rather, the sites have been sufficiently remediated to address human exposures or several ecological ones, and instead only less obvious and more complex ecological impacts remain. At many of these languishing mine and metals sites, operations ceased long ago, such that minimal, if any, contamination is still being introduced. The contamination that does exist has settled out over the years, so natural attenuation may have at least begun to create marginal gains in addressing some ecological risks, though not enough to close out the site. These sites languish because they cannot practically be prioritized or funded, assessment is unclear, and traditional remedies are impractical. Yet because contamination remains in place, they remain in Superfund limbo—not harmful enough to demand immediate attention and resources, but not innocuous enough to be closed.

At such mine and metals sites, ecological augmentation provides a viable alternative remedy to advance these sites to completion. Rather than continuing to linger for years without resolution, an ecological augmentation remedy would present a tool for addressing the remaining ecological risks relatively quickly, at a much lower cost, and often at a greater overall environmental benefit or less overall environmental harm than would removal of the remaining contamination.

Implementation within the Existing Remedy-Selection Framework

Under the human health risk management paradigm, EPA tends to be geared, and properly so, toward traditional dig, dredge, and cap remedies at most sites, but there is nothing that prevents EPA from embracing ecological augmentation and eco-econometric tools and incorporating them into remedial options analysis and selection when the focus shifts to ecology. In fact, CERCLA contemplates an environmental response that enables EPA to take a holistic vision of site closure by evaluating various factors in the remedy selection decision framework. CERCLA and the NCP provide a framework for remedy selection that does not prescribe the substance of such decisions or an exclusive suite of available decisions, despite the historic default to traditional remedial alternatives. 42 U.S.C. § 9621; 40 C.F.R. § 300.430(e)(9).

Rather, CERCLA requires that in selecting a remedy, EPA consider several criteria that reflect the scope and complexity of the site problems, many of which can be comparatively best achieved through ecological augmentation at candidate sites. 40 C.F.R. § 300.430(e)(9)(ii).

Upon performing the comparative analysis under the NCP, the risks associated with leaving contaminants in place at a candidate site can be shown to outweigh the risks and costs of traditional remedial actions. Moreover, the risks would be addressed more directly or better mitigated by the ecological benefit of restoring some of the functions of the ecosystem that occurred prior to the release. If, for instance, productivity is the potential risk being managed, then productivity can be increased directly through an ecological augmentation remedy. In most instances, it is much less costly and time consuming, and the benefits are more readily apparent to the public when the ecological resources of a site are enhanced than when contaminants, which usually are not visible or causing low-level effects, are removed at typically great expense and disturbance.

Upon performing the comparative analysis under the NCP, the risks associated with leaving contaminants in place at a candidate site can be shown to outweigh the risks and costs of traditional remedial actions.

The statute provides room for the use of ecological augmentation, as appropriate. And, conversely, neither CERCLA nor the NCP preclude EPA from selecting ecological augmentation as a remedy, assuming it emerges as the best alternative for a given sort or portion thereof through the remedy-selection framework. To be clear, this policy approach does not propose that EPA overlap with the work of natural resource trustees in the natural resource damages arena; it simply suggests that the science behind a viable remedial technology that has been well developed by the natural resource trustees can be used to inform EPA’s own cleanup program.

In this way, ecological augmentation provides EPA with a tool to take an overall more efficient and more environmentally— and publicly—beneficial approach when it considers remedial alternatives, consistent with the NCP’s charge to embrace innovative remedial options. See 40 C.F.R. §§ 300.430(a)(1)(iii)(E), (e)(2)(ii), (e)(3). Embracing this remediation tool would allow EPA to mitigate the remaining ecological risks without creating additional ecological damage, and to provide what can, in some circumstances, be a more palatable path forward. In many cases, this will reduce the prejudice toward more intrusive, time-intensive and costly remedies that, although they intend to mitigate some predicted ecological risk, too often do so in an indirect and costly way, and in many instances, end up creating actual ecological injury in the process due to their brute disturbance of the ecosystem. And, on the other hand, ecological augmentation mitigates the public’s (and sometimes EPA’s) reluctance to leave marginally ecologically impactful contamination in place.
Through the creation of the Superfund Task Force and related actions by the EPA, this administration has affirmed its commitment to evolve and improve the Superfund program by expediting closure and getting back to basics of addressing those sites that have languished too long.

To effectuate such a policy, neither statutory nor regulatory changes are necessary. It can be deployed immediately within the current NCP framework. See 40 C.F.R. § 300.430. EPA could adopt guidance embracing ecological augmentation as a remedy choice, and direct site project managers and EPA Regions to consider it as a remedy where site conditions warrant. Further, given the wide availability of mine and metals sites over which the EPA has control—particularly orphan mine sites where remedies are limited given the practicalities of funding remediation—EPA could utilize this option to finally reach closure at those sites, and to use those sites to pilot an ecological augmentation remedy to guide its broader utilization and develop further guidance on use of this tool in remedy selection.

**Opportune Climate for Ecological Augmentation Tool**

Almost since its inception, though it has had many successes, the Superfund program has been afflicted by inefficiency, unpredictability, untenable durations, and extreme cost. Those problems are often exacerbated when it comes to mine sites with less-than-obvious remedies and limited resources. And, with human health risks relatively well understood and expeditiously addressed, too much of EPA’s focus has become scattered across a wide array of sites and situations characterized by diffuse or complex ecological concerns that are distinct from the focus of the original drafters of the Superfund program—those with harsh, blatant impacts to human health. Through this complexity, those sites have been administered by the various EPA Regions in different ways. A side effect has been the diversion of scarce resources away from sites that present predominantly environmental, as opposed to human health, risks. And, for many sites, such as mine sites, where the potential for ecological risk is a dominant consideration, ever-decreasing risk and cleanup standards have led to years and many dollars spent futilely chasing assessment and removal of low levels of contaminants without fulsome cost-benefit analyses.

However, the current era of regulatory reform presents an opportunity to address much of this through the adoption of new policy. The current administration’s EPA has committed to evolving the Superfund program, with its notoriously protracted processes, to return contaminated lands and waters to beneficial public and commercial use more quickly. See, e.g., Envtl. Prot. Agency, Superfund Task Force Recommendations (July 25, 2017). Through the creation of the Superfund Task Force and related actions by the EPA, this administration has affirmed its commitment to evolve and improve the Superfund program by expediting closure and getting back to basics of addressing those sites that have languished too long.

In this moment, EPA can choose to add ecological augmentation to its arsenal of site remediation tools. While EPA’s default is contaminant-removal remedies with the intention to reduce risks to ecological receptors by reducing or eliminating contaminants, ecological augmentation can more directly address the ecological risks perceived to be at issue for a given site—such as reduced productivity, biomass, or increased mortality—by instead directly improving the ecological health of the site.

This policy proposal would further strengthen the Superfund program by refocusing on the EPA and Superfund program’s core mission: protecting both human health and the environment. At the same time, this approach helps reach closure, but does not compromise the effectiveness of the Superfund program. This could reduce the total number of sites the EPA is dealing with by more expeditiously reducing risks to human health and the environment, closing sites that primarily implicate ecological effects, and accelerating the reuse of properties whose natural resources were affected by hazardous substance contamination, allowing EPA to focus on the sites that present substantial problems to public health and the environment.

More specifically, this policy proposal provides EPA and responsible parties a greater opportunity to address mine and metals sites that have lingered without resolution for decades. While it may not be a remedy for all mine or metals sites in the United States, it certainly can provide a viable solution to advance several toward closure. And, rather than continuing to maintain mining-impacted and metals-contaminated sites with only ecological risks under the auspices of the Superfund program for another decade or more, ecological augmentation provides EPA and responsible parties a means to address ecological assessment and remediation holistically and relatively quickly. Thus, greater focus and resources can be devoted to those sites that present real problems to public health and the environment.

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Melting Ice and Deep Waters: The United States and Deep Seabed Mining in the Arctic

Ekrem Korkut and Lara B. Fowler

On August 2, 2007, Russia used a submarine to plant its flag on the bottom of the Arctic Ocean. The goal of this symbolic move was to lay a claim to the potential oil, gas, and minerals below the Arctic ice. The Arctic contains significant amounts of minerals and hydrocarbons, including an estimated 90 billion barrels of oil and 44 billion barrels of natural gas, long protected by ice. However, the Arctic region is now warming twice as fast compared to tropical regions, resulting in less formation of ice during cold periods, faster melting, and an overall reduction in sea ice. The right to access and harvest such minerals and hydrocarbons depends both on customary international law and the 1982 United Nations Convention on the Law of the Sea (UNCLOS or the Convention), Dec. 10, 1982, 1833 U.N.T.S. 397, art. 76. The race among nations to access what may be found on and under the seabed is significant and more fraught for the United States because it has not become a signatory to UNCLOS.

As the ice melts, the desire to maximize certainty regarding its rights under the Arctic Ocean may provide the impetus needed for the United States to become a party to UNCLOS. This is particularly true as UNCLOS does not allow non-UNCLOS parties to explore or exploit the “Area,” the area beyond any country's individual jurisdiction. Id. at art. 153. The Area is believed to have abundant mineral and hydrocarbon resources. However, as a non-state party, the United States is prohibited from any mining activities on the deep seabed in the Area. Although the Arctic Ocean does not necessarily need to be open to mining, ensuring the certainty of U.S. rights can be better achieved by signing UNCLOS, which in turn provides the United States a voice in the Arctic governance for mining activities and potential protection of the environment.

The United Nations adopted UNCLOS in 1982 to delineate different countries’ jurisdiction over coastal waters to the high seas. UNCLOS entered into force in 1994 after 60 countries ratified it. The Convention establishes a legal order for the oceans and seas by providing sovereign rights for coastal states over coastal zones. UNCLOS also promotes the peaceful uses of the seas and oceans, efficient utilization of resources, conservation of living resources, and protection and preservation of the marine environment.

While the United States has significant coastal and maritime interests, it has never acceded to UNCLOS. Reasons why include its dissatisfaction with being subject to the authority of organizations created by the UNCLOS, e.g., the International Seabed Authority. UNCLOS opponents are also against its payment provisions. These provisions require a coastal state to make payments or contributions to an entity known as “the Authority” set up to collect revenues derived from exploitation of resources beyond the 200 nautical mile (nm) continental shelf limit. Id. at art. 82. However, the United States is already observing this obligation, as discussed below. UNCLOS opponents also argue that ratifying UNCLOS would subject the United States to international lawsuits due to obligations that might arise. Regardless of the reason, failure of the United States to become a signatory becomes more pressing as the deep seabed under the melting Arctic becomes increasingly accessible.

The rights and opportunities afforded to a signatory country under UNCLOS depend on the distance from the coastline. UNCLOS uses a sectoral approach, dividing maritime areas of a coastal state as territorial sea, contiguous zone, exclusive economic zone, and high seas. The territorial sea extends up to 12 nm from the low-water line of a coastal state, or the baseline. Id. at art. 3. The coastal state’s sovereignty extends to the seabed, subsoil, and air space of the territorial sea. At the same time, all states have the right of innocent passage through a coastal state’s territorial sea. Beyond the territorial sea, a contiguous zone allows the coastal state to exercise its control in order to “a) prevent infringement of its customs, fiscals, immigration or sanitary laws and regulations within its territory and territorial sea; and b) punish infringement of the above laws and regulations committed within its territory or territorial sea.” Id. at art. 33. A contiguous zone may not extend beyond 24 nm from the baseline.

An exclusive economic zone (EEZ) provides coastal states with sovereign rights to explore and exploit, conserve, and manage living and non-living resources of the water column and of the seabed and subsoil and carry out other economic activities in the zone up to 200 nm from the baseline. Id. at art. 56(1)(a). Coastal states maintain freedom of navigation and of over flight, as well as freedom to lay pipelines and cables, throughout their EEZ. The high seas constitute sea areas beyond the exclusive economic zone, territorial sea, and internal waters of a coastal state. Id. at art. 86. On the high seas, states enjoy the freedom of the high seas including freedom of navigation, freedom of overflight, and freedom of fishing. No state may appropriate any part of the high seas.

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UNCLOS, supra, art. 89. In turn, understanding where the Area or deep seabed begins depends on understanding where the continental shelf of a coastal state ends.

The Extended Continental Shelf

A coastal state has sovereign rights over its continental shelf for the purpose of exploring and exploiting its natural resources. Id. at art. 77(1). The continental shelf is the seabed and subsoil beyond the territorial sea of a state, which extends at least 200 nm from the baseline and sometimes more depending on the circumstances. Id. at note 1, art. 76(1). However, such extension either may not be longer than 350 nm from the baseline, or may not exceed 100 nm from the 2,500-meter isobaths (which are lines connecting points of the same depth below the surface of the water). Id. at note 1, art. 76(6). If the second method is used, a continental shelf may be longer than 350 nm from the baselines.

The outer continental shelf may not extend beyond 350 nm from the baseline if there are submarine ridges; however, this limitation does not apply in case of submarine elevations “that are natural components of the continental margin such as plateaus, rises, caps, banks and spurs.” Id. at art. 76(6). For example, Russia claims that the Lomonosov Ridge and the Mendeleev Ridge on its continental shelf in the Arctic Ocean are submarine elevations; this claim would allow Russia to extend its continental shelf beyond 350 nm. UNCLOS does not define submarine ridges or submarine elevations but rather provides examples for submarine elevations. Some commentators explain the difference between submarine ridges, submarine elevations, and ocean ridges as follows:

Clearly, both kinds of structures—submarine ridges as well as submarine elevations—have to be parts of the continental margin and as such genetically linked to it; if this would not be given, the underwater elevation would constitute an oceanic ridge. Against this background, it seems that the only manageable criterion is the geological continuity of the sea-floor high, throughout its entire extent, with the landmass of the coastal State. In this respect, to ask whether the seafloor high in question belongs to the same continental plate (then: natural component) or not (e.g., in the case of volcanic activities; then: submarine ridge) might serve as an indicator. A submarine ridge would, thus, be a structure genetically and morphologically linked with the continental margin at its landward side, but which shares geological characteristics with the deep sea-bed along part or all of its length in the seaward direction.

Alexander Proelss & Till Müller, *The Legal Regime of the Arctic Ocean*, 68 Heidelberg J. of Int. L. 651, 667 (2008). These complex definitions define who can access and/or control access to the seabed and whatever may be under it.

**The Uncertainty Surrounding the U.S. Continental Shelf**

Coastal states that are not parties to UNCLOS, such as the United States, can still claim an extended continental shelf under customary international law but with much less certainty than if they acceded to UNCLOS. Coastal states claiming an extended continental shelf must submit relevant information and data to the Commission on the Limits of the Continental Shelf (CLCS). See UNCLOS, Annex II, art. 4. CLCS recommends delineation of the continental shelf; each coastal state then establishes its outer continental shelf limits based on these recommendations, which makes the limits “final and binding.” UNCLOS, supra, art. 76(8). Annex II, Article 3 allows all coastal states to submit its extended continental shelf claims to the CLCS. Because of this, the United States can submit its extended continental shelf claims to the CLCS without being a party. See Kevin A. Baumert, *The Outer Limits of the Continental Shelf under Customary International Law*, 111 Am. J. of Int. Law 827, 866 (2017). Nevertheless, American oil companies support the ratification of UNCLOS because it will allow them to secure their bids in the outer continental shelf and the seabed area. Becoming a party would maximize legal certainty regarding the United States’ rights in the Arctic continental shelf and seabed.

Despite not being a party, the United States has made statements and taken actions regarding the continental shelf that are consistent with UNCLOS. On November 17, 1987, the United States declared that if it were to accede to UNCLOS, it would use Article 76 (1–7) of UNCLOS to designate its outer continental shelf claims. See “United States Policy Governing the Continental Shelf of the United States of America,” reprinted in J.A. Roach & R.W. Smith, *Excessive Maritime Claims* 189 (3d ed. 2012). The United States is also collecting information through a study conducted by the U.S. Extended Continental Shelf Project (ECS) in accordance with technical methods established in UNCLOS Article 76.

Moreover, the United States has committed to making payments to further its claim to the extended continental shelf. States with an extended continental shelf are required to make payments to the International Seabed Authority (ISBA or Authority) based on the revenues derived from mineral resource exploitation beyond 200 nautical miles. UNCLOS, supra, art. 82. The Convention does not differentiate between...
the payment obligation between state or non-state parties to UNCLOS. As a non-state party to UNCLOS, the United States is required to make payment for its exploitation activities on its extended continental shelf. In fact, the U.S. government has already stipulated this royalty payment requirement in its calls for bids for exploitation of its continental shelf beyond 200 nm. See Bureau of Ocean and Energy Management, Gulf of Mexico, Oil and Gas Lease Sale 249, Stipulation No. 6, (2017), at 12.

At least one commentator argues that the United States does not have to ratify UNCLOS to exploit resources of its extended continental shelf. Steven Groves, U.N. Convention on the Law of the Sea Erodes U.S. Sovereignty over U.S. Extended Continental Shelf, Heritage Foundation Backgrounder, No. 2561 (June 8, 2011). He opines that the United States can demarcate its extended continental shelf through presidential proclamations, acts of Congress, and agreements with neighboring states. Id. As an example, he cites the agreement between the United States and Mexico that divided the extended continental shelves (ECS) between these countries in the area known as the “Western Gap.” The United States has subsequently licensed national and foreign companies to exploit resources within its ECS. Id. However, this argument may be subject to challenge because the Mexican outer continental shelf claim in the Western Gap had already been submitted to the CLCS and Mexico adopted the commission’s recommendations. See James W. Houck, The Opportunity Costs of Ignoring the Law of the Sea, Arctic Hoover Institution, Stanford University (2013).

It is not certain that the United States will always be able to conclude agreements with neighboring countries. Indeed, the United States has an outstanding maritime delimitation dispute with Canada in the Beaufort Sea and one with Russia in the Bering Strait. In the meantime, by not acceding to UNCLOS, the United States risks its claims being challenged by UNCLOS parties in the Arctic Ocean. To defend and strengthen its claims in the division of the Arctic maritime areas and resources, the United States would be well-served by acceding to UNCLOS.

**Claims to the Outer Continental Shelf in the Arctic**

The United States, Russia, Canada, Norway, and Denmark have all asserted both symbolic and actual claims to the outer continental shelf in the Arctic, with the U.S. continental shelf in the Arctic potentially extending 600 miles from the Alaskan baseline. Houck, supra, at 8. As noted at the beginning of this article, a Russian Arctic researcher planted a flag in the Arctic seabed in 2007 to show Russian claims over the Lomonosov Ridge and the North Pole. Other Arctic countries condemned this action because it had no basis in international law.

In addition to this symbolic claim, several Arctic states have already submitted their formal claims to CLCS in the Arctic Ocean. For example, Russia submitted its first outer continental shelf claim to the CLCS on December 20, 2001. The CLCS required Russia to revise its submission regarding its extended continental shelf in the Arctic Ocean, and Russia submitted a partially revised claim to the CLCS on August 3, 2015. According to Russia, the Lomonosov Ridge and the Mendeleev Ridge are part of the Russian continental margin and are submarine elevations, not submarine ridges; therefore, its continental shelf may extend beyond 350 nm from the baselines. As noted before, however, these ridges are treated as submarine ridges, not submarine elevations, which may affect the outcome of these claims. See Proelss & Müller, supra, at 668.

Norway submitted its outer continental shelf claim for the Arctic Ocean on November 27, 2006. On March 27, 2009, the CLCS recognized the Norwegian outer continental shelf claim for the Barents Sea Loophole and the Western Nansen Basin. Third in line, Denmark submitted its outer continental shelf claims for the Arctic to the CLCS on November 26, 2013, and December 15, 2014. This submission is still under review by the CLCS. Finally, Canada submitted preliminary information to the CLCS for its outer continental shelf claim in the Atlantic on December 6, 2013, the deadline for Canada to submit its outer continental shelf claims. By submitting preliminary information, Canada had reserved its right to submit an outer continental shelf claim for the Arctic to the CLCS on a later date. On May 23, 2019, Canada finally filed its submission regarding the Arctic Ocean. To date, the United States has not submitted a formal claim despite asserting its rights to do so.

