www.water-alternatives.org Volume 17 | Issue 2

Berry, K.A.; Vineyard, N.; Lisenbee, K.; Hadder, J. and Tanager, M. 2024.
Extracting ore, mining groundwater: Governmental indicators and
the politics of water rights for the mining industry in Nevada, USA.
Water Alternatives 17(2): 437-454

Extracting Ore, Mining Groundwater: Governmental Indicators and the Politics of Water Rights for the Mining Industry in Nevada, USA

Kate A. Berry
University of Nevada, Reno, NV, USA; kberry@unr.edu

Noel Vineyard
University of Nevada, Reno, NV, USA; nvineyard@unr.edu

Kassandra Lisenbee
Outreach & Just Energy Transition Director, Great Basin Resource Watch, Reno, NV, USA; kassandra@gbrw.org

John Hadder
Great Basin Resource Watch, Reno, NV, USA; john@gbrw.org

Matthew Tanager
Environmental Analyst, Great Basin Resource Watch, Reno, NV, USA; richardsmatthew047@gmail.com

ABSTRACT: In this paper we address governmentality and the politics of water rights by examining the Nevada Division of Water Resources (the Division)'s governance associated with water indicators and accounting practices. We are specifically interested in the political work of water indicators and accounting practices as they are produced, applied, and contested – work that generates advantages for Nevada's mining industry. We focus on perennial yield, an important indicator used by the Division, and examine accounting practices in which mining water rights are designated as temporary and nonconsumptive. We examine how these water indicators and accounting practices are deployed in ways that 1) make groundwater legible and apportionable in ways that advantage the mining industry; 2) reduce the visibility of mining access to groundwater; and 3) enhance the resource state's objectivity and legitimacy.

KEYWORDS: Groundwater, governmentality, water rights, mining industry, Nevada, USA

> *Attempts to govern groundwater are really attempts to reconfigure the flow of power between different users* (Birkenholtz, 2015: 25)

INTRODUCTION

In late November 2023, *The New York Times* ran a major interactive article, *As Groundwater Dwindles, Powerful Players Block Changes*, which connected the disappearance of groundwater with powerful actors – a housing developer in Montana, an irrigation district in Kansas, and a mining corporation in Nevada – each of whom benefited from pumping large amounts of groundwater and intended to keep it that way (Flavelle and Rojanasakul, 2023). The discussion about Nevada presented rare media coverage of massive groundwater pumping associated with industrial-scale gold mining. The *Times* article went further by calling attention to the state's favourable treatment of the mining industry, describing the

political environment in which a representative from Barrick Gold, a Canadian-based transnational mining corporation, and its Nevada subsidiary and joint venture, Nevada Gold Mines, testified against legislation that would have extended groundwater regulations. The bill, AB 387, did not become law but would have extended the regulatory reach of the state's primary water management agency, the Nevada Division of Water Resources (hereafter referred to simply as 'the Division'), in the driest state in the US (Kunkel, 2022; Rothberg, 2023).

Agency personnel at the Division, along with many other Nevadans, are aware of the influence of the mining industry. A university economist put it this way: "The mining industry gets very favourable treatment from the state government" (Flavelle and Rojanasakul, 2023). The influence of the mining industry is simultaneously conspicuous and remarkably obscure, because there is little information available except for that which is generated by the industry. Although contemporary industrial-scale mining operations bear little resemblance to historical mining, there is a common saying promoting the industry: "Nevada has always been a mining state". That Nevada has repeatedly been hailed by the industry as the world's top mining destination (Jamasmie, 2021; Mejia and Aliakbari, 2022) underscores the political and economic weight of mining in the state, which produced 74% of its nation's gold and was ranked as the fifth largest gold producer in the world in 2021 (Visher and Patterson, 2022).