**The Deep Seabed or the “Area” beyond the Continental Shelf**

The seabed and ocean floor and subsoil beyond the limits of the continental shelf or extended continental shelf is the deep seabed or the “Area.” UNCLOS, supra, art. 1(1). The area includes hydrocarbon and critical resources such as polymetallic nodules, cobalt-rich ferromanganese crusts, and polymetallic sulphides. The deep seabed regime or the Area is regulated under Part XI and Annex III of UNCLOS. In 1994, 12 years after UNCLOS was concluded, UNCLOS, Part XI was modified by the Agreement Relating the Implementation of Part XI [hereinafter 1994 Agreement]. See Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, July 28, 1994, 1836 U.N.T.S. 3. The deep seabed regime is limited to mineral resources, excluding living and genetic resources of the seabed. Article 136 defines the Area and its resources as the “common heritage of mankind.” Article 137 prohibits sovereignty over the Area and its resources and designates the “Authority” as the acting body of the Area on behalf of humankind. Signatory parties organize and control the activities in the Area, “particularly with a view to administering the resources of the area” through the International Seabed Authority (ISBA). UNCLOS, supra, art. 157(1).

The principal organs of the ISBA are the Assembly, the Council, and the Secretariat. A party to UNCLOS is an ipso facto member of the ISBA and consequently of the Assembly. Id. at art. 156(2). As of 2019, there are 168 parties to UNCLOS, including the European Union. Therefore, the Assembly has 168 members. The Enterprise is the mining arm of the ISBA and carries out mining activities on behalf of the ISBA. The Legal and Technical Commission and the Finance Committee are the specialized bodies of the ISBA.

The Council of the Seabed Authority enforces UNCLOS provisions relating the seabed on “all questions and matters within the competence of the Authority” and it “invites the attention of the Assembly to cases of non-compliance.” UNCLOS, supra, art. 162(2)(a). Similarly, the Council has...
the power to “issue emergency orders, which may include orders for the suspension or adjustment of operations, to prevent serious harm to the marine environment arising out of activities in the Area.” Id. at art. 162(2)(w). According to Article 140, “activities in the area shall . . . be carried out for the benefit of mankind as a whole.”; the Authority would share the financial and economic benefits derived from activities in the Area between States in an equitable manner. According to Article 185(1), “a State party which has grossly and persistently violated the provisions of this Part may be suspended from the exercise of the rights and privileges of membership by the Assembly upon the recommendation of the Council.”

Because it has not acceded to UNCLOS, the United States is in a more vulnerable position in asserting its claims to the Area than if it were a party.

After the UN adopted UNCLOS, industrialized states opposed Part IX, which risked its successful ratification. Without industrialized nations ratifying UNCLOS, the new regime would be ineffective, and the significant cost of maintaining UNCLOS institutions would be borne by developing countries. The main concern of the industrialized states was the substantial numerical advantage of developing states in the governing bodies. See Donald R. Rothwell & Tim Stephens, The International Law of the Sea (2d ed. 2016), at 130. Specifically, the United States raised numerous concerns including preferential treatment for the Enterprise, the mandatory transfer of mining technology, production limitations that benefited onshore producers, no guaranteed U.S. representation on the ISBA council, revenue sharing obligations attaching to contractors, and the absence of protection for investors already exploring the Area. A final act with two resolutions was adopted in the conference to address the concerns of the developed nations and the United States. Resolution I established a preparatory commission responsible for establishing the ISBA and its rules and procedures. The preparatory commission was also tasked with giving effect to Resolution II, which protected pioneer investors that had already made a substantial investment for seabed mining.

In July 1994, the UN General Assembly adopted the Agreement Relating to the Implementation of Part XI of UNCLOS under the Resolution 48/263. One hundred and twenty-one states voted in favor of the resolution, including the United States; there were only seven abstentions.

The 1994 agreement and UNCLOS are to be applied as single instrument; where there is any inconsistency between them, the 1994 Agreement prevails. The Agreement made the operation of ISBA cost effective. Any advantage provided to the Enterprise has been abolished, and the Enterprise has been put an equal footing with any contractors. Moreover, technology transfer was no longer mandatory; if the Enterprise or a developing state was not able to obtain the technology from the open market, the ISBA would be able to request a state-sponsored contractor to facilitate the acquisition of the technology by the Enterprise or by a developing state. Annex § 3(15)(a) of the Agreement guaranteed a seat for the United States if it acceded to UNCLOS. These changes in general addressed the U.S. concerns about the seabed provisions in UNCLOS.

Because it has not acceded to UNCLOS, the United States is in a more vulnerable position in asserting its claims to the Area than if it were a party. Article 153(2) restricts exploration and exploitation activities in the Area only to the Enterprise or state parties (or their nationals). As a non-party, the United States may not engage in activities in the Area or sponsor its nationals to do so. Some argue that because the United States is not a party to UNCLOS, it may not be subject to the limitation for mining in the seabed area as stipulated in Article 153(2). This position cannot be correct. The 1994 Agreement, as explained above, complements and, if there is inconsistency, replaces UNCLOS. The 1994 Agreement has replaced neither the “common heritage of mankind” doctrine nor Article 153(2). Aware of these provisions, the United States voted in favor of the 1994 Agreement, although it has yet to ratify it. Under Article 18 of the Vienna Convention on Law of Treaties, once a state signs a treaty, it has an obligation not to act against the object and purpose of the treaty. See Houck, supra, at 18. If the United States were to engage in seabed activities without acceding to UNCLOS and 1994 Agreement, it would be in violation of the 1994 Agreement.

Furthermore, given that UNCLOS has been ratified by 168 parties, most of its provisions are accepted as customary international law. The statute of International Court of Justice defines customary international law as “evidence of a general practice accepted as law.” See Statute of the International Court of Justice, art. 38(1)(b), June 26, 1945, 8 U.N.T.S. 993. This definition consists of two components: state practice and opinio juris. State practice is the indication of how states behave in a particular situation. On the other hand, opinio juris requires that such state practice is “rendered obligatory by the existence of a rule of law requiring it.” See Continental Shelf (Fed. Rep. of Ger. v. Den.; Fed. Rep. of Ger. v. Neth.), Judgment, 1969 I.C.J. Rep. 3, 44 ¶ 77 (Feb. 20). The opinio juris is a subjective element, i.e., “the states concerned must therefore feel that they are conforming to what amounts to a legal obligation.” Id. However, under the persistent objector rule, a state that persistently objects to a rule of customary international law from its formation may not be deemed bound by that rule. See Oludemi Elias, Persistent Objector, Oxford Pub. Int’l L. (Sept. 2006). When voting in favor of the 1994 Agreement, the United States never raised an objection to the prohibition on non-states parties regarding seabed activities. On too many occasions, the United States also indicated that it accepts most of the provisions of UNCLOS as customary international law. All these factors, in turn, might be used as evidence that seabed mining provisions are binding on the United States as customary international law. Houck, supra, at 18; Baumert, supra, at 852, 857. Therefore, the United States must accede to UNCLOS in order to have a voice in Arctic seabed mining.
Spotlight on Cavern Closure: The European Approach to a Pressing Issue in the Underground Gas Storage Market

Martin Hamer and Johann-Frederik Schuldtt

The underground gas storage (UGS) industry is an increasingly important industry sector in Europe. The total working volume of stored gas within the European Union (EU) in the year 2018 amounted to approximately 1,131 terawatt hours (TWh). European Commission, DG Energy, 11 Quarterly Report—Energy on European Gas Markets 16 (2018) [hereinafter European Commission, Quarterly Report]. Among the EU Member States, Germany has the largest working gas volume with 232,74 TWh. Jerzy Stopa & Piotr Kosowski, Underground Gas Storage in Europe—Energy Safety and Its Cost (July 2018) [hereinafter Stopa & Kosowski, Underground Gas Storage]. Other critical UGS countries in the EU are the Netherlands, the United Kingdom, Austria, and France. The main purpose of UGS facilities is to provide a quantity of gas that can be used to satisfy daily or seasonal peaks in consumption. In this sense, UGS facilities have a market-stabilizing function.

Furthermore, UGS facilities are of increasing strategic importance stemming from their function in securing the energy supply in the EU. Net gas imports to the EU amounted to 363 billion cubic meters in 2018 and covered 77 percent of total gas consumption in the EU. European Commission, Quarterly Report, at 13. Total gas imports by the EU rose by 8 percent in 2018. In Germany, for example, where natural gas is the second most important energy source comprising 23.8 percent of the country’s energy mix, around 93 percent of the natural gas had to be imported. Untertage-Gaspeicherung in Deutschland (Underground gas storage in Germany), Erdöl, Erdgas, Kohle (Oil, Natural Gas, Coal), 134 Jg. 2018 Heft 11, 410 [hereinafter Untertage-Gaspeicherung in Deutschland]. The scope of these imports is not exceptional in the EU. Indeed, only Denmark and the Netherlands produce more gas than they consume. Despite this high dependence on gas imports, the source of the European gas supply is dominated by only a handful of countries: Russia, Norway, Algeria, and Libya. Stopa & Kosowski, Underground Gas Storage, at 5. Due to the limited political stability in these countries (except for Norway), the gas supply to the EU is not immune to political turmoil and therefore at times may be insecure. The gas quantities stored in UGS facilities are used to balance out potential shortages in the gas supply resulting from such political turmoil. Particularly with a view to Russia, the strategic importance of UGS has grown in recent years.

Despite the growing political and economic significance of the UGS industry, many UGS facilities from a technical standpoint are starting to reach the end of their useful life. Many facilities were constructed 50 to 60 years ago, and the technical elements used in the construction of these facilities have reached the outer limits of durability. Several UGS facilities therefore will need to be closed soon. For this reason, a much-discussed question is which regulatory requirements apply to the closure of such facilities (yet there are currently no EU regulations for UGS facilities). Given the EU’s rather broad competencies in the energy and environmental fields, this is rather surprising. In the absence of EU regulations, the closure of UGS facilities is only regulated on the EU Member State level. Outlining the regulatory requirements applicable to the closure of UGS facilities in Germany, the Netherlands and the United Kingdom illustrate three different approaches to the closure issue. These approaches may serve as a model for the EU and, eventually, for regulators on the other side of the Atlantic.

There are two different types of UGS facilities in Europe: aquifers and caverns. Aquifers are porous reservoir rock formations that are created by natural processes. Caverns are human-made cavities that are created underground, usually in salt rock formations. In Germany, for example, approximately two thirds of the UGS facilities are caverns and one third are aquifers. Untertage-Gaspeicherung in Deutschland, at 414. Caverns are more common than aquifers because caverns react more quickly to changes in gas flow rates than aquifers. This makes caverns better suited to fulfill gas supply functions.

In previous years, the UGS industry has developed a technical concept to implement the closure of UGS facilities. While the specifics of implementation depend on a variety of characteristics (i.e., temperature, pressure, and material of the concrete in the UGS facility to be closed down as well as on the geological and physical conditions of the facility’s location), the following five basic steps are currently state-of-the-art for the implementation of closure: (1) complete removal of the stored gas from the UGS facility; (2) filling of the cavity with brine or water; (3) dismantling and removal of all technical elements (e.g., casing, tubing) from the storage well; (4) a waiting period to achieve a temperature balance between the liquid filled into the cavity and the rock formation surrounding the cavity, accompanied by regular measurements; and (5) permanent closure of the UGS facility by filling it with cement.

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the closure of underground gas storage facilities in Germany], Working Paper, 2 et seq.

The first three steps of the closure process usually take around 18 months. The duration of the fourth step (the waiting period) varies from facility to facility. It can last at least 10 years, but may also be significantly longer. The closure process is reversible up to and including step four. Once step five (permanent closure) is implemented, the closure is irreversible and reactivation of the facility is no longer possible.

After the technical implementation of the closure, the post-closure care period begins. During this period, monitoring measures are carried out. The closure process is subject to certain physical influence factors, particularly due to the temperature and pressure changes in the UGS facility. These factors may cause aboveground deformations and subsidence of the ground. This type of activity can impair buildings and infrastructure facilities such as roads or railway tracks. Furthermore, contamination due to salting of water-bearing layers in the ground may also occur. These impacts can be mitigated, but not fully excluded, by monitoring and taking precautionary measures.

Legal Framework in Germany
As the largest UGS market in Europe, Germany has promulgated a variety of laws relevant to the closure of UGS facilities. The most important law applicable to the closure is the Bundesberggesetz [BBergG] [Federal Mining Act], Aug. 13, 1980, Bundesgesetzblatt I (BGBl. I), 1310, as amended, which was enacted by the German parliament. The main objective of the BBergG is to regulate the exploration and extraction of raw materials. However, the BBergG also includes UGS facilities in its scope of application. The BBergG stipulates two key requirements for UGS facilities: a permit for the construction and operation of UGS facilities; and a permit for the closure of such facilities. BBergG § 126, para. 1 in conjunction with BBergG § 52 and § 53.

The closure permit is defined in the BBergG as the “closure plan.” BBergG § 53. The closure plan must be provided by the UGS operator and approved by the mining authority. BBergG § 53. The closure plan must be implemented as approved by the operator. The purpose of the closure plan is to ensure that the public is not harmed by the closure. Reinhart Piens, Hans-Wolfgang Schulte, Stephan Graf Vitzthum, Bundesberggesetz [Federal Mining Act], 267 (2d ed. 2013) (Ger.) [hereinafter Piens/Schulte/Graf Vitzthum, BBergG]. For this reason, a closure plan will only be approved if it provides for precautionary measures necessary to avoid dangers to life, health, and the property of third parties. In addition, according to the BBergG, the closure plan must include provisions that ensure an adequate protection of the surface and the proper disposal of waste resulting from the closure. BBergG § 55, para. 1, no. 5. Finally, the closure plan must stipulate measures that enable the rehabilitation of the surface around the former UGS operation. BBergG § 55, para. 2, no. 2.

It should be noted that when deciding whether to approve the closure plan, the mining authority also reviews how the closure will impact other public interests. In this context, the mining authority must review the closure’s compliance with soil protection law, nature preservation law, waste law, and water law. Piens/Schulte/Graf Vitzthum, BBergG, 198 et seq.

To carry out this purpose, the mining authority will usually consult with the other public authorities responsible for the implementation of the environmental laws (e.g., the waste authority or the water authority). The main instruments to ensure compliance with these laws are so-called auxiliary provisions (Nebenbestimmungen), which are included in the closure plan. These provisions have the same effect as public orders and place the UGS operator under a public law obligation to take the measures stipulated in the auxiliary provision.

Under BBergG § 56, para. 2, the mining authorities may also require UGS operators to provide financial securities. The financial securities serve to ensure that the mining authority can cover the costs arising from the implementation of the obligations laid down in the closure plan if the UGS operator does not or is unable to fulfill these obligations on its own. In practice, mainly bank guarantees are used as financial securities. Given the range of potential environmental damage scenarios that may result from UGS closures, it can be expected that the financial securities instrument will become more important in the future.

In addition to the stipulations of the Federal Mining Act, the German federal states have issued a variety of ordinances that regulate the procedural and technical requirements applicable to UGS facilities—e.g., the Bergverordnung für Tiefbohrungen, Untergrundspeicher und für die Gunning von Bodenschätzen durch Bohrungen im Land Niedersachsen [Mining Ordinance for Deep Drilling in the State of Lower Saxony], Sept. 20, 2006, Niedersächsisches Gesetz-und Verordnungsblatt, 887. These regulations differ from federal state to federal state, and they contain very few precautionary stipulations regarding the closure of UGS facilities.

The stipulations of the BBergG and the mining regulations are enforced by the mining authorities of the federal states. Due to the geographical location of the UGS facilities in Germany, the mining authorities of Lower Saxony, North Rhine-Westphalia, and Saxony are most relevant. In addition, the mining authorities usually publish administrative guidelines. These guidelines do not have a binding effect on UGS operators and citizens (since they technically are not legislation), but they must be followed by the mining authorities, and the mining authorities cannot arbitrarily deviate from the adopted administrative guidelines. P. Stelkens, H.J. Bonk, M. Sachs, & H. Schmitz, eds., Verwaltungsverfahrensgesetz [Administrative Procedure Act], § 40, no. 124 et seq. (9th ed. 2018). Therefore, in principle, cavern operators have a legally enforceable claim to be treated by the mining authorities as provided for in the administrative guidelines. For this reason, administrative guidelines are highly relevant to the application of the mining regulations in individual cases. However, to date, administrative guidelines regarding the closure of UGS facilities have not been established.

Supervisory Control and Limits to Liability
The operators of UGS facilities in Germany are subject to a special type of control by the mining authorities—the so-called mining supervision (Bergaufsicht). As part of their supervisory powers, the mining authorities can oblige the UGS operators to supply information and documents, enter and inspect the UGS operators’ business premises, and issue administrative orders requiring the UGS operators to comply with specific obligations under mining law, BBergG § 70 and § 71.
Due to these far-reaching supervisory powers, a key practical question is when the mining supervision will end. The Federal Mining Act stipulates two cumulative conditions that must be met for the mining supervision to end. First, the closure plan must have been completely implemented. This requires that the UGS operator fulfill all obligations as set out in the closure plan. Second, there must be sufficient assurance that the UGS facility cannot endanger third parties or cause damage to the public. Piens/Schulte/Graf Vitzthum, BBergG, 746 et seq. The mining authorities assess this second requirement based on a risk assessment that is conducted, inter alia, by resorting to technical and scientific evaluations. In the risk assessment, interests such as soil and groundwater conservation as well as nature protection also must be considered by the mining authorities. Courts have held that the threshold for the end of the mining supervision must not be set too high. Bundesverwaltungsgericht [BVerwG] [Federal Administrative Court], Nov. 9, 1995, BVerwGE 100, 31. Therefore, minor impairments (such as impairments to the soil) due to the closure of the UGS facility are not sufficient legal grounds to delay the end of mining supervision. If the two conditions are met, the mining supervision ends ipso jure—that is, no further decision of a mining authority or any other state body is required for the mining supervision to end. However, particularly due to the risk assessment, in many cases there is legal uncertainty as to whether the two conditions are met or not. It may therefore be advisable for the UGS operator to have a mining authority confirm the end of the mining supervision in a formal decision.

Regarding liability, German law draws a fundamental distinction between two different types of liability: public law liability and civil law liability. Public law liability means the liability vis-à-vis public authorities, i.e., the power of public authorities to oblige private parties (e.g., UGS operators) to take or omit certain actions by means of a public order. In contrast, civil law liability means the liability of private parties vis-à-vis other private parties in the event of damage.

As mentioned, public law liability extends until the end of the mining supervision. But even after the end of the mining supervision, UGS operators are not exempted from public law liability. Only their liability under mining law ceases; the UGS operators remain liable under the general police laws of the federal state in which they operate the UGS facility. Under these police laws, any person or legal entity can be held liable by the public authority to eliminate imminent dangers that they have caused. Boldt et al., Bundesberggesetz [Federal Mining Act], §89 et seq. (2d ed. 2016). For UGS operators, this means that in principle they can be required by the competent police authority to eliminate dangers stemming from the site or cavity of the UGS facility they used to operate even after the closure of that UGS. However, there is a rather high threshold for the public authority to be able to oblige the operator in this way because only an imminent, concrete danger to private interests or the general public suffices. For this criterion to be satisfied, the courts demand that there must be a sufficient probability that damage will occur (e.g., Verwaltungsgericht Würzburg [VG] [Administrative Trial Court], June 14, 2019, juris, W5 K 15.1109).

In principle, the UGS operator's public law liability is unlimited in both a temporal sense and a corporate sense. However, in our opinion the public law liability of UGS operators should be limited by the so-called principle of proportionality. Proportionality is a fundamental principle of German public law, which is also acknowledged by German courts in the area of mining and environmental law. The principle of proportionality provides that any state action that encroaches upon the rights of individuals or businesses must be proportionate, which essentially means that the impairments stemming from the state action must be justified in the light of the pursued state action objective. In the so-called Meggen case, the Federal Administrative Court held that the public law liability of mining companies is limited by the principle of proportionality. BVerwG, judgment of Dec.18, 2014, BVerwGE 151, 56. In our opinion, this ruling must be applied to UGS facilities as well and in concrete terms such that the mining authorities can only order monitoring measures in the post-closure care phase to the extent that these measures do not lead to disproportionate burdens for the UGS operator. The point at which the threshold of disproportionality is reached can only be assessed on a case-by-case basis. Relevant criteria for this assessment include the responsibility of the operator for the damage, the predictability of the damage, and the level of compliance with the current engineering standards for the closure of UGS facilities.

Regarding the topic of public law liability, there also arises a question as to when a UGS operator can liquidate the legal entity that had operated the UGS facility after it has been closed. This question is of high practical importance since after liquidation the operating company can no longer be held liable by public authorities (since it does not exist anymore). While there is no clear jurisprudence on this issue yet, a liquidation most likely will be precluded if the company still has concrete obligations (i.e., obligations stemming from a closure plan or an administrative order). The operators’ public law obligations generally end once the mining supervision has ended. At that point, the operator may then liquidate the company. Against this background, UGS operators may want to consider aligning the corporate structure of their operations with these liquidation requirements.

In contrast, according to BBergG § 126, para. 1, sentence 2 and § 114, the legal basis for the civil law liability of UGS operators is the mining damage law (Bergschadensrecht). The mining damage law only applies to caverns, not to aquifers. The idea behind this distinction is that human-made cavities such as caverns create a higher risk for third parties and the general public than aquifers created by natural processes. Under the mining damage law, cavern operators are obliged to pay compensation if a person is killed or injured or if assets are damaged because of the cavern operation. This liability applies regardless of whether the UGS operator acted negligently or intentionally. For damages stemming from the operation of aquifers, only the liability provisions of the general Civil law as stipulated in the Bürgerliches Gesetzbuch [BGB] [Civil Code], Aug. 18, 1896, Reichsgesetzblatt [RGBl] 195, as amended, apply, since BBergG § 126, para. 1, sentence 2 declares the mining damage law applicable only to artificially created cavities. The key difference between the civil law liability of UGS operators under the mining damage law and the BGB is that only the mining damage law contains a legal presumption that the mining operation—i.e., the operation of the cavern—has caused the respective damages (provided that the damage occurred in the vicinity of the mining operation). If the causality presumption of the mining damage law applies, the UGS operator, to rebut the presumption, must prove that the respective damage
was not caused by the cavern operation. Generally, the burden of proof in this regard is high, so that the mining damage law presents a challenging liability regime for cavern operators.

Regulatory Framework in the Netherlands
The legal framework for UGS facilities in the Netherlands is similar to the German approach. As in Germany, the Netherlands also has its own federal regulation—the Mijnbouw Wet [Dutch Mining Act], Jan. 1, 2003, Staatsblad van het Koninkrijk der Nederlanden [Stb.] 2002, 542—that provides stipulations regarding UGS facilities. The construction and operation of UGS facilities require both a mining permit and an approved storage plan. The competent authority for both permits is the Ministry of Economic Affairs and Climate. Other local permits as well as a general environmental permit may be required for the construction and operation of UGS facilities, depending on site-specific details and the facility’s potential environmental impacts. For the closure of UGS facilities, an environmental permit and an approved closing plan are required under Dutch law. Dutch Mining Act, art. 39. The closing plan must, among other things, include descriptions of the disposal of materials belonging to the mining installation, measures to prevent damage, and measures designed to return the grounds of the mining installation to its original state as much as possible. The Dutch closing plan thus includes elements similar to the German closure permit. In the Netherlands, there are not yet any technical standards or administrative guidelines further detailing the obligations of the operator regarding the closure. However, a financial security for UGS facilities may be required by the competent authority in accordance with article 46 of the Dutch Mining Act.

In principle, the Dutch public law liability is unlimited after closure of the UGS facility. Indeed, there is an explicit obligation that the UGS operator carry out measurements of soil movements up until 30 years after termination of the storage activities. Dutch Mining Act, art. 41. With such an explicit measurement obligation, the Dutch law goes beyond the requirements of German mining law. Even though Dutch law does acknowledge the principle of proportionality, given the 30-year measurement obligation, it is unlikely that public enforcement action against the UGS operator in case of security risks to humans or the environment will be excluded before the end of the 30-year monitoring period. In addition to the public law liability, a civil law liability also applies to UGS operators in the Netherlands. Next to the general obligation to refrain from activities that cause harm or nuisance to third parties, Dutch law contains several strict-liability provisions that may apply to UGS operators. For example, strict liability applies under Burgerlijk Wetboek [Dutch Civil Code] art. 6:177 to the operator of a mine in the event of a discharge of minerals or soil movement caused by the mine. There exists a state default fund that offers compensation to injured parties if the UGS operator is declared bankrupt and the damage is not otherwise compensated.

Regulatory Framework in the United Kingdom
The regulatory framework for UGS facilities in the United Kingdom takes a different approach. In contrast to Germany and the Netherlands, UGS facilities in the United Kingdom fall not only under mining law, but also under general infrastructure law. The infrastructure law applies because UGS facilities typically constitute nationally significant infrastructure projects and therefore fall within the scope of the UK Planning Act of 2008. Under the UK Planning Act of 2008, the construction of a UGS facility requires a permit, called a development consent order. The permit procedure for development consent orders usually also contemplates the submission of a decommissioning scheme that describes the specifics of the closure of the UGS facility. This decommissioning scheme must be approved by the planning authorities. The closure of the UGS facility then must be implemented in accordance with the approved decommissioning scheme. This is essentially the same mechanism that applies to UGS facilities that were approved before the UK Planning Act entered into force in 2008 because the applicable legal regime to the permit procedure at the time, the Gas Act, also stipulated that applications for permits include a decommissioning plan. Furthermore, depending on the circumstances of the individual UGS facility, the construction and operation as well as the closure of a UGS facility may also be subject to other permit requirements, such as a flood defense consent order, a hazardous substance consent order, or a gas transporter license. However, in the United Kingdom there are no technical standards or administrative guidelines setting out more detailed requirements for UGS facilities.

Regarding the liability, the law of the United Kingdom also takes a different approach compared to the continental European countries. UGS operators in the United Kingdom are liable under general civil law liability regimes, such as nuisance or negligence. These regimes provide for a potentially endless civil liability, subject to limitation periods once damage has occurred. In some cases, compensation obligations also are imposed under the development consent orders, i.e., in the permit itself. There is no default fund to cover the liability in case a UGS operator goes bankrupt. However, damages caused by UGS facilities in many cases are covered by insurance policies.

Need for More Coordination on the EU Level
Despite its growing practical relevance, there are only rather broad regulatory requirements applicable to the closure of UGS facilities in Germany and other European countries. Many decisions regarding the implementation of closures are left to the whim of specific supervisory authorities. The channel for these authorities to impose their requirements is the permit procedure. At this point in time, there is no common regulation for UGS facilities on the EU level. Even though the different legal approaches taken in European countries may show that there is not necessarily one correct way to handle UGS facility closures, the lack of a centralized regulation on the EU level causes legal uncertainty for UGS operators and exposes operators that are active in several European countries to higher transaction costs. For these reasons, but also with a view to the potentially severe environmental damages caused by UGS facilities, an intergovernmental coordination of (at least) the leading European countries in the UGS market is desirable. In the midterm, common standards set across the EU also should be pursued. For the time being, the different regulatory approaches taken by the European countries can be seen as a competition between regulatory systems, with the aim to learn from one another and to identify the best solution possible. The results achieved may serve as a basis for an improved European approach to the closure issue, which may then also influence this discussion on the other side of the Atlantic. 
The Brazilian Brumadinho Mining Disaster: Environmental Regulation on Debate

Leonardo Munhoz

Mining shares a close relationship with Brazil’s economy. This relationship has existed at least since colonial times, when in the seventeenth century the Portuguese discovered gold in the state of Minas Gerais and quickly set up infrastructure to recover the resource. Indeed, mining even justifies the state’s name to this day—Minas Gerais translated to English means “general mines.” Today, mining in Brazil involves much more than gold, silver, and precious stones. It is equivalent to 5 percent of Brazil’s gross domestic product, creating 180,000 direct jobs and resulting in the extraction of a vast range of minerals. Vale, Sobre a Vale (2017), www.vale.com/brasil/pt/aboutvale/news/paginas/qual-a-importancia-da-mineracao-para-a-economia-do-pais.aspx.

Despite heavy reliance on and a long history with the mining industry, mining remains a very dangerous activity and involves significant environmental impacts. These risks came to a head on January 25, 2019, when a mining dam owned by the Vale company and located in Minas Gerais collapsed, releasing a mining tailings mudflow of approximately 12 million cubic meters. This massive human-caused mudflow immediately destroyed Vale’s local facilities and nearby communities in Brumadinho. Semad/MG, Clarificação Note 1—Disaster Damage B1, Jan. 25, 2019, www.meioambiente.mg.gov.br/noticias/1/3734-nota-de-esclarecimento-brumadinho.

This disaster, known as the “Brumadinho Disaster,” caused unprecedented environmental damage to the entire region by contaminating soil, impairing important water resources, and destroying millions of hectares of forests. Even more tragically, the disaster killed 203 people and left another 103 missing, making it the worst mining disaster in Brazil’s history.

While the Brumadinho Disaster caught global headlines and created a sense of concern around the world, the disaster was not the first of its kind in Brazil. For example, on November 5, 2015, the Fundão dam, also owned by Vale and located in the state of Minas Gerais, collapsed in what is known as the Mariana Disaster. That event released a mining tailings mudflow of 43 million cubic meters, destroying the city of Bento Rodrigues, killing 19 people and causing similar severe environmental damages. Ibama, Breaking of the Fundão Dam: Documents Related to the Samarco Disaster in Mariana/MG, Oct. 23, 2018, www.ibama.gov.br/cites-e-comercio-exterior/cites/id=117.

Thus, in the aftermath of the Brumadinho Disaster, Brazilians were forced to grapple with the question of whether their environmental laws will be effective in holding mining companies like Vale responsible for protecting their workers and the environment.

As to Brumadinho, the authorities are still assessing the best approach to redress damages and investigating possible punishments. And while some have worried that little has been done to punish the violators, actions were taken after the Mariana disaster. Specifically, in June 2018, the federal public prosecutor and the corporations associated with the Mariana Disaster (i.e., Fundão Dam) entered into a settlement agreement that created the Renova Foundation. This foundation was established with the purpose of managing and assisting in numerous restoration actions, and collectively this settlement identified 42 projects to be funded. See Fundação Renova, www.fundacaorenova.org.

However, neither Brumadinho nor Mariana is likely to be the last major collapse as the Barão de Cocais Dam, also located in Minas Gerais and owned by Vale, presents severe stability problems with the risk of collapsing at any time. Smaller mining disasters are also relatively common.

Even if Brazilian mining companies are not going unpunished for these major catastrophes, it is alarming that both massive mining disasters occurred within such a short period of time in Brazil. It is little wonder then that people are concerned about whether Brazil’s environmental mining regulations are fundamentally flawed or, alternatively, whether compliance and enforcement are ineffective such that the question is not “if” but “when” the next disaster will occur.

This article sets out to reflect on whether Brazil has a problematic regulatory framework or otherwise lacks capacity to enforce the law by giving an overview of the regulations most relevant to the Brumadinho case and identifying possible problems with that framework. With this assessment, suggestions will be made for mitigating the problem and insights provided regarding what to expect as a result of these unfortunate events.

Environmental Permitting in Brasil

Environmental law in Brazil began with the National Environmental Policy Act (Política Nacional do Meio Ambiente—PNMA Lei No. 6.938/1981) in 1981, which set forth a system known as the Sistema Nacional do Meio Ambiente (SISNAMA) to address environmental protection. One of the several purposes of the law was the creation of a federal environmental agency, Instituto Brasileiro do Meio Ambiente (IBAMA), and state environmental agencies. Each of these agencies have their own respective jurisdictions to enforce environmental regulations and issue permits. As in many systems, permitting was established as a primary instrument for environmental protection.

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Additionally, Resolution No. 237/1997 of Conselho Nacional do Meio Ambiente (CONAMA) details the general environmental permitting instruments that apply in the country. Specifically, environmental permitting in Brazil consists of three consecutive phases, each phase corresponding to the issuance of a different permit. These three permits are issued according to the stage of development of the activity proposed. First, the Preliminary Permit, which is granted during the planning phase, serves as approval for the activity or project. This stage also includes consideration of environmental feasibility through an Environmental Impact Assessment, which is similar to the assessment produced in the United States under the National Environmental Policy Act. Second, the Installation/Construction Permit authorizes the activity’s construction. Third, the Operation Permit authorizes the activity’s operation.

On the day of the Brumadinho Disaster, ANM through a press release stated that according to the reports presented by Vale, no irregularities with the dam stability and safety were detected.

In Brazil, an agency's authority to issue permits, enforce regulations, and monitor activities arises from its basic, plenary police power, which means that all levels of government can determine whether it is necessary to regulate an activity. Constituição Federal, art. 23, Sc. VII (Braz.). However, the CONAMA Resolution and Federal Law No. 140/2011, which were enacted with the goal of better organizing and clarifying such common authority, established that only one level of government can issue particular permits. In most cases, these permits are issued by Brazilian state agencies, though for certain matters, such as when two or more states are involved, or when the permit relates to nuclear technology, military facilities, or national borders, IBAMA has jurisdiction.

On the other hand, when it comes to the authority to legislate on issues of environmental protection, Brazil recognizes the concept of concurrent authority. Constituição Federal, art. 24, Sc. VI (BRAZ.). Therefore, similar to American federalism, the federal government has the authority to establish and enact a minimum standard of protection and procedure, and the states can supplement those standards established in federal statutes by enacting even stricter standards. The states may also freely legislate in the event of federal inaction. Constituição Federal, art. 24, §§ 2, 3, 4 (BRAZ.).

The authority responsible for permitting Vale’s operations, including the dam that collapsed in the Brumadinho mining disaster, was the state of Minas Gerais through its state environmental agency (Secretarias do Estado do Meio Ambiente e Desenvolvimento Sustentável (SEMA)). But, as is often the case in the United States, the state was acting under the guidance of various federal standards. If one simply looked at the paperwork of inspections required by law before the disaster, one would not necessarily suspect something was wrong.

According to SEMAD, the dam’s Operational Permit had had its last renewal performed in 2011 with no irregularities and the permit was valid until 2017. Additionally, inspections indicated that the dam was not receiving any more waste or discharge. Therefore, in 2018 Vale filed a request for a permit to discontinue its operations at the dam and to reuse those materials. Since decommissioning can itself lead to pollution, the activity was classified as a low environmental impact and, under state regulation, did not have to go through the full three-phased permitting programs discussed above. Instead, the discontinuance permit was subject only to a single phase of “simplified permitting.” Thus, at the time of disaster, the mining dam was permitted to be decommissioned. After the accident, SEMAD claimed that this procedure did not affect the quality of the permitting process.

**National Dam Safety Policy Act (Política Nacional de Segurança de Barragens)**

In addition to the permitting process established by Brazil’s National Environmental Policy Act, Federal Law No. 12.334/2010 enacted a national policy to ensure the safety of dams. In short, it sets forth a system of dam risk classification, listing assessment, and reporting instruments, and authorizes the National Mining Agency, Agência Nacional de Mineração (ANM), as a competent authority to monitor mine dam risks.

Thus, the ANM is responsible for regulating private companies to ensure they are properly following safety measures, including the implementation of various required safety reports and inspections. To allow ANM to accomplish its mission, there exists a system of shared responsibility between the federal agency and the private sector, in which the private corporations generate the monitoring data upon which the ANM evaluates compliance.

On the day of the Brumadinho Disaster, ANM through a press release stated that there were no pending documents regarding the dam monitoring, and it was classified as “low risk.” Also, it stated that according to the reports presented by Vale, no irregularities with the dam stability and safety were detected. See Agência Nacional de Mineração, www.anm.gov.br/noticias/nota-a-imprensa-1, last modified Jan. 28, 2019. However, recent investigations performed by SEMAD and a Congress Inquiry Committee have suggested that Vale might have ignored data demonstrating potential stability risks of the dam and then possibly passed false information on to ANM through the monitoring report. Congresso Nacional, CPI Relatório, https://legis.senado.leg.br/sdleg-getter/documento?d=7974085&ts=1562172217942&disposition=inline.

Hence, despite having a system in place to identify and address risks such as failing tailings dams, the system clearly did not work in the case of Brumadinho. The reliance of regulators on the private sector is one of the reasons many Brazilians have begun to question the system in the aftermath of the disaster. Questions have also arisen because the dam was permitted by SEMAD while the monitoring inspections must be attested by ANM, which is a federal agency. This gap between state level for permitting and federal level for monitoring might also be problematic.
Environmental Liability

Once environmental damages occur, Brazil holds violators liable through three independent and different spheres: civil, administrative, and criminal. The strict, joint civil liability applies to all persons responsible, directly or indirectly, for the activity that causes the environmental deterioration irrespective of fault, resulting in the obligation to indemnify or remedy the damage caused to the environment and to third parties. In addition, the obligation to redress damages has a retroactive effect for all potentially responsible parties (Federal Law No. 6,938/1981, art. 14§ 1º). In other words, the law applies somewhat similarly to the United States’ Comprehensive Environmental Response, Compensation, and Liability Act.

Administrative liability applies to parties that engaged in building, installing, or operating potentially polluting establishments, projects, or services, without permit or authorization from the proper environmental bodies, and subjects the violators to punishments such as fines, permit suspensions, and embargoes. Criminal liability applies to a company or person that commits infractions characterized as crimes under the Environmental Crimes Law (Federal Law No. 9.605/98), and subjects the infringing parties to criminal sanctions such as prohibition from doing business with the government and detention, among other penalties.

It must be stressed that unlike civil liability, the applicable criminal and administrative laws do not apply strict liability; there must be demonstrated fault, negligence, or recklessness by the infringing parties. Thus, the system is designed relatively similar, though not exactly like, the United States’ general system of enforcement in statutes such as the Clean Water Act.

Possible Outcomes of Brumadinho Disaster and Redressability

A range of legal outcomes has started to play out in the wake of the Brumadinho Disaster, and more can be expected to play out in the coming years.

With respect to administrative liability, on January 29, 2019, IBAMA issued four fines against Vale with a total of approximately $60 million USD for (1) causing pollution to the environment and human health, (2) making urban or rural areas unfit for human habitation, (3) causing water pollution and interruption of water supply services, and (4) polluting effluents and causing biodiversity loss. See Ibama, Ibama Fines Vale in R$250 Million for Catastrophe in Brumadinho, Jan. 26, 2019, http://www.ibama.gov.br/noticias/730-2019/1879-ibama-multa-vale-em-r-250-milhoes-por-catastrofe-em-brumadinho-mg. Additionally, SEMAD also issued five fines against Vale for similar reasons amounting to approximately $25 million USD. Recently, in May 2019, a new fine of $80,000 USD was issued for possible false information on the monitoring report given to ANM. See Semad/MG, Infractions—Disaster Damage B1, Jan. 25, 2019, www.meioambiente.mg.gov.br/component/content/article/13-informativo/3750-autos-de-infracao-desastre-barragem-b1.

As to criminal liability, at present it is hard to predict whether criminal sanctions will be pursued in the Brumadinho case. As to strict civil liability, in Brazil the public prosecutor has standing to bring public legal claims, with the option of seeking collective moral damages (i.e., the Brazilian version of punitive damages). Due to the extent of the destruction that resulted from the Brumadinho Disaster, the state public prosecutor recently filed a civil action against Vale to redress the environmental damages seeking about $12.5 billion USD for emergency measures to mitigate and compensate the environment. ACP No 5000056-68.2019.8.13.0090.

Since the National Dam Safety Policy sets a shared responsibility system of monitoring between the entrepreneur and the National Mining Agency, according to the strict, joint civil liability, the agency can also be held liable.

Because Vale is responsible for two severe accidents in similar circumstances (Brumadinho and Mariana), there is a strong case for bringing a claim for more punitive damages and new civil actions in the future. It is important to point out that since the National Dam Safety Policy sets a shared responsibility system of monitoring between the entrepreneur and the National Mining Agency, according to the strict, joint civil liability, the agency can also be held liable.