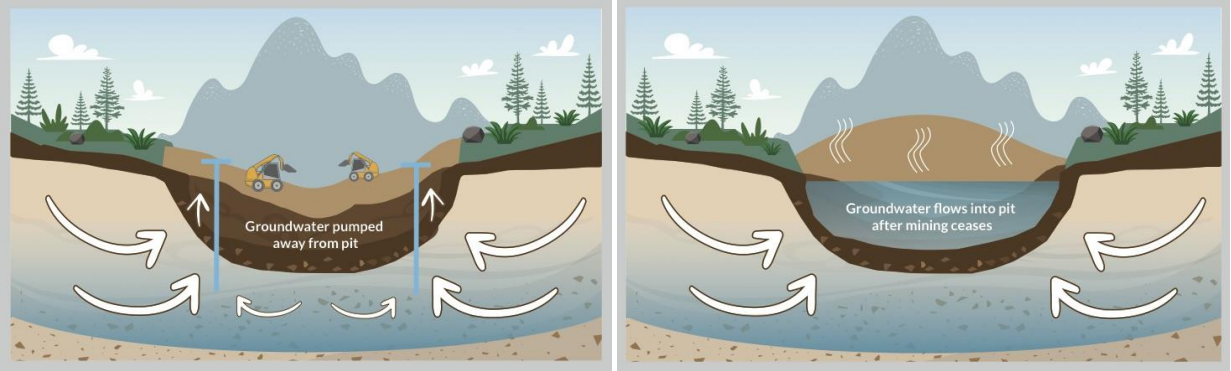
But while gold and other hard rock mining generates enormous revenue, relatively few Nevadans benefit from it. In terms of mining's support for state and local government, Nevada's gold, silver, and copper mining operations during the 2022 fiscal year generated over $9 billion dollars in gross revenues but produced only 1% of this amount in taxes for the state government and another 1% in taxes for local government (Nevada Department of Taxation, 2022a, 2022b). State and local governments receive little in part because Nevada has a low mining tax rate and in part because taxes are calculated on 'net proceeds', which were reported to be only about 40% of gross revenues (Nevada Dept. of Taxation, 2022b). There is also a common (mis)perception that the mining industry is a major employer in Nevada, though the entire sector employs less than 1% of the state's work force (US Bureau of Labor Statistics, 2023). While mining donates to the political campaigns of state legislators who tacitly or actively support the industry – for example, donating $306,431 during the 2022 legislative cycle – it is not even in the top ten industries who donate (Golonka and Solis, 2023), so campaign support funding does not fully explain why the industry remains so influential. Arguably it is because few inside or outside the state question mining's dominance, which has allowed the industry to operate with few obstacles and has rendered mining relatively invisible, except when the industry shapes the public dialogue about mining.

Even in arid places such as Nevada, industrial-scale mining involves the manipulation of water as well as earth. Water is involved in nearly every stage of hard rock mining operations. During exploration, water is needed to lubricate drills for wells used to test the concentration of minerals in the area. During design and permitting, no water is physically used, but the mining companies estimate how much water will be needed for operations and how much will be pumped during dewatering. The operation stage is when the most water is used, including water for on-going dust suppression, processing, and dewatering. Dewatering is extremely water intensive, occurring when the excavation for ore intercepts groundwater, which must then be pumped out and moved elsewhere. Dewatering can regionally lower groundwater levels, reducing available water far beyond the mine site and altering the contours of terrain and groundwater tables in ways that change access to water for people, plants, wildlife, springs, and rivers for decades or even centuries. Even when mines cease operations, water levels continue to decline because groundwater flows back into the dewatered regions (Spitz and Trudinger, 2019). Finally, the formation of pit lakes continues to draw down groundwater indefinitely (Figure 1).

Other types of mining in Nevada also impact groundwater. For example, Nevada has the only active lithium mine in the US – Silver Peak Mine, in Clayton Valley. This is a lithium brine mining operation that is dependent on massive groundwater brine pumping. Two monitoring wells close to the mine have gone dry as mining operations ramped up in recent years; one had been monitored for 45 years before going permanently dry, and the other well went dry despite being over 60 metres deep (Pennington, 2022). In

support of these operations, mines sometimes purchase water rights, which in Nevada can be sold either separately or with land. Other times, mining companies purchase water rights as a means to quash dissent and keep things quiet. Mining companies also make new applications to the Division for water rights.

Figure 1. The effect of mine dewatering on groundwater.



Mining's access to groundwater is made possible through actions taken by the Division, which we argue has treated the industry favourably in comparison to other water users. For example, in a 2022 ruling in Crescent Valley, the Division allowed additional water usage for a major mining complex to "accommodate the necessities and unique characteristics of mining operations". The Division specified that, in addition to their existing permanent water rights, the mining company should annually request the groundwater pumping that they needed in the places they needed it (Division Order 1189A, 2022). This action by the Division advantaged the mining company but was not made available for other water users.