Additionally, compensation for the deaths involved and socioeconomic impacts for local communities can be asserted in specific actions. To date, there is one ongoing civil action filed in April 2019 by the state public prosecutor addressing the socioeconomic damages and requesting collective moral damages up to $12.5 billion USD (i.e., ACP 0001827-69.2019.8.13.0090). See Ministério Público de Minas Gerais, www.mpmg.mp.br/comunicacao/noticias/caso-brumadinho-procedimentos-de-investigacao-instaurados-e-aces-ajudadas.htm.

Historically many mining disasters have been handled through settlement agreements between violators and the public prosecutor, as was the case with Vale’s earlier Mariana disaster. While these agreements have the advantage of allowing faster avenues to redress violations and help the families of victims, they also generally fall short of holding companies fully liable. Thus, these settlements might be viewed as falling short, in part because they have not had the desired deterrent effect.

Regulatory Framework on Debate

Because the Brumadinho Disaster happened in large part due to the inability to detect safety stability problems during dam inspections, the National Dam Safety Policy (Federal Law No. 12.334/2010) has become a center of attention and debate. Its application to upstream tailings dams, which was the type
of dam that failed in both the Brumadinho and Mariana accidents, has faced scrutiny. An upstream tailings dam involves a type of construction in which the dam body (i.e., wall) is built using the deposited tailings. Water is then drained away, so that the waste sludge hardens and makes a tailings shell that does not need to be reinforced by concrete or stone. As such, this approach represents the cheapest and fastest option. Problems arise, however, if the sludge gets wet, leading to liquefaction that makes the dam susceptible to cracks and eventually collapse. Given this problem, and in light of recent accidents, in February 2019, ANM issued Resolution No. 4/2019 banning the use of new upstream tailings dams and requiring that all remaining 84 must be deactivated by 2021. See Agência Nacional de Mineração, www.anm.gov.br/assuntos/barragens/pasta-classificacao-de-barragens-de-mineracao/plano-de-seguranca-de-barragens.

Regarding the Brumadinho Disaster and the National Dam Safety Policy Act, ANM’s prohibition on the use of new upstream tailings dams due to their high risks is a positive step. But the initiatives to amend the existing law that only impose higher punishments will not necessarily bring results.

Despite being phased out in Brazil, other companies in other countries still use this method. However, due to the risks involved the dams need constant monitoring, which in the Brumadinho case clearly was not effective. This failure highlights problems with the National Dam Safety Policy Act, which relies on private companies to perform all inspections and generate all monitoring data. While it is not ideal to have companies self-regulate, in most cases Brazilian agencies do not have the resources to perform official in loco inspections and thus conduct independent inspections to check the data. Given recent events, it appears that there are some flaws and irregularities occurring with this reporting procedure. Ever since the Mariana accident, Brazilians technicians, scholars, and legislators have been discussing whether this policy should be improved or amended (e.g., Bills 18, 20, 109, 110, 184, 188, and 336/2019). For example, some have asked whether there should be additional defined punishment for corporations and prohibitions against new upstream tailings dams, a step already taken by ANM. The issue of how to craft an effective regulation has long been discussed in Brazil, with the main question being when to punish versus when to incentivize? In other words, which would be the best approach—harsh punishments to act as a deterrent to bad behavior, or persuasive benefits to obtain beneficial compliance? According to some scholars a combination of both is appropriate. John Braithwaite, To Punish or Persuade (1985).

A responsive regulation is a regulatory framework that escalates the intensity of government intervention in order to enable enforcement while adapting to the situation. This framework consists of a pyramid structure combining persuasion with command and control instruments, with the base of the pyramid consisting of instruments that encourage self-regulation and, where there is no cooperation from private actors, an escalation to the top of the pyramid through harsher punishments.

A preference for persuasion over command and control occurs because even though the latter approach often appears to be more effective, it is more expensive than self-regulation instruments. The additional cost stems from the need for more personnel and administrative infrastructure. Also, for a system strongly based on command and control to be productive, the regulator must have the capacity to escalate the punishments, creating a deterrence effect by making it cost more to break the law than respect it. This effect can be problematic and difficult to achieve where there are institutions and agencies with fewer resources and little history of full or aggressive enforcement.

Meanwhile, a system based only on self-regulation instruments rests on the belief of nurturing the virtuous citizen, but this approach does not always represent reality. It can be difficult to obtain desired outcomes using such a self-regulatory system even when the rewards for compliance (e.g., tax benefits) appear significant on the surface.

A responsive regulation takes from both and can create a more balanced and efficient system—“it comes up with a way of reconciling the clear empirical evidence that sometimes punishment works and sometimes it backfires, and Likewise with persuasion.” John Braithwaite, Responsive Regulation and Developing Economies, 34 World Development 884, 887 (Elsevier 2006) (doi: 10.1016/j.worlddev.2005.04.021); see also Ian Ayres & John Braithwaite, Responsive Regulation (1992). It must be noted, however, that responsive regulations can be more challenging for economics in Brazil’s current position to implement effectively; as scholars have pointed out, such economies often have more difficulty implementing this type of system because they have less regulatory capacity and resources, and are thus often more susceptible to corruption. Braithwaite, Responsive Regulation and Developing Economies, supra at 896.

One proposed solution to this problem that may work in Brazil is a networked governance strategy aimed at minimizing these deficits. This strategy relies on weak actors or regulators in a system becoming stronger by joining forces. In other words, the system must enable an environment of pluralism in which several other players can assist public authorities in an affirmative way, not simply by reducing corruption, but also by addressing the costs associated with infrastructure and monitoring. Such an approach would make the most of the limited resources available in Brazil. Third parties such as nongovernmental organizations (NGOs) can have a fundamental role in this strategy. Another front is to encourage whistleblowing among private actors to help identify problems in sectors that have capacity deficits. Id. at 890–893.
Regarding the Brumadinho Disaster and the National Dam Safety Policy Act, ANM’s prohibition on the use of new upstream tailings dams due to their high risks is a positive step. But the initiatives to amend the existing law that only impose higher punishments will not necessarily bring results. Strengthening command and control instruments without increasing the regulators’ capacity to actually enforce them is ineffective. Because Brazil has limited capacity and resources for monitoring and enforcement, as well as a high rate of litigation in courts and countless types of appeals, this approach alone likely will not prevent future accidents simply because enforcement is not robust in the first instance.

Brazil is a developing economy, and a networked governance approach could be helpful. In particular, regulators could benefit from the assistance of third parties for inspections and monitoring. In this sense, state agencies such as SEMAD in Minas Gerais and NGOs could help enforce the policy by assisting inspections and verifying the data. In the case of NGOs, this could include the use of name shaming for corporate activities that indicate procedural irregularities, and in the case of state agencies, this could include reducing the information gap between state-level permitting and federal-level monitoring. This networked governance could be positive during the period of deactivation of the other upstream tailings dams until 2021 and perhaps even prevent disasters by overcoming ANM’s lack of resources, personnel, and capacity to monitor. This approach could be applied similarly to other environmental regulatory challenges faced by Brazil.

Ultimately, Brazil has a wide range of environmental legislation, including for permitting, which is not only established in the law but also at the constitutional level. Unfortunately, as the Brumadinho Disaster illustrates, these systems are not always effective at protecting the environment or preventing disasters. Indeed, because Brumadinho is the second big mining accident in the country in recent years, it is likely that monitoring standards have been lacking or not properly executed. This directly leads to an inquiry into whether the National Safety Dam Policy can in fact ensure safety, especially as it relates to the method of dam construction.

The ANM decision to deactivate all upstream tailings dams is a positive step; however, it seems more of an aggressive response to try to cover and mitigate a deeper problem in Brazil such as the lack of resources and capacity to enforce the law. This policy has generic wording and relies upon a shared monitoring procedure between the entrepreneur and the competent authority, thus ANM is only informed about the monitoring data assessed by the entrepreneur, and not by the agency’s own inspections.

Reforming the existing policy toward a more responsive regulation may be appropriate by mixing self-regulation with command and control to make it more efficient.

In this sense, reforming the existing policy toward a more responsive regulation may be appropriate by mixing self-regulation with command and control to make it more efficient. Such an approach could use a networked governance model that utilizes third parties such as NGOs and state agencies. Ultimately, this type of system would enable a smarter regulatory framework and also minimize capacity deficits and corruption.

Finally, concerning redressability of the damages already caused in Brumadinho, the possibility of another settlement agreement as happened in Mariana, must be carefully considered. The criminal, administrative, and strict civil spheres of environmental liability must be properly and fully enforced, and the regulated community must in fact be subject to an escalation of punishments. All environmental damages must be fully, not partially, redressed, to discourage possible future negligent or reckless behavior by mining companies.

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The Liquid Left Behind: Uncertainty about the Cleanup Costs and Liability for Water Used in Fracking

James T. O’Reilly

Natural gas extraction from the fracturing of shale rock (fracking) was once a rare and novel phenomenon. Today, its commercial value is very well communicated to global investors through financial and business sources. World energy markets have been impacted. Global investors have made very large financial commitments to the delivery of natural gas commodities from fracking “plays.”

Some wells produce petroleum and gas liquids such as xylene in addition to, or instead of, methane gas. But what will be the future of fracking leave behind for students to examine and landowners to pay for in future years?

A quiet but formidable intergenerational transfer of costs is underway. This brief review of surface well site conditions, liquid waste injection, and landfill acceptance of “hot” rocks, will offer insights into the three levels of uncertainties that lie ahead. As a scholar studying these phenomena, I recognize that investor-backed energy companies will have different perspectives, and the reader should certainly consider their views before making decisions about the policy choices involved.

A brief overview of the geology of shale rocks with trapped methane gas “bubbles” will summarize what other sources have so ably described. Deep wells drill down through layers of earth and penetrate the shale rock thousands of feet below the surface. The well driller then uses advanced techniques to turn the direction of the pipe away from the vertical drill pipe, and a lateral pipe begins to bore into shale for thousands of feet, in some cases a mile or more laterally deep underground. When all is ready, a mixture of chemicals, high pressure water, and very fine sand is pumped down into the L-shaped pipe. Fracking occurs when an explosive charge is sent down, which shatters the pipe and floods the broken shale. Then the mixture of gas bubbles, liquids, and shattered rock particles are sucked up to the surface. The powerful pumps that deliver the pressure down and suck the gas upward are used to separate the saleable methane gas and remaining residual liquids and slurry. Gas goes off to pipelines and is shipped toward end uses. That mechanical description is not the end of the story. That is where our tale begins.

Ingredients of the mixed residual materials include large amounts of water that make the round trip from being trucked to the site and sent down from pumps on the surface. This water was then drawn upward, and intermingled with other water produced from deep aquifers, fine sand, pieces of shattered shale rock, and a mix of water and chemical agents used for fracking. By-products of the fracking process are rocks, shale particles, chemicals, water and liquids, often containing measurable levels of radium 226/228 and thorium, varying with the geology at the shale level of depth from which the quantities of gas had been extracted. The liquid remains for disposal as the valuable methane gas has been piped away for treatment and sale into the interstate pipeline system.

**Liability for Leaks from Wastewater Impoundments**

Regulators will sometimes consider “life after death” issues. One issue may be what happens after a drilling location has an open waste impoundment that later leaks or collapses. Future scholars are invited to debate the property law “abandonment” concepts. In some instances, the site’s legal status is covered by a lease, typically drafted by an agent of the gas extraction operator, and that may allocate post-closure responsibilities. For example, a willful violation by an offshore oil and gas operator of produced water into the Breton Sound area of the Gulf of Mexico (instead of into disposal injection wells) led to a $3.1 million fine and three-year probation in a 2014 plea agreement with Xplor Energy SPV-1, an Oklahoma corporation residing in Southlake, Texas. Envtl. Prot. Agency (EPA), Envtl. Crimes Case Bulletin, EPA Pub. 310-N-14-011 (Nov. 2014). If the failure of pond liners or leakage of radioactive wastewater destroys adjacent fields of crops after a well is abandoned or closed, one question is what entity bears the state law “legacy liability” obligations to pay.

A search of state abandonment precedent cases is suggested. In some states, statutes from decades ago dealt with “orphan well” closure by requiring operators to post bonds. Additionally, if the operating company goes bankrupt or disappears, the state remains responsible for closing the orphan wells. Sophie Quinton, Pew Trusts, Why “Orphan” Oil and Gas Wells Are a Growing Problem for States, Stateline Report, July 9, 2018, www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2018/07/09/why-orphan-oil-and-gas-wells-are-a-growing-problem-for-states. A related question is whether state property abandonment case law is robust enough to cover a multi-orphaned well site that was hurriedly abandoned by a now-dissolved company that left no forwarding address. Major energy companies will contractually craft their gas purchase supply agreements to avoid being tied to any of the practices of drilling site service companies whose output supplied gas to their pipelines.

And finally, “Does site abandonment mean the landowner..."
is fully accountable for the post-departure conditions?” Sometimes a hostile landowner was forced into the “taking” of its surface land for drilling, by threat of a state gas “pooling” order (a form of eminent domain that once was premised upon efficient use of a single liquid “pool” of petroleum that most nearby landowners wished to tap). James T. O’Reilly, Free to be Fracked: The Curious Constitutional Consequences of Ohio Gas Law, 41 Capital L. Rev. 675 (2013); M. Baca, Forced Pooling: When Landowners Can’t Say No to Drilling, ProPublica News, May 18, 2011, www.propublica.org/article/forced-pooling-when-landowners-cant-say-no-to-drilling. Today, shale fracturing is different from extraction out of a liquid petroleum pool, but the controversies continue, including conflicts between operators for drainage of oil and gas on adjacent or adjoining leaseholds. Heidi Gorovitz Robertson, Get Out from Under My Land! Hydraulic Fracturing, Forced Pooling or Unitization, and the Role of the Dissenting Landowner, 30 Geo. Envtl. L. Rev. 633 (2018) (concluding that the best approach for addressing drilling oil and gas between operators should be legislative). Future courts may have to decide if that objector now must pay a share of damages for the losses of neighbors’ use of land or of drinking water wells, around that formerly “pooled” wellhead, resulting from leaks or spills detected after the actual drillers’ companies have dissolved. Benjamin Robertson, Top Lease Vultures: Title Failure, Bad Faith Pooling, and the Validity of Top Leases in Texas Shale Plays, 44 Texas Tech. L. Rev. 463 (2012). Other questions arise. For example, must the landowner who later sells the land disclose to future purchasers that the waste pond on 10 acres of the 200 acres being sold contains radioactive levels of thorium? James T. O’Reilly, Superfund and Brownfields Cleanup § 12:14 (2018). And will there be a novel state constitutional precedent when such a legacy of liability is asserted against the unwilling landowner, who never wished to drill into shale beneath its lands?

For key answers to the complex waste issues, we look to the Clean Water Act’s National Pollutant Discharge Elimination System (NPDES) permits, 33 U.S.C. § 1342, and to the Resource Conservation and Recovery Act (RCRA) gas and oil exclusions, James T. O’Reilly, RCRA and Superfund: A Practice Guide (2018), and, among state laws, at lessee and lessor legal obligations over land. The impoundment outflow of liquid and sludge is very likely deemed a hazardous liquid, and wastewater with detectable radium or toxic chemical contents cannot simply be released from waste pipes into a stream, or dumped out of tanks into the creek, or delivered by tank trucks to the typical county wastewater plant. 80 Fed. Reg. 18,557, 19,579 (Apr. 7, 2015) (EPA’s proposed effluent limitations guidelines and standards for the oil and gas extraction point source category to prevent discharge of produced water to publicly owned treatment works (POTWs)); see, e.g., Press Release, U.S. Dept of Justice, Saltwater Disposal Well Operator Pleads Guilty to Multiple Felony Charges (Apr. 12, 2017) (operator pleaded guilty to violating the Safe Drinking Water Act by injecting produced water into a saltwater disposal well without first meeting the state’s requirement to test the well’s integrity, and also for injecting fluids in the wrong location in the well in violation of the well’s permit); Ben Lupo Sentenced to 28 Months in Prison, Fined $25K, Youngstown Vindicator, Aug. 5, 2014, www.vindy.com/news/2014/aug/05/breaking-news-ben-lupo-sentenced-28-months-prison/?n (former oil and gas company owner sentenced for violating the Clean Water Act for directing his employees to dump tens of thousands of gallons of oilfield waste down a storm drain that emptied into a major river).

The legal liability for the fracking waste impoundment may be impacted by the anticipated 2019 decision of the U.S. Supreme Court in a water pollution case with a scenario that seems to be made for waste impoundment leak disputes: “Whether the [Clean Water Act] requires a permit when pollutants originate from a point source but are conveyed to navigable waters by a nonpoint source, such as groundwater.”

County of Maui v. Hawaii Wildlife Fund, 886 F.3d 737 (9th Cir. 2018), cert. granted, 139 S. Ct. 1164 (U.S. Feb. 19, 2019) (No. 18-260) (set for argument on Nov. 6, 2019). The situation seems to track the case for fracking liquids. Because radium and thorium can be traced into and out of shale waste liquids, the regulatory agency responsible for the nearby river could seek injunctive relief to halt the pond owner from allowing its leaking waste liquids to run through subsurface cracks or fissures into that protected river. The pond owner or the operator would then be liable for unpermitted releases.

The legal liability for the fracking waste impoundment may be impacted by the anticipated 2019 decision of the U.S. Supreme Court in a water pollution case with a scenario that seems to be made for waste impoundment leak disputes.

Likewise, will the state-issued solid waste landfill regulatory permit allow the local landfill to accept rock and shale sludges from deep drilling, without first measuring and reporting the thorium or radium levels of the rock being disposed? And if the landfill’s permit to expand is conditional upon a years-long pattern of taking mixed municipal waste, where the organic garbage that would degrade and shrink to allow more tons of garbage to be piled on top (see James T. O’Reilly, State & Local Government Solid Waste Management (2d ed. 2004)), then would the addition of thousands of cubic yards of rock violate that landfill operator’s state permit because filling its limited space with rock wastes, instead of degradable garbage, inevitably lessens the useful life of the landfill? State law will govern.

Consider also the wide disparity of knowledge between the parties to a fracking lease on a ranch or farm. If the lease had been signed by a soybean farmer to allow access to subsurface mineral rights, is that same landowner/lessor responsible, after abandonment of the well site, for the impoundment pond’s chemical and radiological “legacy” costs? Is the unsophisticated landowner/lessor responsible for the impoundment’s groundwater effects on aquifer/neighbor well water quality?
How many lease payments of what amounts would it take to cover the remedial costs that eventually must be borne by the less-sophisticated lessor of the wellhead acres? State laws may produce divergent results.

The value of a large but finite flow of shale gas is contrasted to the extraction costs, the radium or thorium contents of residues, and the uncertainties of contract liabilities after “abandonment” of the fracking wellhead. Each will make this a multifactor puzzle for the next generation of environmental lawyers.

Wastewater Injection and Seismic Activity

Let’s also shake things up. Before natural gas extraction introduced a new vocabulary for terms like “fracking,” virtually no one outside academia knew of the word “seismicity.” Thea Hincks et al., Oklahoma’s Induced Seismicity Strongly Linked to Wastewater Injection Depth, Sci., Mar. 16, 2018, at 1251–55. Trends for liquid waste disposal from fracking wells have expanded the use of diesel-powered injection of waste liquid “brine” into deep wells. The benefit to the gas extraction process from having slick chemical additives in the well has a corresponding downside (literally) as the waste liquids are pumped back into the earth, lubricate the deep layers of rock, and potentially cause them to slip and slide under some conditions. Litigation is very likely to increase. See, e.g., Ladra v. New Dominion, 353 P.3d 529 (Okla. 2015) (holding that the district court, rather than the Oklahoma Corporation Commission, had exclusive jurisdiction over private tort action property owner brought against operators of wastewater injection wells, alleging that wells caused earthquake causing injury to property owner). Again, proof standards under state laws will vary.

Public response to perceptions of the gas industry causing small earthquakes has had a backlash against the industry’s disposal practices. Increasingly, local governments have sought to regulate the siting of injection wells, or to constrain the well operators’ acceptance of fracking chemicals. The goal of the local laws is to prevent deep subsurface tremors, with occasional manifestations in earthquakes. Cincinnati and other cities have banned injection wells to avoid this risk.

Parallel to liquid disposal is the growing concern among neighbors of municipal waste landfills that radium levels in the drillers’ rock shipments need to be tested, and higher-level equipment for measurement of radioactivity should be used to screen drilling company deliveries at the landfill gate. Trends for future municipal solid waste landfill acceptance of deep rock with radioactivity are likely to parallel the tremor-avoidance constraints on liquid waste injection. But without lawful access to a nearby landfill, it is not clear where thousands of feet of rock wastes should be sent for off-site disposal.

Ultimately this is best seen as a significant cross-generational tradeoff. One could say: “drill now, pay later.” But who will pay later? The value of a large but finite flow of shale gas is contrasted to the extraction costs, the radium or thorium contents of residues, and the uncertainties of contract liabilities after “abandonment” of the fracking wellhead. Each will make this a multifactor puzzle for the next generation of environmental lawyers. I and others of the “baby boomer” generation wish future generations good luck in discerning the proper legal outcome of the era of “fracking boom” cleanups. Stay tuned for the future cost allocation decisions still to come.

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Using Emerging Technologies to Rethink and Enhance Coal Mine Reclamation Programs in the Western United States

Kara Haas, Paul Nazaryk, and Linda S. DeLay

Coal mining reclamation in the western United States faces some unique challenges due to the harsh environment and often rugged landscapes. Over the last 10 years, mining companies have begun to use new approaches to reclamation including geomorphic reclamation methods, global positioning systems (GPSs), and new design software to improve landform stability. These new reclamation procedures are more effective at utilizing precipitation to harvest moisture by mimicking natural landforms. Yet until now, the final and most intricate aspect of reclamation—revegetation—has been relatively stagnant in terms of technological advancement.

Natural vegetation is influenced by variations in slope percent, slope aspect, moisture content, temperature, soil chemistry, elevation, geography, and other ecological parameters. Revegetation at coal mines in the western United States can be affected by a range of these parameters in a small area, which adds complexity to monitoring revegetation success effectively and comparing it with traditional methods. But emerging technologies, including unmanned aerial systems (UASs, or drones), high accuracy GPS receivers, high-resolution sensors, access to cloud computing, and machine learning can now empower mining companies to build upon traditional methods of measuring revegetation success by providing an opportunity to monitor the reclamation holistically.

The federal Surface Mining Control and Reclamation Act (SMCRA), 30 U.S.C. § 1201 et seq., was signed into law on August 2, 1977, by President Jimmy Carter. Congress enacted SMCRA to mitigate the adverse environmental impacts associated with coal mining. The statute created the Office of Surface Mining Reclamation and Enforcement (OSMRE) within the U.S. Department of the Interior (DOI) to regulate coal mining operations and authorized DOI to adopt implementing regulations. Key elements of the program include requirements for coal mining operations to obtain a reclamation permit and post reclamation bonds to ensure the requirements for coal mining operations to obtain a reclamation program's vegetation standards in New Mexico list a selection of species that could be used.

To implement this provision, OSMRE adopted “standards for success” for the revegetation of disturbed mine sites. These standards for success, as well as “statistically valid sampling techniques for measuring success shall be selected by the regulatory authority, described in writing, and made available to the public.” 30 C.F.R. § 816.116(a)(1). Moreover, these standards must include “criteria representative of unmined lands in the area being reclaimed to evaluate the appropriate vegetation parameters of ground cover, production, or stocking,” Id. § 817.116. The regulations in turn state that “[g]round cover, production, or stocking shall be considered equal to the approved success standard when they are not less than 90 percent of the success standard,” and “[t]he sampling techniques for measuring success shall use a 90-percent statistical confidence interval (i.e., a one-sided test with a 0.10 alpha error).” Id.

Neither the statute nor the regulations explicitly state how a mining operation should conduct “statistically valid sampling” to determine whether the reclamation has been successful and the standard met. State SMCRA programs do suggest possible options and cite references for sampling methods, but revegetation success standards for various land-use classes are not uniformly applied across all land types. Therefore, reclamation applicants are encouraged to discuss land-use options, success standards, and sampling methodology early in the permitting process. This dialogue informs the basis of review among regulator and operator.
Until recently, the accepted method for determining whether reclamation had succeeded was through field vegetation surveys. To help ensure that mining companies properly perform these vegetation surveys, agencies have issued guidance on how to correctly perform the surveys. See e.g., New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division, Coal Program Guidelines: Coal Mine Reclamation Program Vegetation Standard, www.emnr.state.nm.us/MMD/CMRP/CoalProgramGuidelines.html. Often the prescribed field survey methodologies are incorporated by reference into state regulatory requirements or into issued mined land reclamation permits. Today, however, new and more efficient ways of conducting vegetation surveys are on the horizon.

The vegetation success criteria and statistical validation tends to be unique at each mine site. Determining if revegetation of the reclamation meets regulation standards requires vegetation samples to be collected at a frequency required by the reclamation plan.

Vegetation Field Surveys
Despite the rapid technological advances occurring throughout society, the mining industry is using the same methodologies for monitoring revegetation that were used in early twentieth century. For example, the identification of plant species is still a manual, laborious, and time-consuming process. Although many tools have been developed over the years to help catalog and report on plant species, the identification, classification, and description of the plants rely solely on the keen eye, experience, and knowledge of the botanist completing the task. The identification of plant species at a mine reclamation site can very quickly become an impractical task when thousands of acres are being considered for bond release.

Accordingly, OSMRE and each state SMCRA program have adopted “standards for success” for the revegetation of disturbed mine sites. As stated previously, neither the statute or the regulations specifically state how a mining operation should conduct “statistically valid sampling” to determine whether the success standard has been met. A determination of successful revegetation of a reclaimed area is based upon a technical standard or reference area and comparison to both pre-mining conditions and the declared post-land use of the mine.

Vegetation Field Surveys
The identification of plant species at a mine reclamation site can very quickly become an impractical task when thousands of acres are being considered for bond release. The vegetation success criteria and statistical validation tends to be unique at each mine site. Determining if revegetation of the reclamation meets regulation standards requires vegetation samples to be collected at a frequency required by the reclamation plan. Vegetation sampling is often conducted in a line transect at a length, which is determined by the reclamation plan. Sampling can require plant species identification, calculating the relative percent, density, and biodiversity of vegetation types and cover, and determining the health of the vegetation cover, but these criteria can vary depending on the requirements of the reclamation plan. The data collected is used to determine the measurement of “statistical significance.” If, at the end of the process of collecting vegetation transect samples, it is determined that the sampling was not statistically valid, there are two choices: (1) the bond release criteria was not met, or (2) the entire area must be resampled or more samples must be added based on a stratified randomized design. This determination can be made by the operator before submitting the area for bond release, or by the regulator during the bond release review process.

Because the vegetation transect sample locations are randomly generated, there are often instances where the reclamation revegetation success is actually greater than the vegetation transect samples and measurement of statistical significance predictions. In other cases, the opposite has been true and the vegetation transects samples and measurement of statistical significance was greater than the revegetation success. As a result, this method is not always reliable in measuring the success of the revegetation, which can lead to delays in bond release and extra costs associated with the recollection of the data.

As an example, New Mexico can be one of the most challenging environments for revegetation due to its arid environment and often rugged and varied landscapes. Moreover, seed production in an arid environment such as New Mexico can be low, episodic, and difficult to cultivate. The environment within the state requires the development of strategies to harvest moisture from precipitation. Over time, the New Mexico Mining and Minerals Division (MMD) Coal Program learned that revegetation on uniformly flat or gently sloping reclamation areas often fails after it is established. To avoid this outcome, MMD had been encouraging topographic diversity on reclaimed areas to improve moisture harvesting and “to reduce the percentage of south aspect slopes,” which receive less moisture each year. Dave Clark, Geomorphic Reclamation in New Mexico: A Regulator’s Perspective, www.landforma.com/wp-content/uploads/2009/04/Geomorphic-Reclamation-in-New-Mexico-Dave-Clark.pdf. “MMD believes that emulating nature is a better method, and is arguably required by [SMCRA],” which mandates the use of the “best technology currently available.” Id. In response, mining companies in New Mexico in the last 10 years have begun to utilize new approaches including geomorphic reclamation methods, GPS, and new design software to improve landform stability and moisture harvesting by mimicking natural landforms. See id. Topographic diversity provides the opportunity for a greater variety of parameters to be present on the reclamation site. It also provides the opportunity for a more diverse plant ecosystem and increases the likelihood communities will develop. Although this is good for the environment, it also adds to the complexity of determining whether revegetation has been a success.
The Advance of New Technologies
The inherent limitation of field revegetation sampling is the inability to "see" an entire reclamation site when the area encompasses hundreds or thousands of acres. However, recent technological developments now make it possible to collect site-wide, high-resolution imagery data using various sensors attached to UASs (unmanned aerial systems). Furthermore, new trends in cloud computing and machine learning now make it possible to process and analyze this data for new insights.

Aerial photography has long been collected and utilized on mine sites to assist in mine development, planning for operations, reporting requirements and for mine inspection. Clairene Bailey et al., Mine Inspection Assistance Using Remote Sensing Imagery, www.asmr.us/Portals/0/Documents/Conference-Proceedings/2009/0044-Bailey.pdf. Photography falls into the category of remote sensing, which can be defined as the acquisition of information about an object or phenomenon without making physical contact with it. In the nineteenth century, the first patent was issued for the idea of using aerial photography in map making and surveying, and this type of remote sensing has evolved and improved over time. Professional Aerial Photographers Association, History of Aerial Photography, https://papa.clubexpress.com/content.aspx?page_id=22&club_id=808138&module_id=158950. Typically, aerial photography is collected using aircraft and has historically been too low in quality to be used effectively in the application of revegetation monitoring.

Recent advances in commercially available UASs now allow for remotely sensed data to be collected at lower altitudes and slower speeds, resulting in higher resolution data sets. The resolution of data that are collected from UASs can be more than an order of magnitude greater than data collected from an aircraft or satellite. For example, aerial photography collected from aircraft or satellite is at a scale of meters and feet of accuracy, while UASs combined with improved GPS can collect data at a scale of centimeters and inches of accuracy. Jakob J. Assmann et al., Vegetation Monitoring Using Multispectral Sensors—Best Practices and Lessons Learned from High Latitudes, 7 J. of Unmanned Vehicle Systems 54–75 (2019), www.nrcresearchpress.com/doi/10.1139/juvs-2018-0018#.XY8u-JyRD8. UASs can carry various sensors depending on the data requirements. The most common type of sensor is a red, green, and blue (RGB) camera, which is similar to a photographer's camera. However, for vegetation analysis, sensors capable of measuring distances or wavelengths beyond the visible spectrum can be very useful.

LIDAR (also known as “light detection and ranging”) sensors use a remote sensing method that was first developed in the 1960s, shortly after the invention of the laser. National Oceanic and Atmospheric Administration, What Is LIDAR, https://oceanservice.noaa.gov/facts/lidar.html. This technology combines laser-focused imaging with the ability to calculate distances by measuring the time for a signal to return using sensors and data acquisition electronics. LIDAR can use ultraviolet, visible, or near-infrared light to image an object. With LIDAR, differences in laser return times and wavelengths can be used to make three-dimensional images of a target. LIDAR can target a wide range of materials, including vegetation. LIDAR combined with machine learning has had some limited success with identifying plant species. However, this technology has been successful in identifying invasive species and weeds in agricultural settings and distinguishing between vegetation categories or types (i.e., crops versus natural areas or crop types). LIDAR is an excellent tool to determine the height, leaf area, crown shape, biomass, and basal area. Hyper-spectral Remote Sensing of Vegetation (Prasad S. Thenkabail et al. eds., 2011). These applications of LIDAR can now be refined, as lighter weight and portable LIDAR sensors have been developed recently for UASs.

In addition to LIDAR, multispectral and hyper-spectral sensors are important remote sensing methods for vegetation analyses. The human eye can see light wavelengths from approximately 380 to 750 nanometers (nm). National Aeronautics and Space Administration, https://science.nasa.gov/ems/09_visiblelight. This electromagnetic spectrum range is referred to as the “visible light spectrum.” In contrast, multi- and hyper-spectral sensors collect data from a much broader range of the electromagnetic spectrum. UASs compatible high-resolution multispectral sensors have been developed that target the optimal wavelengths of the electromagnetic spectrum for vegetation analyses. These wavelengths can target the blue (405–490 nm), green (515–570 nm), red (650–687 nm), red edge (705–740 nm), near infrared (760–1245 nm), and infrared/thermal (8000–14,000 nm) wavelengths. Hyper- and multispectral sensors are useful tools for determining biochemistry, including chlorophyll content and water content in plants. Prasad S. Thenkabail et al. eds., supra. The main difference between multispectral and hyper-spectral sensors is the number of wavelength ranges they can sense and how narrow the wavelength ranges are.

The primary way in which machine learning is changing research is its ability to compare new data to what we already know. Armed with information, machine learning identifies patterns and alters its response accordingly.

Machine learning is considered a branch of artificial intelligence, which can be defined as technology that makes myriad decisions without the need for human intervention. Within this realm, machine learning is used to leverage large data sets (i.e., “big data”) to perform analytical functions at incredible speeds. In doing so, efficiency, productivity, and functionality are rapidly enhanced. In many cases, data analysis tasks that would have been impossible for a human can be achieved using machine learning.

The primary way in which machine learning is changing research is its ability to compare new data to what we already know. Armed with information, machine learning
identifies patterns and alters its response accordingly. Images are one common data source for machine learning analysis. For example, some technology companies are applying machine learning to medical imaging data with the hopes of improving medical diagnoses. Another example of image analysis is the facial recognition capabilities used to enhance security on handheld devices. Using these same concepts, machine learning can be applied to the high-resolution imagery data collected by UASs to identify various features, such as vegetation characteristics and perhaps even individual plant species.

Couple higher resolution data across a much broader light spectrum not visible to the human eye with machine learning and suddenly a whole new holistic method of vegetation identification might be possible.

An Agency Perspective
Remote sensing is not a new concept either to the mining industry or to government agencies. DOI’s Bureau of Reclamation (BOR) uses remote sensing to monitor consumptive water usage river compact compliance throughout the West. The agency adopted guidelines for the use of remote sensing within the agency nearly 15 years ago. Bureau of Reclamation, Remote Sensing Technology: Guidelines and Applications within the Bureau of Reclamation (Reclamation Managing Water in the West: Series Report Number D-8260-05-05) (2005), www.usbr.gov/tsc/techreferences/mands/mands-pdfs/RemtSens.pdf. Likewise, OSMRE has experience in remote sensing, and this agency has a Technical Information and Professional Services (TIPS) Program with a Remote Sensing and Geographic Information Systems Group. The TIPS Offices in OSMRE’s Appalachian Region and, more recently, in Mid-continent and Western Regions have trained certified pilots to fly UASs to help support SMCRA-related missions, such as taking aerial photographs and creating digital terrain models to track the changes due to mining activities and reclamation efforts. See OSMRE, www.tips.osmre.gov.

The New Mexico MMD Coal Program is among the early adopters of remote sensing, and it has the beginnings of a drone program of its own that could help facilitate other state coal mine reclamation programs to adopt emerging technologies in the reclamation process. Indeed, those working on reclamation projects at the state, federal, and tribal levels participate in discussion groups that consist of both experienced and beginning adopters of new technologies.

MMD has two SMCRA programs for which it is responsible, including the Coal Mine Reclamation Program (CMRP) and the Abandoned Mine Land Program (AML). In New Mexico, most of the operational coal mines are large, in various phases of reclamation, and use the “contemporaneous reclamation” approach (i.e., reclaiming areas that have been previously mined while simultaneously mining new areas within the same permit). MMD CMRP, www.emnrd.state.nm.us/MMD/CMRP/cmrmmain.html. The work of MMD’s CMRP at active mines includes reviewing the accuracy of maps provided by the operator and visiting the mine sites to monitor mined land reclamation efforts. These reviews generally include the following: checking and confirming the information provided on areas mined and in the various stages of reclamation along with volumes of moved earth and slope; comparing the geomorphic design to the area of original contour; reviewing soil and water quality inspection data; and reviewing vegetation reports describing revegetation success to the applicable technical standard or reference area based on pre-mining conditions. MMD CMRP, Coal Program Guidelines, www.emnrd.state.nm.us/MMD/CMRP/CoalProgramGuidelines.html.

Decisions on whether revegetation of the reclamation has met New Mexico regulatory standards is currently based on data from vegetation transect samples and their measurement of statistical significance. Agency inspections generally include MMD personnel “walking the site” to provide the agency with a chance to evaluate deficiencies visually (e.g., problems in vegetation cover, diversity of plants, and topsoil cover). During these visits, MMD discusses its observations concerning the progress of mine revegetation and reclamation progress with the mine operator, landowners, federal agencies, and others. MMD experience suggests that site biodiversity, biomass, and land productivity information is difficult to obtain using remote sensing. Likewise, remote sensing may miss hidden subsidence and erosion. As a result, given the current state of technology, there is no substitute for field checks on the ground.

This does not mean, however, that there is currently no role for remote sensing or that this could change in the future. UASs certainly can cover a larger area at a more accelerated rate than MMD staff when conducting visual inspections by walking or in vehicles. As UAS capability increases and the quality of imagery improves, we anticipate that regulatory agency confidence in using the information provided also will increase. MMD, for example, expects that UAS and remote sensing technology may soon be used for visual inspection of revegetation, plant associations, and erosion identification; quantitative evaluations paired with on-ground sampling; and state sampling to confirm the information provided by the mine operator and their consultants.

Conclusion
SMCRA has established requirements to ensure that land disturbed by coal mining is properly reclaimed, and its implementing regulations include success criteria for revegetation.
and require “statistically valid sampling.” But neither prescribe the definitive methodology to be used to meet that standard. Over the years, OSMRE and state agencies have developed field survey methodologies to meet the standard and, in many cases, have incorporated these methodologies into regulatory and permit requirements.

Advances in remote sensing and machine learning are creating opportunities to demonstrate the utility of new technologies to both mining companies and regulatory agencies in meeting the standard. UASs equipped with advanced sensors and machine learning cover more territory and will be more likely to detect problem areas, such as erosion, invasive species, and landform design concern, allowing the identification of deficiencies earlier in the bond release process. Soon this new technology may be used to calculate the overall area of vegetation cover, and possibly plant species and biodiversity.

Ground validation should accompany this use to ensure a measure of statistical confidence to compare with agreed-upon standards. The goal should be to use this technology not only to identify problem areas that ground crews can investigate but also as a tool to help quantify overall reclamation metrics. As these methods are developed and tested for accuracy, they will likely decrease the total cost of inspections and ground surveys, improve site-wide understanding of reclamation status, and provide better communication among stakeholders.

Will these new technologies ever be recognized as a substitute for revegetation field surveys? This is uncertain. It all depends on the ability of remote sensing combined with machine learning to detect key elements of reclamation requirements and the resulting degree of statistical confidence. At the very least, however, the technology will be used to supplement field surveys and more efficiently direct greater attention to problem areas, thereby contributing to the overall success of the reclamation.

As these methods are developed and tested for accuracy, they will likely decrease the total cost of inspections and ground surveys, improve site-wide understanding of reclamation status, and provide better communication among stakeholders.

SAVE THE DATE

NATIONAL ENFORCEMENT CONFERENCE

NOVEMBER 12, 2019

Ronald Reagan Building and International Trade Center
Washington, DC

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The state of New York recently established one of the most ambitious economy-wide climate targets in the world: 100 percent carbon-free electricity by 2040 and economy-wide, net-zero carbon emissions by 2050. This follows similar actions taken by other states—notably California—and other nations as part of their efforts to meet commitments made under the Paris Agreement. Meeting these targets will require a significant expansion of renewable energy, grid-scale storage, and electric vehicles, among other actions. Technology, mining, manufacturing, automotive, and energy businesses will need to innovate and implement new technologies, coordinate actions, and increase the scope and scale of the transition to a decarbonized economy.

Transportation and electricity generation are the two primary sectors of the economy that will need to reduce emissions to meet the targets. While short-term corporate actions to decarbonize, taken in isolation, may appear to be progress toward the targets, examination of all interconnected actions is necessary to facilitate a holistic assessment of risk and opportunities. Batteries and energy storage are keystones to reducing emissions from transportation and electricity generation and illustrate the tension between short-term actions and longer-term risks and opportunities. This article highlights considerations the private sector may need to assess to maximize business opportunities while reducing emissions to meet climate targets.