In this article we address the politics of water quantification by examining the Division's approach to allocating groundwater for the mining industry, paying close attention to water indicators and accounting practices. Water indicators and accounting practices facilitate the making of life-altering decisions about who gets which water. We examine the development and deployment of indicators and accounting practices, as suggested by Bridge (2014) and Birkenholtz (2015), as expressions of the resource-state, which strategically enables resource grabs and capital accumulation.

Guided by a better understanding of how indicators and accounting practices operate as instruments of governmental rationality, our analysis of groundwater allocation in Nevada is designed to uncover more about the social, historic, and geographic contexts and the political importance of indicators and accounting practices with respect to mining and water regulators at the Division. We are specifically interested in how groundwater is made legible and apportionable through the Division's water indicators and accounting practices in ways that advantage Nevada's mining industry. We also concern ourselves with how the Division's water indicators and accounting practices reduce visibility, making it more difficult to recognise the mining industry's access to groundwater and obscuring major groundwater losses associated with mine dewatering. Finally, we examine how water indicators and accounting practices are connected to enhanced objectivity and the scientific credibility of the Division. This article begins with the conceptual basis for our research and then provides some historical background about state regulation of water in Nevada. We then focus on perennial yield, an important indicator used by the Division, and examine accounting practices in which mining water rights are designated as temporary and nonconsumptive.

CONCEPTUAL BASIS

In examining the political work accomplished by resource-states deploying water indicators and accounting practices, we are informed by literature on governmentality. We also incorporate scholarship on classification as well as the production of knowledge and ignorance.

Foucault is well known for his thinking on governmentality, by which he meant governmental rationality. More specifically, Foucault's interest in governmentality covers "the ensemble formed by the institutions, procedures, analyses and reflections, the calculations and tactics that allow the exercise of this very specific albeit complex form of power, which has as its target population, as its principal form of knowledge, political economy, and as its essential technical means, apparatuses of security" (1991: 102-103). More specific to groundwater governmentality, Birkenholtz (2015: 22) describes this as "processes through which the state attempts to simultaneously enhance its control over groundwater extraction and reconfigure its uses through particular 'technologies of government'" while producing water users who internalise the goals of the state as their own.

The calculations, tactics, and technologies of government mentioned by Foucault and Birkenholtz not only include laws and policies but encompass other means of governing through which things are intentionally arranged to achieve specified ends. While Foucault (1991) looked specifically at the work of statistics in producing and articulating a population, we see similarities with the work indicators do in making groundwater legible and apportionable in the allocation of water rights. Accounting practices are a related dimension of governmentality. As tools of the resource-state designed to simplify making distinctions, accounting practices are employed to determine which things count and in what ways they count. Both water indicators and accounting practices facilitate the quantification and allocation of water through the water rights system. To adopt Foucault's language, water indicators and accounting practices are types of calculations or tactics that states employ to arrange groundwater in such a way that a regulatory scheme can be implemented to achieve what the state defines as the public good.

Foucault's (1991) thinking on the state's security apparatus being central to modern governmental rationality is also relevant here. Security is fundamental to the work that indicators and accounting practices contribute to water rights systems. Water rights not only intentionally establish varying degrees of security for water users (Jepson et al., 2017), but the entire system of water rights operates as an apparatus of security for the state; water indicators and accounting practices are pivotal to the operation of this apparatus. This is because water indicators and accounting practices aid in making groundwater legible and apportionable in ways that go beyond dualistic logic, contrasting what is allowable with what is forbidden, and instead help establish an "optimal mean within a tolerable bandwidth of variation" (Gordon, 1991: 20). Water indicators and accounting practices can also facilitate operational flexibility by ending up at different points along a continuum of knowledge-to-ignorance so that acts of water governance are made more or less legible depending on the political situation (Martin, 2021). Increasing operational flexibility extends the ability of the resource-state to make groundwater legible and appropriable in ways that allow groundwater to be directed towards prioritised users (Birkenholtz, 2015), which in our case would be Nevada's powerful mining industry.