The largest source of greenhouse gas (GHG) emissions in the United States is the transportation sector, which accounts for 29 percent of emissions. Transportation emissions comprise an even larger percentage in some states: approximately 37 percent in California and 35 percent in New York, for example. Achieving the climate targets would require a shift from internal combustion engines to electric or similar designs that result in zero-emission vehicles.

The International Energy Agency estimates there will be 140 million electric cars globally by 2030 if countries meet their Paris Agreement commitments. To meet California’s 2030 target of emissions, that state’s government estimates that 40 percent of all new vehicle purchases must be zero-emission vehicles by 2030 (up from five percent in 2017). Some countries are explicit about the future—China and European Union (EU) countries have proposed plans to prohibit the future sales of internal combustion engines.

Government policies will likely drive growth in electric vehicles and influence how the products are designed. Despite current low demand in the United States for electric vehicles (two percent of the market in 2018) the automotive industry is investing billions in the technology and new products. The expectation is that a new regulatory framework, like the climate targets, combined with improvement to existing barriers (e.g., battery-charging infrastructure, prices, and performance) will lead to greater market demand.

Electric vehicles largely rely on lithium-ion batteries, which are not new; they power our cell phones and computers. What
will be new is their large-scale application in the transportation sector to significantly reduce emissions. Lithium-ion batteries illustrate the risks and opportunities of decarbonization. An economy-wide transformation of this size creates technological, business, and legal uncertainties associated with the design, sourcing of raw materials, manufacturing, a global supply chain, and the product’s end-of-life use, including recycling, reuse, or disposal. Successful companies will be those that recognize the connections and potential synergies between traditionally distinct industries, are able to identify and mitigate risks, and fully capitalize on opportunities.

Lithium-ion batteries include lithium, cobalt, and nickel, among other components, which often exist in limited amounts, are expensive to extract, and are located in limited and developing parts of the world. More than half of the world’s cobalt, for example, is found in the Democratic Republic of the Congo, where child labor in artisanal mining is estimated to account for approximately 20 percent of cobalt exports. Most of the world’s lithium comes from the “lithium triangle” of Argentina, Chile, and Bolivia, where indigenous peoples have protested environmental concerns associated with lithium production. Nickel production allegedly is associated with deforestation and the loss of biodiversity, as 40 percent of reserves are in locations with high biodiversity, notably Indonesia and the Philippines.

Batteries require mining, mineral processing, battery manufacturing, and transportation, among other steps in the supply chain that results in GHG emissions and traditional environmental, health, safety, and social (EHSS) risks. The increase in demand associated with the scaling of lithium-ion batteries also may create new risks. Traditional lithium production in South America, for example, relies on brine-focused production that consumes little energy because the sun processes the lithium. However, because of a rise in demand, there has been an increase in directly shipping ore from rock mining sites to China for processing and use in manufacturing of the batteries, resulting in an increase in energy consumption and emissions associated with transportation. Likewise, the rise in demand for nickel has led to an increase in extraction of the laterite-type of nickel ore, which is of a lower grade than the sulphide-type ore. Extraction operations for laterite ore are less efficient; more energy is used in mining and refining it; and the laterite ore is located in biologically diverse locations such as Brazil, Indonesia and Guatemala.

As a matter of public policy, it may not make sense for a government to mandate electric vehicles if the emissions associated with the manufacture of electric vehicles and their components negates the emission reduction associated with transitioning to zero-emission vehicles. Moreover, companies will need to ensure that their involvement in this supply chain not only is consistent with applicable regulatory requirements, but also satisfies corporate social responsibility obligations. The benefits of the transition to electric vehicles should not be outweighed by negative externalities, whether they be emissions or EHSS risks.

Options for alternative sources of these materials are limited in the short term. Therefore, to mitigate legal, commercial, contractual, and reputational risks, companies should implement appropriate audit policies and procedures throughout the supply chain to ensure, for example, that cobalt used in manufacturing lithium-ion batteries does not originate from child labor.

Additionally, technology, mining, manufacturing, automotive, and energy businesses are joining forces with international organizations and nongovernmental organizations to create a responsible global supply of batteries in a market that is predicted to be worth $100 billion by 2025. Companies will need to understand the framework of international standards and best practices that is being created and incorporate it into decision-making and supply chains. Notably, these international standards often are incorporated into governmental authorizations, financing, and contractual obligations as demonstrated through application of the Equator Principles, the IFC’s Environmental and Social Performance Standards, and similar industry-specific guidelines. See Samuel Brown & Scott Burton, Trends in Social and Environmental Responsibility, 34 Nat. Resources & Env’t 50 (Spring 2019).

Strong demand for these raw materials leads to increased risk for companies. One solution is to decrease the need to extract these materials by creating a closed-loop cycle via recycling of the lithium ion batteries. Currently, less than 3 percent of lithium-ion batteries globally are recycled. In contrast, 99 percent of lead-based batteries in the United States are recycled. This difference is attributable to numerous factors, including the lack of uniform design of lithium-based batteries, an underdeveloped recycling infrastructure, and current unfavorable economics of recycling.

A combination of regulatory and market drivers will create a need for a functional recycling industry, especially with the expected increase in the number of batteries that will require end-of-life disposal. Pressure for a recycling solution will increase in response to governments enacting product stewardship requirements that apply to lithium-ion batteries, including a ban on their disposal. The EU, for example, requires battery manufacturers to finance the cost of collection, treatment, and recycling of all batteries. Further, the European Commission is expected to review its Battery Directive in 2020. This evolving legal framework already is encouraging closer strategic relationships between automotive manufacturers and the recycling sector. In the United States, there is no federal requirement for recycling large-format lithium-ion batteries. However, establishing a recycling industry would assist with managing the corporate risk associated with compliance with the Resource Conservation and Recovery Act and equivalent state hazardous waste requirements. Recycling lithium-ion batteries on a large scale also could reduce the demand for their raw material components, mitigating the risk of supply chain choke points, reducing emissions and EHSS concerns, and mitigating corporate reputational and legal risk.

The benefits of recycling demonstrate the importance of design and early, thoughtful, integrated planning for the product’s entire life cycle. While there likely is universal agreement that recycling the components of lithium-ion batteries is one appropriate end-of-life solution, the bottom line is that a recycling industry will struggle if it does not make financial sense to recycle the components when compared to sourcing raw materials. Design decisions made now by manufacturers may determine the financial viability of recycling decades into the future.

Repurposing the batteries may be a preferable approach to recycling, but the viability of that also will be dictated by design and integration with symbiotic industries. Repurposing
could provide automotive manufacturers with a critical revenue stream during a time of upheaval within the industry. Lithium-ion car and bus batteries can, on average, collect and discharge electricity for another eight to ten years after being taken off the road. During their “second life,” the repurposed batteries can be integrated into stationary sources (e.g., residences, commercial facilities, or the power grid) to store power from, for example, solar panels during periods of low demand and feed it back during periods of localized high demand. Repurposing batteries could reduce the need to manufacture large grid-scale batteries, increase the reach of renewable energy generation, and further decrease the cost of production and the scaling-up of electric vehicle use. Cross-industry integration, product standardization, cross-manufacturer compatibility, and certification programs can increase the repurposing opportunity.

Electricity generation accounts for 27 percent of GHG emissions in the United States, which is the second-largest source of GHG emissions. The current state of grid-scale battery storage poses a barrier to the utilization of solar, wind, and other renewable energy to reduce GHG emissions. The use and design of lithium-ion batteries illustrates the potential for an increase in the interconnection of the transportation and electric generation sectors and future opportunities. A consortium of automobile and energy companies in Europe, for example, are examining the deployment of “smart” electric vehicle charging stations that are tied into the electric grid. A smart design and deployment of electric vehicles and related infrastructure could create an opportunity for electric cars to charge during low-demand periods and batteries that feed back into the grid during high-demand periods.

Relatedly, traditional wind and solar power is expected to continue to grow as a percentage of the total energy generation, spurred by government mandates like the one in New York. In April 2019, hydro, solar, and wind power supplied more electricity in the United States than coal for the first time ever. Similar material sourcing, design, and end-of-life considerations for the associated renewable energy infrastructure will need to be evaluated, and risks and opportunities should be assessed. Solar photovoltaic (PV) panels, for example, are a key component associated with solar energy, but the PV panels contain lead, cadmium, and other metals. The International Renewable Energy Agency estimates that by 2050 there will be 78 million metric tons of solar energy infrastructure that has reached the end of its life.

The private sector is indispensable to meeting the climate targets. The path to a decarbonized economy is laid with term risks, and the ongoing dismantling of the walls between short-term actions to address climate change, longer-term risks, and the ongoing dismantling of the walls between traditional industrial sectors.

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Dirtying the Waters
Jim Murphy

In the late 1960s and early 1970s, our nation’s waters were in trouble. Lake Erie was virtually dead, the Cuyahoga River caught on fire, and the Androscoggin River in Maine was so polluted it peeled paint on nearby buildings. Many of America’s waters had become little more than lifeless, open sewers. In a move that seems quaint by today’s political standards, members of both parties came together in Congress to pass the Clean Water Act (Act) in 1972 in numbers strong enough to override President Richard Nixon’s veto of the legislation. The purpose of the Act is “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters” with the lofty goal “that the discharge of pollutants into the navigable waters be eliminated by 1985.” 33 U.S.C. § 1251. The Act regulates the point source discharge of pollutants into navigable waters and provides for implementation through a cooperative relationship between the federal government and the states.

While the Act was successful in cleaning up many waters, stopping the rampant loss of wetlands and aquatic habitat, and ending the worst of pollution problems in terms of untreated sewage and waste being dumped directly into our streams, the goals of the Act still have not been achieved. Due to factors including agricultural runoff, expanding urban growth in watersheds, and the various impacts of climate change such as more extreme precipitation events, droughts, and hotter temperatures, about 70 percent of assessed lakes, reservoirs, and ponds, 78 percent of assessed bays and estuaries, and 55 percent of assessed rivers and streams in the United States do not meet water quality standards. U.S. Envtl. Prot. Agency, National Summary of State Information, available at https://ofmpub.epa.gov/waters10/attains_nation_cy.control#total_assessed_waters (last visited June 17, 2019).

Given these growing threats to our nation’s waters and the continued need to further clean up our waters, the U.S. Environmental Protection Agency (EPA) should be prioritizing ways to ensure that the Clean Water Act is more effectively implemented and enforced to address the pollution problems. Yet, in the face of mounting pollution challenges, EPA appears to be doing all it can to weaken the Act and wind the clock back to the free dumping days of the late 1960s. After nearly a half century of successfully collaborating with states to implement the Act, under the Trump administration, the EPA has launched a series of initiatives designed not only to weaken federal oversight of clean water, but also to tie the hands of states to protect their own waters. This demonstrates not an ideology of federalism, but rather an anti-regulatory agenda designed to allow business interests more latitude to externalize their costs. It is a troubling trend indeed.

For instance, the EPA recently closed a notably short period for public comment on a proposed rule that would eliminate protections for half of America’s wetlands and countless miles of smaller streams that provide drinking water for millions and
serve as the lifeblood of larger streams and rivers. 84 Fed. Reg. 4154 (Feb. 14, 2019). This rule would replace a 2015 science-based rule that builds upon Justice Kennedy’s pivotal opinion in the 2006 U.S. Supreme Court case Rapanos v. United States, 547 U.S. 715 (2006), that the Clean Water Act intended to broadly protect all waters with a “significant nexus,” measured individually or in the aggregate (e.g., wetland systems or tributary systems), to navigable waters.

The Trump administration’s proposed new rule would toss aside this science-based approach in favor of an approach similar to that described in Justice Scalia’s minority opinion in Rapanos, which concluded that the Clean Water Act should protect only relatively permanent waters with a continuous surface connection to navigable waters. That approach ignores the vital functions of wetlands that don’t directly flow into or out of other, larger waters and intermittent and ephemeral streams—such as pollutant filtering, water retention, habitat provision, and nutrient uptake—to achieve and maintain water quality. The proposed rule could remove many headwater streams and wetlands from federal protections against pollution and destruction, which is an enormous threat to water quality, particularly in more arid regions of the country.

In April, the EPA also announced in an “interpretative statement” that the Act protections no longer would apply to pollution or sewage discharged into underground wells or aquifers, even if the polluted discharge flows directly into drinking water sources such as lakes or rivers. U.S. EPA, Interpretive Statement, Application of the Clean Water Act National Pollutant Discharge Elimination System Program to Releases of Pollutants from a Point Source to Groundwater, Apr. 12, 2019, www.epa.gov/sites/production/files/2019-04/documents/interpretive_statement_application_of_cwa_npdes_memo_-_signed.pdf. This interpretive statement (a document of dubious legal authority) was issued shortly after the U.S. Supreme Court agreed to take up County of Maui, Hawaii v. Hawaii Wildlife Fund, a case from the Ninth Circuit Court of Appeals that is intended to decide that very same issue. Prior to this interpretive statement, the EPA and most courts generally had held that discharges from point sources into groundwater tributary to (or directly traceable to) surface waters require National Pollutant Discharge Elimination System discharge permits under the Act.

Also in April, President Trump issued an executive order that instructed the EPA to limit the time that states have in which to decide, and the information available to them in deciding, whether to approve or veto potentially polluting projects that require federal permits and discharge into waters. Executive Order on Promoting Energy Infrastructure and Economic Growth, Apr. 10, 2019, www.whitehouse.gov/presidential-actions/executive-order-promoting-energy-infrastructure-economic-growth/. The executive order is clearly aimed at making it easier to build oil and gas pipelines and restricting the ability of states under their Clean Water Act section 401 water quality certification processes to halt harmful projects. Contrary to principles of federalism and states’ rights, the executive order likely will result in limiting the ability of states to object to federally permitted projects that can degrade water quality, such as dam operations or oil and gas pipelines. The details and the extent to which this executive order ties the states’ hands in protecting state water quality will take shape in subsequent guidance and rules.

Sadly, these attacks on clean water are par for the course for the Trump administration. In the last two years, we’ve seen attack after attack on clean water with attempts to whittle away decades-old safeguards. For example, the Trump administration also is rewriting the rules to restrict EPA’s express authority under section 404(c) of the Act to block projects with unacceptable environmental impacts. Although it has been used just 13 times, EPA’s actions have saved 210,000 acres of wetlands and 36 miles of rivers and streams in 11 states. In recent testimony, EPA Administrator Andrew Wheeler told a Senate subcommittee that EPA is contemplating revisiting a veto from the George W. Bush administration that blocked a particularly egregious wetland drainage project known as the Yazoo Backwater Pumps. John Surratt, New hope for Yazoo backwater project, Vicksburg Post, Apr. 5, 2019, available at www.vicksburgpost.com/2019/04/05/new-hope-for-yazoo-backwater-project/.

Joining EPA in that action, the Army Corps of Engineers has drafted new guidance—that has not been made available to the public for input—restricting the amount of time states have in which to review Clean Water Act permits to dredge or fill wetlands and streams. See R.D. James, Ass’t Sec. of the Army, Memorandum for the Chief of Engineers, USACE Regulatory Policy Directives Memorandum on Duration of Permits and Jurisdictional Determinations, Timeframes for Clean Water Act Section 401 Water Quality Certifications, and Application of the 404(b)(1) Guidelines, Dec. 13, 2018 (detailing Corps review of timeframes for CWA Section 401 certifications). Likewise, the U.S. Department of Agriculture issued an interim rule that makes it easier for landowners to drain seasonal wetlands while still receiving federal farm bill subsidies. See 83 Fed. Reg. 63,046 (Dec. 7, 2018).

The U.S. public largely opposes these attacks on clean water. For example, despite the short public comment period on EPA’s proposed rule limiting wetlands protection, more than half a million Americans spoke out against the proposed reductions to the scope of the Clean Water Act. Clean water is vital to people and wildlife. The health of our waters faces enough challenges. Our federal agencies need to live up to their charge to protect the health of waters, not undermine that charge.

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Disability Rights and Dignity in Disasters

Aleksandra “Sasha” George and Erin Flannery Keith

One in four U.S. adults—61 million people—have a disability that impacts their ability to walk, breathe, communicate, hear, process information, and see. See Catherine A. Okoro et al., Prevalence

People with disabilities may rely on mobility and communication devices and practices that environmental disasters can severely disrupt. Federal and local emergency responders may fail to anticipate the needs of disabled persons at times when there is no electricity, no gas, and no clear pathways to safety before, during, and after a climate change disaster. Climate change—enhanced storms and disasters are, devastatingly, giving governments increasingly frequent opportunities to deploy proactive emergency response plans. Municipalities and other government entities across the United States (including U.S. territories) should revisit these plans to ensure that they are inclusive of people with disabilities, including people of color with disabilities living in colonies.

Governments should not wait for the next disaster to test the effectiveness and shortcomings of their emergency response plans in meeting the intersectional needs and protecting the rights of people with disabilities. Nancy López and Vivian L. Gadsden describe intersectionality as

[a] way of understanding and analyzing complexity in the world, in people, and in human experiences. The events and conditions of social and political life and self . . . are shaped by many factors in diverse and mutually influencing ways. When it comes to social inequality, people’s lives and the organization of power in a given society are better understood as being shaped not by a single axis of social division, be it race or gender or class, but by many axes that work together and influence each other.


An anti-discrimination legal framework outlines what federal agencies and state and local agencies that receive federal money for emergency and disaster planning and response must do to meaningfully address the needs of people with disabilities. Section 504 of the Rehabilitation Act of 1973 prohibits discrimination or denial of benefits based on a disability “under any program or activity receiving Federal financial assistance or under any program or activity conducted by any executive agency.” 29 U.S.C. § 794(a). Title II of the Americans with Disabilities Act of 1990 (ADA), 42 U.S.C. § 12132, requires that “no qualified individual with a disability shall, by reason of such disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of a public entity, or be subjected to discrimination by any such entity.” The ADA aims to prevent intentional discrimination against persons with disabilities as well as de facto discrimination that arises from “thoughtlessness and indifference.” Alexander v. Choate, 469 U.S. 287, 301 (1985). Title VI of the Civil Rights Act (Title VI), 42 U.S.C. § 2000d, prohibits discrimination based on race, color, or national origin in all programs and activities receiving federal financial assistance. Courts have “relied on case law interpreting Title VI as generally applicable to later statutes,” including the ADA and other statutes concerning disability discrimination. U.S. Dept of Transp. v. Paralyzed Veterans of Am., 477 U.S. 597, 600 n.4 (1986).

At least three federal district courts have found that municipalities violate ADA Title II when their emergency and disaster response plans fail to meaningfully accommodate people with disabilities. In Communities Actively Living Independent and Free v. City of Los Angeles, No. CV 09- 0287(CBM), 2011 WL 4595993 (C.D. Cal. Feb. 10, 2011), the court found that Los Angeles’ emergency response plan discriminated against people with disabilities because it did not “include provisions to notify people with auditory impairments or cognitive disabilities of an emergency, or evacuate, transport, or temporarily house individuals with disabilities during or immediately following an emergency.” Id. at *13. The court found that Los Angeles also did not “provide or identify accessible shelters when such shelters are available to other residents” and that the city’s “ad hoc accommodations” in shelters and for evacuation transportation were “legally inadequate and practically unrealistic” to meet the needs of people with disabilities. Id. at *13–14.

In California Foundation for Independent Living Centers (CFLIC) v. County of Sacramento, 142 F. Supp. 3d 1035 (E.D. Cal. 2015), the court found that Sacramento County’s emergency evacuation plans violated the ADA and Rehabilitation Act because the county “provided no evidence of plans to communicate the locations of accessible emergency exits, stair chairs, or other emergency evacuation devices when an emergency rises, and it has provided no evidence of plans to tell people with mobility disabilities who will help them or where to wait for help. By providing specific plans for communications to the general public but not to the mobility impaired, the county’s plans disproportionately burden people with disabilities.” Id. at 1063–64. In March 2019, CFLIC and Sacramento County entered into a settlement agreement in which Sacramento County agreed to revise its emergency evacuation and communication plans. See Settlement Agreement, Mar. 18, 2019, Case No. 2:12-CV-03056- KJM-GGH.

In Brooklyn Center for Independence of Disabled v. Bloomberg, 980 F. Supp. 2d. 588 (S.D.N.Y. 2013), the court thoroughly criticized New York City’s failure to address the needs of people with disabilities before, during, and after Hurricane Sandy in October 2012—an extreme weather event whose severity was exacerbated by climate change. The court found that most aspects of New York’s emergency evacuation, transportation, communication, shelter, power outage assistance, and interim housing plans and practices violated ADA Title II. The city’s evacuation plans assumed that multi-story building residents would evacuate independently and use public transit to reach a shelter. However, many multi-story building residents who rely on mobility devices were unable to evacuate independently prior to Hurricane Sandy’s onset, and residents with disabilities testified that there was confusing and conflicting information about paratransit services. The court concluded that these gaps “ensure[] that the opportunity of people with disabilities to evacuate will be unequal to that of individuals without special needs—that is, that the opportunity of people with disabilities to benefit from advance planning for evacuations is unequal
to that of others . . . because the City’s evacuation plans do not sufficiently account for the transportation needs of people with disabilities, people with disabilities lack meaningful access to those plans.” Id. at 644–45. As the Brooklyn Center case demonstrates, municipalities cannot rely on ad hoc plans to evacuate and transport people with disabilities in the event of an emergency. The court also found that New York City’s emergency shelter practices violated ADA Title II. Based on testimony that people with mobility disabilities had difficulty accessing and using shelter entrances and facilities, the court stated, “there is nothing in the City’s plans that requires evacuation centers to be located in buildings with usable entrances (let alone anything that provides guidance as to how to modify non-accessible entrances such that they are usable).” Id. at 647. Even if individuals with disabilities were able to find a usable shelter entrance, the court found that New York City violated ADA Title II because many shelters lacked backup generators and accessible restrooms, dormitories, and communication systems.

U.S. disability and antidiscrimination laws also apply in Borikén, also known as Puerto Rico, which Hurricanes Irma and Maria devastated in 2017. For any community in the Caribbean and the global south, intersectional considerations complicate climate change preparedness and resilience. Without measures that center intersectional realities, individuals of color with disabilities are left alone to address the unique climate challenges that disproportionately impact the poorest and darkest communities. See López & Gadsden, supra. Spanish and Italian colonists invaded the Caribe, the land of the Taino people of the Arawak Nation, in 1492. Shortly afterward, in 1502, the Spanish monarchy brought the first ships of enslaved Africans to the shore of Quisqueya, or present-day Haiti and the Dominican Republic. Since acquiring independence from Spain in 1898, Puerto Rico has remained a colony of the U.S. government. In 2019, this translates to black and brown Puerto Ricans living in the poorest regions left to survive climate change catastrophes in a political structure that does not afford them the ability to vote on federal preparedness measures and in bodies overburdened with inherited and present-day trauma. In the spring before Hurricanes Irma and Maria consumed Borikén, Natural Resources Defense Council released the report Threats on Tap: Widespread Violations Highlight Need for Investment in Water Infrastructure and Protections (May 2, 2017), available at www.nrdc.org/sites/default/files/threats-on-tap-water-infrastructure-protect/report.pdf. It identified Puerto Rico as having the worst rate of drinking water violations of any U.S. state or territory. In 2015, 99.5 percent of Puerto Rico’s population was served by water systems in violation of the Safe Drinking Water Act. After the hurricanes, inhabitants of physically isolated towns, such as Dorado, relied on the only drinking water available—in some instances from Superfund sites. Miles de puertorriqueños toman agua contaminada y se bañan en ella por falta del servicio tras el paso del huracán María (Oct. 17, 2017), Univision Puerto Rico.

After the hurricanes, towns far from the colonial San Juan, like Maní and Humacao, waited the longest before encountering emergency responders. Viktor Manuel Camacho Rodríguez is a Puerto Rican from Caguas who lived in Humacao. He cares for his father, who has Alzheimer’s. We interviewed Mr. Rodríguez in May. Mr. Rodríguez described the conditions that some of the “most vulnerable” members in the predominantly black and brown communities in Puerto Rico faced after the hurricanes. He said that individuals with disabilities were “forgotten,” and stated that “[emergency responders] have forgotten about the individuals that were on beds, that couldn’t move themselves from one area to a safer one.” In a disaster, individuals with cognitive or mobility disabilities may be afraid or unable to move to temporary housing, unsure of what they will encounter. Mr. Rodríguez explained that “[t]he only options we got were to go to temporary housing or stay in our homes . . . [and] my father gets aggressive when he’s in locations he doesn’t know. If there had been a doctor or a nurse assigned beforehand to each shelter, it would have been more viable.” Humacao is a remote area (and is an Afro- and Taino-descendant community), and Mr. Rodríguez and his father were not able to seek shelter or immediate medical attention. He said that “[t]wo to three months after the hurricane, we started to see support from medical professionals. Before then we [would have] needed to take him to the Navy’s boat stationed in San Juan. Because we were one of the most devastated areas after hurricane, we didn’t get the help we needed.”

Mr. Rodríguez reflected, “I would like people to keep the caretakers in mind, and more so the individuals who can’t move . . . the individuals with disabilities. And they have no other choice to stay where they’re at.” Mr. Rodríguez knows that “this won’t be the last [hurricane] that will consume the island. I think the next ones will be stronger. And for individuals with patients that are immobile, folks with Alzheimer’s, or anyone that relies on equipment to breathe, Puerto Rico should take all of that into account. We’re in a zone vulnerable to hurricanes. We’re going to have to evolve. It’s necessary to survive. When your enemy gets stronger, you have to find a way to fight it.”

We write from multiple perspectives that carry privilege, as two cisgender women with U.S. citizenship, higher education levels, and not living with disabilities. We hope this conversation continues to be led by individuals that live with disabilities, and we encourage journal and newspaper editors and managers to give priority to writers and communities that live with disabilities. Puerto Ricans continue to process the impact climate change will have on the lands of their ancestors. Persons with privileges inherited from white Spanish, French, Dutch, and British ancestors likely will have the means to relocate as climate refugees if necessary, while most of the black and/or Taino-descendant communities likely will not. When devising climate change resilience strategies and emergency response plans, governments should give prominence to the intersectional realities individuals with disabilities face. Drills, improved emergency planning, and adjusted targeted outreach can help governments prevent unlawful discrimination against people with disabilities and people of color and save lives.

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UK Parent May Be Liable for Pollution by Zambian Subsidiary

Lois G. Paine

Can an English holding company be held liable for the actions of its overseas subsidiaries that cause harm to third parties? A year ago, my answer would have been that third parties had never succeeded in such a claim, and that even employees of such a subsidiary would have found it very difficult to win an action against the parent company.

This changed with a new case, Vedanta Resources Plc v. Lungowe [2019] UKSC 20. The Supreme Court judgment (the highest court in the United Kingdom (UK), replacing the House of Lords) was given on April 10. It was the culmination of four years of dispute over the jurisdiction of the courts of England and Wales to hear the claims against Vedanta (V), the English registered holding company of a multinational group. From about 2005, 1,826 impoverished villagers in Zambia alleged that a subsidiary of V, Konkola Copper Mines (K), had discharged toxic matter into their only source of water, causing injury to them, their livestock, and farms. They brought an action against V and K.

Although the case concerned jurisdiction, the most important issue related to parent company liability. Until now, the most widely cited case on this issue was Chandler v. Cape Plc [2012] EWCA Civ 525, where a parent company (Cape) was found to be liable to the employees of its subsidiary. The employees had been exposed to asbestos, and a duty of care was owed by Cape to those employees due to an omission to advise on precautionary measures. This was because of Cape’s “state of knowledge” about the factory where the employees worked and “its superior knowledge about the nature and management of asbestos risks” associated with its subsidiary’s operations.

But in Thompson v. The Renwick Group Plc [2014] EWCA Civ 635, no duty of care was found between a parent company and the employees of its subsidiary. There was no evidence that the parent company in question carried on any business apart from holding shares, and so there was no duty of care owed by the parent company as a subsidiary of an English subsidiary of a multinational group.

Lord Briggs gave the written judgment of the Supreme Court in Vedanta. He stated that the negligence claim did not raise any novel issue of law. A parent company might owe a duty of care to those living nearby its subsidiary and affected by the subsidiary’s operations or use of the land on which the operations were conducted. It all depended on the extent to which, and the way in which, the parent company availed itself of the opportunity to take over, intervene in, control, supervise, or advise the management of the relevant operation, including land use of the subsidiary.

He stated that parent and subsidiary were separate legal persons, each with responsibility for their own separate activities. A parent company would only be found to be subject to a duty of care in relation to an activity of its subsidiary if ordinary, general principles of the law of tort regarding the imposition of a duty of care on the part of the parent in favor of a claimant were satisfied in the particular case.

V had published material in which it asserted its own assumption of responsibility for maintaining proper standards of environmental control over the activities of its subsidiaries and, in particular, the operations at this mine. It laid down and implemented those standards by training, monitoring, and enforcement. That was sufficient on its own to show that a sufficient level of intervention might be demonstrable at trial to find the relevant duty of care.

Two previous recent cases, AAA v. Unilever plc [2018] EWCA Civ 1532 and HRH Emere Godwin Bebe Okpabi v. Royal Dutch Shell plc [2018] Bus LR 1022, had, at first sight, similar facts to the Vedanta case, but the judgments both went against the African claimants. They followed the earlier cases of Chandler and Thompson, mentioned above. In the Unilever case, the English Court of Appeal dismissed an appeal against a decision that the English court did not have jurisdiction to hear a tort claim against an English company (Unilever) and its Kenyan subsidiary (UTKL). It found that the claimants, Kenyan employees of UTKL, had no arguable claim against either Unilever or UTKL, because neither company owed them a duty of care in tort to take effective steps to protect them from post-election violence in Kenya, which had spilled from the surrounding area to the relevant tea plantation. The employees said that the parent had given relevant advice to the subsidiary about how it should manage the risk, so a duty of care existed. However, the court held that the evidence did not support this duty of care. It found that evidence showed that UTKL carried out its own crisis management training program. UTKL had sole responsibility for devising its relevant policies and for deciding what to do when the crisis arose. Because the claimants did not have a good arguable tort claim against Unilever, they could not establish that the court had jurisdiction to hear the claim.

In the second case, Okpabi, Nigerian claimants appealed against a decision, also on jurisdiction, that the parent company (RDS) did not owe them a duty of care regarding pollution and environmental damage caused by oil leaks from pipelines and associated infrastructure operated by its subsidiary company (SPDC). The Nigerian claimants lost, but by a 2:1 majority decision of the Court of Appeal judges. The appellants were Nigerian citizens and inhabitants of the areas affected by the leaks. RDS was incorporated in the UK and was the parent company of the Shell group. SPDC was an exploration and production company incorporated in Nigeria. SPDC was involved in a joint venture with Nigerian oil companies and operated the pipelines and oil-pumping facilities alleged to have been managed negligently. The appellants brought actions for damages for negligence against RDS and SPDC. They claimed that RDS owed them a duty of care either because it controlled the operation of the pipelines and infrastructure, or because it had assumed a direct responsibility to protect the appellants from the environmental damage caused by the leaks.

The court concluded that there was no arguable case that RDS owed the appellants a duty of care. Their reason included the following findings:

RDS was not operating the same business as SPDC. RDS was the ultimate holding company, and did not operate any business other than holding shares, and dealing with the...
financial matters that affected it as the ultimate holding company. SPDC was the company in Nigeria that was licensed to carry out the relevant operating activities. RDS did not have superior or specialist knowledge compared to the subsidiary SPDC. SPDC had all the specialist knowledge relevant to an operating company licensed by the relevant Minister in the Nigerian government under the relevant legislation. RDS could not be said to know that SPDC was relying upon it to protect the claimants. SPDC was a wholly autonomous subsidiary with considerable income and sizeable assets of its own.

On July 24, lawyers appealing the Okpabi decision announced that they had been granted permission to take their legal claim against Shell to the UK Supreme Court. It will be interesting to see the result of this appeal.

The next issue in Vedanta relates to why the villagers could bring the claim in England. Lord Briggs confirmed that the villagers had an unfettered right to sue V in its country of domicile under Article 4.1 and 8.1 of Regulation (EU) 1215/2012 (Brussels Recast Regulation), which provides that claimants may sue EU-domiciled defendants in their home country courts. This right was recognized, despite V and K arguing that the Article 4.1 and case law on it meant that an English incorporated company could be sued in England by claimants around the world. Such actions could lead to irreconcilable judgments (duplication of proceedings in different countries and the risk of inconsistent judgments) if V and K could not be sued in the same court. The judge stated that Article 4.1 was blind to considerations of that kind.

The villagers also relied on the rules for joinder of an additional non-EU defendant, as contained in the English Civil Procedure Rules (Rules). Under the Rules, the villagers had to demonstrate (1) that the claims give rise to a real issue to be tried against V (which they did, as discussed above in relation to parent company liability); (2) that V was a necessary and proper party to the claims against K; (3) that the claims against K had a real prospect of success; and (4) that either England was the proper place to bring the claims or that there was a real risk that the villagers would not obtain substantial justice in Zambia. The villagers prevailed on all points except the first part of (4); the Supreme Court concluded that England was not the proper place to bring the claims.

The Judge stated that despite this, the court may permit service in England, out of jurisdiction, if satisfied that the villagers would not obtain substantial justice in Zambia. The lower court was so satisfied, but was at pains to avoid any hint of English justice being any better than Zambia’s, or any colonialist or imperialistic reasoning. Lord Briggs stated as follows:

In the present case, the [lower court] judge described this as an “access to justice” issue. By this he meant that the real risk (in his view a probability) that substantial justice would be unavailable in Zambia had nothing to do with any lack of independence or competence in its judiciary or any lack of a fair civil procedure suitable for handling large group claims. Rather, it derived essentially from two factors: first, the practicable impossibility of funding such group claims where the claimants were all in extreme poverty; and secondly, the absence within Zambia of sufficiently substantial and suitably experienced legal teams to enable litigation of this size and complexity to be prosecuted effectively, in particular against a defendant [K] with a track record which suggested that it would prove an obdurate opponent.

Vedanta, [2019] UKSC 20 at ¶89.

Lord Briggs gave weight to a similar Zambian case (Nyasula [2015] ZNSC 33), explaining that action was also against K (Konkola Copper Mines, the subsidiary in the Vedanta case) where 2,000 claimants joined in group litigation about a discharge from the copper mine in 2006 into nearby streams and local river. Medical reports evidencing personal injuries were put in evidence only for 12 claimants. The trial judge found in favor of the claimants on liability, and awarded general damages to all 2,000 claimants on the basis of medical evidence regarding only 12 of them. In the Zambian Supreme Court, the judge was upheld on liability, but the claim by the remaining 1,989 claimants was dismissed for want of medical evidence to prove that they had suffered any loss. This would have required funding from the claimants that they could not afford for disbursements that the claimants’ lawyers would not have been able to pay.

Brexit may affect later cases, because part of the Vedanta case was decided on the basis that the villagers had an unfettered right to sue V in its country of domicile under Article 4.1 of the Brussels Recast Regulation. This may or may not apply in the future because that regulation is currently directly applicable in the UK. The regulation should continue to apply post Brexit until it is repealed or amended by the UK Parliament. Because later courts are likely to follow the Supreme Court’s ruling in Vedanta, another Supreme Court decision may be necessary to overturn this part of the case.

Holding companies in the UK with subsidiaries overseas will be looking at their policies and practices relating to environmental issues in light of the Vedanta case. They should first thoroughly review potential liabilities and seek to mitigate any risks, and also ensure that if they do take responsibility for environmental policies and practices throughout the world, these responsibilities are implemented properly by subsidiaries. Before purchasing a subsidiary abroad, a company should undertake a full and comprehensive due diligence process in the relevant country. If there is any risk of a claim by either employees or third parties, the purchasing company should be aware that it may be taken to court and be held responsible. There is also potential exposure to human rights–based litigation in the purchasing company’s home jurisdiction.

As for Brexit, it is a question of “watch this space.” The stated aim of the government is to make all existing EU environmental legislation continue to apply in the UK upon its exit from the EU, but there will be divergence eventually. This will raise all sorts of legal questions, ensuring the jobs of environmental lawyers in the UK for many years to come.

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Water Banking: A Distribution Solution

Cedar Q. Cosner

By the year 2060, 420 million people are projected to live in the United States, an increase of approximately 100 million from today. Stephanie Ewert, U.S. Population Trends: 2000 to 2060, U.S. Census, NCSl Fiscal Analysts Seminar (Oct. 15, 2015), www.ncsl.org/Portals/1/Documents/nalfo/USDemographics.pdf. As the population increases, the demand for water will increase accordingly. Water banking presents one option for certain states, particularly those in the arid West, to prevent the waste of water by removing the risk of forfeiture for unused quantities, thereby serving to maximize the use of limited water resources. By creating consolidated markets of unused water that third parties can lease for use at a fair market price, public water banking programs help distribute water that otherwise would go unused. This article discusses the various governance structures that have been used or attempted to implement water banking programs.

Water banking is a relatively untested addition to the traditional prior appropriation water doctrine, which was adopted by settlers moving into the western states. In summary, the prior appropriation doctrine gives an appropriator who first diverts and applies a water resource to a beneficial use—such as industry, irrigation, residential, or municipal use—the right to use the quantity of water so applied to the exclusion of any later-established uses. If the appropriator continues to use that water beneficially, the right will typically exist in perpetuity, and the appropriator will have the right to stop subsequent water users from diminishing the appropriator’s water right. Conversely, if the appropriator fails to use all or part of his or her water right in a beneficial way for a period of years, most jurisdictions have the authority to forfeit the right or unused portion. See, e.g., Utah Code Ann. § 73-1-4 (seven years).

Under the prior appropriation system, water rights typically began tied to the land for which they were appropriated, and a person could not appropriate more water than that person could beneficially use on the land. As land uses changed, situations arose in which the appropriated right exceeded the land on which it could be beneficially used. For example, due to marginal crop yields or values, a water right holder may find that it is not economically viable to beneficially use an entire water right. One option under those circumstances is to sell the right or unused portion. However, that does not address situations in which the right holder anticipates resuming full beneficial use of the right in the future. In that situation, a water right holder may have, and intend to keep, the right to beneficially use more water from a right than he currently has land to viably use it on.

This can create a problem. If a water right goes unused too long, it is forfeited. But that takes years. For an extreme example, a surplus water right holder in Utah need only find a way to beneficially use his surplus water once every seven years to preserve the right. See id. More typically, a farmer may let irrigable acreage go dry on crop rotation for a year, or a developer may hold water rights in reserve while a project is built out. Municipalities or other public water suppliers may also hold idle water reserves in anticipation of future development. In each of these cases, an idle water right is a wasted opportunity.

Water banking is an attempt to resolve the problem of wasted or unused water. Fundamentally, water banks are institutional mechanisms through which water right holders can safely deposit unneeded rights into a regulated account, and people who need water can lease it from the account at a fair market-rate on a temporary basis. See Water Transfers in the West: Projects, Trends, and Leading Practices in Voluntary Water Trading, Western Governors’ Ass’n (Dec. 2012), at 38, www.westernstateswater.org/wp-content/uploads/2012/12/Water_Transfers_in_the_West_2012.pdf. By creating a centralized market for the leasing of water rights, and better ensuring that water rights remain productive, lessors, lessees, and the water-using public benefit.

Private leasing is not new to water rights. Generally, private parties are free to contract for water use, and if the change of use does not impair other water rights, the transaction goes smoothly. However, even with contractual provisions to the contrary, a private lease agreement cannot ensure that water rights leased actually are used or otherwise protected from forfeiture. Water banking takes leasing a step further by protecting a lessor’s water rights from forfeiture. Under a typical water banking system, water deposited in the water bank is protected from forfeiture statutes that otherwise would apply, even if the right in the bank sits unleased and unused. See, e.g., Idaho Code Ann. § 42-222(2) (“failure for the term of five (5) years to apply [a water right] to the beneficial use for which it was appropriated” results in forfeiture of the right); Id. § 42-223(5) (“A water right shall not be lost or forfeited . . . . while the water right is placed in the water supply bank or is retained in or rented from the water supply bank . . . .”).