Bowker and Star (1999) emphasise the importance of rendering visible complex classification systems that are "suffused with traces of political and social work" (49) while often being virtually "erased by their naturalisation into the routines of life" (47). We see similarities between such classification systems and the water indicators and accounting practices of interest here. Beyond being inconspicuous because they are normally taken for granted, indicators and accounting practices do significant political work in making water legible and apportionable in ways that support preferential access to groundwater for certain users. For instance, Valladares and Boelens' (2019) study examined the actions of the Ecuadorian government in re-defining constitutionally enshrined 'Nature's Rights' in ways that allowed for mining projects. In this case, indicators developed by the resource-state made Nature's Rights legible in ways that facilitated mining operations (Valladares and Boelens, 2019). Another relevant analysis is from Flores

Fernandez and Alba's (2023) research about governmental accounting practices in lithium mining operations in Chile, which found that mines were made possible because saline groundwater brine pumped to the surface for lithium extraction was counted as being a mineral resource rather than a water resource. This accounting practice made brine and groundwater legible as a mineral rather than designated as water. Not only is the language associated with groundwater important in how water unseen below the ground is conceptualised and articulated (Adams, 2021; Powis, 2021), but in this case an accounting practice had the political effect of shielding mining water use from laws associated with water allocation and enabled mining industry access to groundwater in ways that were unavailable to other water users.

We also concern ourselves with the ways indicators and accounting practices obscure the visibility of mining access to groundwater, shifting attention away from the values, imaginaries, priorities, and processes embedded in governance, as well as away from mining operations' material impacts on groundwater. This aligns with Fernandez (2014), who points out water indicators' ability to refract the power of the state while hiding water's social, physical, and historic contexts and obscuring the political implications of governance decisions. Focusing on minimum in-stream flow as a water indicator in France, Fernandez (2014) observed how this indicator narrowed water into being nothing but water quantity and abstracted water into 'modern water' while also naturalising the notion of water scarcity. Another relevant analysis of deploying indicators to obscure the type, nature, and magnitude of resource use is Campero and Harris' (2019) work documenting the mining industry's practice of creating 'new' water through desalination technology. This water was allowed to exist outside the Chilean legal framework for water. Because desalinated water was counted differently, traditional sources of water that had a long history of use by communities were redirected to mining operations. Beyond semantics, indicators and accounting practices obscure and naturalise governance actions taken by the resource-state and, in the Chilean case, led to the mining industry gaining an advantage in accessing water.

Water indicators and accounting practices also contribute to perceptions of regulatory consistency and institutional credibility. Because they are recognised as being scientific rather than political, water indicators and accounting practices are used as evidence of objectivity; they enhance the legitimacy of the resource-state. As Holifield (2009) observed, from a conventional view that holds that there is (or should be) a rigid separation between science and policy decisions, indicators and accounting practices may be viewed as impartial, scientifically produced knowledge, and in doing this they contribute to perceptions of accountability and legitimacy of governance. We take this a step further to suggest that by contributing to perceptions of objectivity and governmental legitimacy, indicators and accounting practices support operational flexibility and enhance the security apparatus of the resource-state.

BACKGROUND ON THE STATE REGULATION OF WATER IN NEVADA

The Division, which is also called the Nevada State Engineer's office, was created by state statute in 1903 as a statewide office to make decisions related to water management and the appropriation of water rights. Prior to 1903, Nevada law allowed anyone who drilled a well to use groundwater, but the state did not issue water rights of any kind; claims of water rights were all adjudicated in Nevada courts until the creation of the Division (Shamberger, 1991; Harrison, 2001). While the initial focus of the Division was to manage surface water (for example, streams, springs, and lakes), a law in 1913 gave the Division the role of managing groundwater and issuing groundwater rights (Shamberger, 1991; Welden, 2003). A comprehensive groundwater law was enacted in 1939, expanding the jurisdiction of the Division to allocate and regulate all groundwater (with the exception of domestic wells that produce minor amounts of water for indoor household use) (Welden, 2003). It is also worth noting that, in the late 1990s, the state legislature created the Division of Water Planning, which produced a State Water Plan in 1999 (Nevada Division Water Planning, 1999). Soon after, this independent water-planning agency was dissolved and the Division resumed control over all activities related to water allocation, which include