Lessors who participate in water banking can lease their water without risk of loss. Rather than letting a water right sit idle during a crop rotation, it may make more sense for the holder of a surplus water right to bank the right temporarily and be compensated for its use. This complements the primary focus of water banking—the creation of a single market that can effectively distribute unused water reserves. By getting water right holders to deposit their unused water rights into a bank, a single accessible market is created that potential lessees can use to satisfy their water needs without hunting for available water rights in the private market.

To date, California, Colorado, Idaho, Montana, Oregon, Texas, and Washington have created some form of public water bank system designed to facilitate water right transactions between private parties. Nazaret M. Montilla-Lopez et al., Water Banks: What Have We Learnt from the International Experience, Univ. Cordoba Dept’t of Agric. Econ., Water (2016), at 5–8. Utah and Wyoming may be the next states to join the public water banking field. (While Arizona, Nevada, and New Mexico are also sometimes discussed in the water banking context, the existing programs in those states do not enable centralized markets. Instead, they are designed for the storage of water to serve long-term future needs, or in the case of New Mexico, to augment stream flows. They are not discussed here.)

Although water banking systems share common features, such as protection from water right forfeiture, there is no magic formula behind the creation of a successful water bank.

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In fact, there are at least three distinct operational schemes that water banking systems have adopted.

Some water banking systems provide for centralized public governance. The longest-running water banking system, in Idaho, has been singularly controlled by the state water resource board since 1979. The bank is centralized and holds all banked water rights in the state. Idaho Code Ann. § 42-1761. The board has authority to “contract with lessors and lessees to act as an intermediary in facilitating the rental of water,” and all rentals from the bank “must be approved by the director of the department of water resources.” Id. § 1762–63. Contracting lessees are entitled to take water from one of several reservoirs managed by state districts. In 2018, Idaho recorded 300 water lease applications.

To a lesser degree, California utilized this form of governance when it instituted its Drought Water Bank program, a conditional water banking system that is implemented in periods of drought. The state entered a series of purchase agreements to buy excess water rights from private parties and then redistributed it from a centralized market. It was first utilized from 1991 to 1994 and was generally considered a success, redistributing approximately one million acre-feet of water in that period. It was utilized again in 2009 with diminished effect, redistributing only 82,000 of the state’s 600,000 acre-foot goal. One possible reason for the 2009 bank’s limited success was the addition of regulations defining who could sell water to the state, which served to increase the transaction cost between seller and buyer. See Robin Kundis Craig, Drought and Public Necessity: Can a Common-Law “Stick” Increase Flexibility in Western Water Law?, Utah Law Faculty Scholarship 98 (Mar. 2018), at 10–11.

Texas also attempted direct public governance in its ill-fated Texas Water Bank instituted in 1993. While still technically active, the project is largely considered a failure for lack of participation, completing only one transaction in its first ten years of existence. Currently, seven lessors are involved in the program, with the last deposit in 2009. The state’s decision to allow other private leasing markets to endure and to compete with the public system greatly inhibited its ability to gain traction with local water users. See Peggy Clifford et al., Analysis of Water Banks in the Western States, Wash. Dep’t of Ecology, Pub. No. 04-11-011 (July 2004), at 112.

The Washington water banking program provides an example of a second type of governance—centralized public-private partnership. While Washington’s water board will act as a bank to individual water users, it also permits private parties to conditionally assume the role of water bank. Washington’s water board has broad statutory authority to administer “trust water rights acquired by the state.” Rev. Code Wash. Ann. § 90.42.040(1). Rather than directly distributing water rights, the state water board contracts with private bankers or water users, who place water rights in the state trust as part of the agreement. Those water rights are considered mitigation for new water uses that are subsequently made through the bank or by the water user. See Rev. Code Wash. Ann. § 90.42.100. Because Washington does not directly manage its water banks, it is difficult to determine how many individual water lease arrangements have been made. However, Washington has authorized 25 water banks across the state.

Finally, some water banking systems provide for direct local public governance. States in this third category have set up region-specific banks that are locally managed by water districts or conservancies, subject to broad rules at the state level. In Oregon, the Deschutes River Conservancy administers the Deschutes Water Alliance Water Bank, a water bank specifically focused on the central part of Oregon. Deschutes Water Alliance, Water Bank: Balancing Water Demand in the Deschutes Basin, at 3 (last visited Aug. 8, 2019), https://www.deschutesriver.org/DWA-Water-Bank.pdf. In 2002, Colorado launched an unsuccessful pilot program governed by a local conservancy that had no recorded transactions—likely due to skepticism from the local water community as to whether the system would effectively protect deposited rights or facilitate transactions. Utah appears poised to adopt a local public governance system, citing a need to account for the “unique circumstances and needs” of various water regions in the state. Summary of Water Banking Subgroup Findings (May 29, 2018), at 2–3, www.waterrights.utah.gov/meetinfo/task_force/wbanking/20180529_subgroup_findings_summary_addendums.pdf. However, no specific legislation has been formally proposed in Utah yet.

As water needs grow, it will become increasingly important that states find ways to reintroduce water that is not being used back into the stream of commerce. Water banking has emerged as a viable candidate to accomplish just that. Moreover, water banking has been shown to work under multiple operational schemes. But any plan for implementation should take into account the potential pitfalls to success, including overly cumbersome transactions between lessor and lessee, skepticism from water right holders, and competition from private water markets where applicable. Although multiple operational schemes may be workable for a state’s specific needs, all states designing a water banking program should endeavor to implement lean water banking mechanisms with an eye toward making water leasing as easy as possible without adversely impacting water right holders.

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Barry Lopez

Reviewed by Madeline June Kass

**BOOKS**

Horizon

Barry Lopez

ALFRED A. KNOPF, 2019

* * *

**LITERARY RESOURCES**

Reviewed by Madeline June Kass

What we saw when we got there had the same two effects, it seemed, on each of us. No one in the group was talking as we approached, but in that moment we all came to a standstill and remained in utter silence, motionless, for many minutes. In a kind of vast amphitheater on the sea ice below us was the sort of wildlife spectacle one fantasizes about seeing one day, and then gazes at in disbelief, as though confronted by an illusion, a scene that would resolve itself into ordinary reality when the spell broke. The spell never broke.

* * *

Below us all is ice, radiant under a uniform fall of direct sunlight. The frozen sea is all gray and white—the grays of fog, of smoke; the whites of gypsum. The “alleluia plain” of sunlit sea ice here carries heterogeneous patches and narrow lines of dark charcoal, with dabs of light brown within the dark patches. With my binoculars, the dollops of brown resolve into fuzzy emperor penguin young, the charcoal patches and lines into
adults. The orange blotches at the back of the adult’s heads and the yellowish glow of their upper chests sharpen in the glass of the binoculars.

* * *

The hour we spend with them is intimacy without narrations, an experience without increments of measured time. The unvoiced emotions we felt, which we mention to one another later, include inexplicable tenderness, moments of soaring elation. In Antarctica, where death seems to lurk more than it does in other places, each of us is drawn strongly to anything as clearly alive as these birds.

In Horizons, Lopez draws on his boyhood memories, travel experiences, and knowledge of history, art, archeology, geography, geology, and cosmology to offer readers an expedition through one man’s physical and spiritual life of travel. As for the book’s title, Lopez explains,

[when a boundary in the known world—say, a geographical one for Thule people migrating eastward from Alaska, moving farther into an inhospitable world than anyone had ever gone—becomes instead a beckoning horizon, the leading edge of a farther destination, then a world one has never known becomes an integral part of one’s new universe. Memory and imagination come into play. The unknown future calls out to the present and to the remembered past, and in that moment of expansion, the imagined future seems attainable.

**Falter: Has the Human Game Begun to Play Itself Out?**

*Bill McKibben*

**Henry Holt & Company, 2019**

Bill McKibben’s latest book, *Falter*, examines whether humanity, as we understand it, may be coming to an end. An environmental advocate, climate activist, and prodigious author, McKibben describes *Falter* as “an account” of how the climate crisis and new technological developments threaten our human future.

McKibben employs the term “human game” to capture the “sum of the projects of our individual lives, the total of the institutions and enterprises we have created, the aggregate of our wishes and dreams and labors, the entirety of our ceaseless activity.” This human game, according to McKibben, is “unimaginably deep, complex, and beautiful.” But, “it is also endangered. Indeed, it is beginning to falter even now.”

The human game is faltering, according to McKibben, in part because of climate change, a threat with effects so far-reaching that we can’t be confident of surviving them.” The first part of the book details the profound challenges of climate change and how they are shrinking planet habitability: “Our earth is large but it is finite, and we’re beginning to lose parts of it.” The second part of the book examines confounding factors—the leverage—that make it difficult to address climate change and that shut down serious counteraction. This leverage derives from the greed, self-interest, and hyper-individualist worldview of very powerful fossil fuel industrialists.

Climate change, however, is not the only threat to the human game raised in *Falter*. The book covers risks to the human game from gene altering technologies, artificial intelligence (AI), and leverage of tech billionaires motivated by profits and a quest for immortality. In the third part of the book, McKibben raises serious—science fiction level scary—drawbacks of germline genetic engineering and unlimited expansion of AI and questions whether humans will survive such transformation and, if so, how far “can we go and still stay ourselves.”

Despite McKibben’s bleak picture of the future, he offers readers the possibility of hope, “an outside chance” of preserving the game. The final chapters of the book are about “resistance” and “the tools and ideas that might help us contain global warming and technological mania within some limits and, in the process, keep the human game recognizable, even robust.” McKibben argues that we need to see ourselves as “part of one human family” with a “sense of social solidarity.” Adopting this mindset, he contends that we might then engage two powerful, transformative technologies toward preserving the human game: the “miracle” of solar and the persuasive force of nonviolent movements capable of changing hearts and minds. *Falter* examines each of these tools, their transformative capabilities, their limits, and their ability not only to save us, but to make the human game “more beautiful.”

Although *Falter* leaves unanswered the ultimate question of whether we will find our way, it dangles a sliver of hope for humanity. In the book’s opening note, McKibben writes:

I’ve come to believe that we have the tools to stand up to entrenched power. Whether that entrenched power can actually be beaten in time I do not know. A writer doesn’t owe a reader hope—the only obligation is honesty—but I want those who pick up this volume to know that its author lives in a state of engagement, not despair. If I didn’t, I wouldn’t have bothered writing what follows.

In closing, McKibben reiterates:

So, yes, we can wreck the Earth as we’ve known it, killing vast numbers of ourselves and wiping out entire swaths of other life—in fact, as we’ve seen, we’re doing that right now. But we can also not do that.

* * *

I do not know that we will make these choices. I rather suspect we won’t—we are faltering now, and the human
game has indeed begun to play itself out. . . . But we could make those choices. We have the tools (nonviolence chief among them) to allow us to stand up to the powerful and the reckless, and we have the fundamental idea of human solidarity that we could take as our guide.

Natural Resource Damages: A Guide to Litigating and Resolving NRD Cases

Brian D. Israel, Brett Marston, and Lauren Daniel

ABA SECTION OF ENVIRONMENT, ENERGY, AND RESOURCES, 2019

The newly released American Bar Association (ABA) publication, Natural Resource Damages: A Guide to Litigating and Resolving NRD Cases, tackles the complex and challenging practice of natural resource damages (NRD). As defined in the book’s introduction, NRD claims are “claims asserted by federal, state, or tribal governments seeking restoration of injuries to natural resources resulting from certain types of industrial contamination and oil spills.” These claims are particularly complex and often involve very high stakes, as noted by the authors, because they “involve a constellation of complicated legal questions, ranging from overlapping governmental oversight to uncertain standards of proof to a myriad of untested legal defenses,” “present difficult evidentiary issues involving biology, chemistry, ecology, economics, engineering, statistics, toxicology, and numerous other academic disciplines,” and give rise to a multitude of “formidable” strategic questions and considerations.

Addressing these complexities, the book offers a guide to “the legal, evidentiary, and strategic issues associated with litigating and resolving NRD claims.” Book chapters include detailed explanations of the statutes and regulations comprising the NRD legal framework, the key NRD defenses, the steps for conducting NRD assessments (NRDA), and the methods for determining the monetary value of the natural resource injury. Additional chapters discuss and recommend strategies for approaching cooperative assessments, litigation, restoration, and settlement of NRD claims. Many of these chapters include discussion of the advantages and disadvantages of various approaches and methodologies along with “expert insights” related to the chapter’s subject matter.

In addition, the authors offer approaches for dealing with particularly complicated NRD claims—situations involving sites with multiple trustees, third-party practice and contribution claims, insurance disputes, damages to historic and cultural resources, and climate change implications.

A final chapter in the book compares the NRD approach taken by the United States with that taken by the European Union (EU). The authors provide an overview of the EU’s NRD approach—as adopted in the Environmental Liability Directive—and touch on some of the challenges of transcribing and implementing the directive across the member states.

Resources at the end of the book include a 100-page NRD claims appendix (providing website links to site, settlement, and consent decree information and listing associated NRD assessment costs, restoration payments, and implemented projects) and a table of referenced cases.

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date, its power as a regional metaphor has endured and gathered strength. “The delicate balance of the short-grass prairie, empire and development through subsidy and technology,” writes Professor Stephen Wall of the White Earth Nation and chair of the Indigenous Liberal Studies Department of the Institute of American Indian Arts in Santa Fe, New Mexico, “are rapidly coming into contention with the reality of climate change, costs of production and diminishing populations.” He observes that the primordial vastness of the region creates a spiritual connection between humans with other beings, animate and inanimate, conjuring a view of the natural world open to all and for the benefit of all. Stephen Wall, Reimagining the Buffalo Commons, Green Fire Times, Aug. 2, 2017 (files of the author; article not online).

In a recent telephone conversation, Deborah and Frank Popper reasserted the rightness of their fundamental thesis. The Great Plains’ irrigation-dependent agriculture will dwindle as the Ogallala Aquifer is exhausted. Its cattle industry, cyclical as always, faces a clouded future as overall domestic demand for beef declines. See, e.g., Livestock & Meat Marketing: Historical Demand Indices, AgManager.info, Kan. State U. Agric. Econ., www.agmanager.info/livestock-meat/meat-demand/historical-domestic-demand-indices. As alternative energy expands and climate action accelerates, the handwriting is on the wall for the Plains’ fossil-fuel industries and the smaller communities they sustain.

The demographic fallout may be uneven. The Fargo (N.D.)–Moorhead (Minn.) area has swelled from 175,000 in 2000 to 245,000 in 2018, fueled by agricultural prices; the latest energy boom; and growth in the area’s medical, technology, and manufacturing sectors. Greta Kaul, What’s Behind Fargo-Moorhead’s Boom? Minnpost, July 9, 2019, https://www.minnpost.com/economy/2019/07/whats-behind-fargo-moorheads-boom/?

The two cities may end up, in the words of the Poppers’ essay, “urban islands in a shortgrass sea.”

Echoing Stephen Wall, Frank Popper told me he sees the Buffalo Commons as fostering reconciliation between Indians and non-Indians where both share an identity shaped by climate, isolation, poverty, and powerlessness. At the symbolic level, the Buffalo Commons can inspire more appropriate planning for the shared use of Western land beyond its nineteenth century parceling into uneconomic homesteads fenced by barbed wire—or the modern walling off of its federal acreage from local influence in decision-making. Deborah Popper & Frank Popper, “Regional Planning on the Frontier,” ch. 5 in Regional Planning in America: Practice and Prospect (Ethan Seltzer & Armando Carbonell eds., 2011).

In the end, the wider national debate over the private versus the commons, over resource exploitation versus protection, may usefully draw from the experience of a region where the choices have been presented longer, and their consequences more starkly, than in any other part of the country. Mr. Scoll is a member of the editorial board of Natural Resources & Environment. He may be reached at jonscoll@gmail.com.
"Grass no good upside down"
—Pawnee chief, watching settlers plow up shortgrass prairie, northeastern Colorado, late nineteenth century

Over 30 years ago, Frank and Deborah Popper, husband and wife professors at Rutgers University, published a short essay from which the quote above is taken. They chronicled the post-settlement economic history of a sparsely populated region in 10 states of the Great Plains, one-sixth of the land mass of the lower 48 states. Reviewing its scarce water and extreme climate; its cycles of farming, ranching, and energy-extraction booms and busts; soil degradation; and subsequent abandonment, they wrote that “over the next generation the Plains will, as a result of the largest, longest-running agricultural and environmental miscalculation in American history, become almost totally depopulated.”


The region, they said, “represents a spectacular variant on the tragedy of the commons,” an “ecological fable of how individual short-term rationality can lead to collective long-term disaster.” They imagined, as an “intriguing alternative” to inevitable decline, a federally sponsored “deprivatization” program in which the U.S. Department of Agriculture would buy out economically marginal properties, relocate their own occupants, and replace row cropping and ranching with a restored grassland and its original game animals, including the American bison—in effect the creation of a large national park they termed the “Buffalo Commons.”

From a tiny spark in a specialist publication, the Buffalo Commons spread as quickly as a prairie wildfire. The Popper, urbanites from Chicago and New York, respectively, found themselves minor celebrities, with speaking invitations, public testimony, and even death threats. Lauren Donovan, Buffalo Commons, 20 Years Later, Bismarck Tribune, Aug. 31, 2007, https://bismarcktribune.com/news/local/buffalo-commons-years-later/article_cc83255b-3ca1-5055-a33e-5cd8d3b5ec63.html. They had hit a nerve with locals whose aversion to the federal presence on the Plains is matched only by their eagerness for the subsidies it brings.


But their vision of a literal reversion of the region to its pre-settlement condition remains unfulfilled. While reestablishing tallgrass prairie in more easterly and wetter areas of the Midwest—e.g., Iowa, Kansas, and Missouri—has proven practical, widespread restoration of the shortgrass biome, whose fragility the Poppers recognized, may no longer be feasible. See, e.g., Edward S. DeKeyser et al., Cool Season Invasive Grasses in Northern Great Plains Natural Areas, 33 Nat. Areas J., Jan. 2013, at 81–90, https://doi.org/10.3375/043.033.0110 (subscription required).

And we now know more about the key role Native Americans played in the creation and maintenance of prairie ecosystems, through deliberate burning and other practices over millennia. See, e.g., Charles Mann, 1491 283–288 (2d ed. 2011) (Mann), and authorities cited. Far from being “largely empty and unexploited,” as the Poppers said, the Plains supported significant populations. The giant bison herds encountered by early white settlers may have been an anomaly, reflecting a historically recent decimation of native peoples by European diseases that arrived before Europeans themselves, leaving bison numbers to grow unchecked. Mann, at 367–370, and authorities cited.

But if the Buffalo Commons idea has flaws as ethnohistory and botany, and has found little political traction to

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Environmental Litigation
Law and Strategy, Second Edition
Kegan A. Brown and Andrea M. Hogan, Editors

With challenges that are often unique and wide-ranging, environmental litigation can be an especially complex area of practice. This updated edition of *Environmental Litigation: Law and Strategy* provides practical guidance on the most critical issues in environmental litigation from authors who represent a variety of professional settings, including academia, government, and private practice. The book examines many of the most important topics in environmental litigation, including:

- Federal and state agency regulatory actions and the litigation challenging them
- Government enforcement in both the civil and criminal context
- Issues in specialized litigation, including CERCLA cost recovery and damages, citizen suits, toxic torts, pesticides and FIFRA, natural resource damages, and insurance recovery
Our life is a faint tracing on the surface of mystery, like the idle, curved tunnels of leaf miners on the face of a leaf. We must somehow take a wider view, look at the whole landscape, really see it, and describe what’s going on here.

—Annie Dillard, *Pilgrim at Tinker Creek*

Just remember one thing: I owe everything to the ocean; it generates electricity, and electricity gives the *Nautilus* heat, light, motion, and, in a word, life itself.

—Captain Nemo, in Jules Verne’s *Twenty Thousand Leagues Under the Sea*

We dig, dig, dig, dig, dig, dig, dig in a mine the whole day through To dig, dig, dig, dig, dig, dig, dig is what we really like to do . . .

—“Heigh-Ho,” The Seven Dwarfs in *Snow White and the Seven Dwarfs*