hydrologic and hydrogeologic data collection; reviewing water right applications; allocating and making decisions on water rights; communicating water rights information to the general public; serving in a quasi-judicial capacity to make rulings on water disputes; and communicating with water users and legislators about changes to water law and policy. The Division prides itself on transparency, scientific/engineering logic, and eschewing subjectivity, as is evident in their Basin Status Assessment Map Series, in which they have commented, "It is important to note that these maps are entirely data-driven and rely on publicly available baseline data. No subjective or qualitative assessments were made regarding the data" (Division, 2023: 1). It is not without reason that the *New York Times* exposé article identified the head of the Division – the Nevada State Engineer – as having one of the most powerful jobs in the state (Flavelle and Rojanasakul, 2023).

Nevada, like many other states in the US West, follows the legal doctrine of prior appropriation in allocating water. Major tenants of the prior appropriation doctrine include: a) the state owns and manages water as a trustee for its citizens, making water allocation decisions about who gets water rights by considering the broad public interest; b) the person who first uses water has a prior right to those who begin using water later; and c) water needs to be actively used in a 'beneficial' way that the state approves, or the water right may be lost (Schorr, 2005). Interestingly, the origins of the prior appropriation doctrine are often traced back to historic mining practices and governance (see, for example, former Division Director Shamberger, 1991), although it is more appropriate to envision this legal doctrine "as part of a complex of pro-settler and anti-speculator laws and rules prevalent in mid-nineteenth-century America, particularly in the West" (Schorr, 2005: 32). Importantly, prior appropriation in Nevada extends to the allocation of groundwater, per the 1939 comprehensive groundwater law (Welden, 2003).

To get a sense for the impacts of pumping as a result of water rights, the Division now relies on 3,262 wells to track groundwater level change. One thing this means is that many groundwater rights throughout the state are not regularly monitored. Of those that are part of this well-monitoring network, the Division collects less than half of their own groundwater measurements (Division, 2024a). For the other wells in the monitoring network, the Division relies on self-reported groundwater data. Mining companies are the largest group to report their own groundwater data (Division, 2024a). Moreover, the Division is aware that some of their own data from wells is far from perfect (Division, 2023), making them more appreciative of the mining companies' producing what the Division considers to be reliable and systematic well log data. Because many mines self-report groundwater data that supports the Division's data collection program, communications are facilitated between the state and mining industry. As a result, a set of shared values around science and technology has developed. The Division's reliance on mines providing groundwater data that the resource-state wants allows the mines to occupy what Kroepsch (2018: 60) has called "an especially privileged position in knowledge production".

The practice of groundwater accounting in Nevada relies on spatially distinguishing different areas for groundwater management. The Division breaks down the management of the water into 14 separate hydrographic regions within the state, each of which is then divided into smaller subdivisions based on topography and hydrogeology, which are called hydrographic or, more simply, groundwater basins. At least theoretically, "each basin is managed as a separate unit with the State Engineer issuing orders and rulings as needed for the management of the groundwater resources" (Nevada Division of Water Planning, 1999). Thus, hydrographic regions and groundwater basins are spaces created by and for the state's water governance to establish boundaries within which water rights are addressed.

In several groundwater basins in central and northern Nevada, mining companies control most (and in some cases nearly all) of the groundwater rights. For example, take Kobeh Valley (groundwater basin 139) in central Nevada, northwest of the town of Eureka. In this basin, mining companies, their subsidiaries, and their affiliates control 93% of the rights to groundwater, which amounts to 18,255,531 m^3/year out of the basinwide total of 18,866,104 m^3/year (Division, 2022). The Division identifies most of these water rights as being controlled by Kobeh Valley Ranch LLC.; which, as a subsidiary of a mining

company, is ostensibly a ranching company, even though its water rights are specifically designated for mining, milling, and dewatering (Division, 2022). Having mining subsidiaries or affiliates control water rights is not uncommon. By keeping the water rights in use, a mining company ensures that the Division will continue to recognise those water rights as active, meaning a mining company will not lose them even if they end up being used for irrigation rather than mining. Kobeh Valley groundwater basin is not alone in having such a high proportion of groundwater appropriated to the mining industry.

Indicators and accounting practices are used by the Division as they determine which water uses are allowed by whom, where, and when through the system of water allocation that they developed and routinely apply. The Division also makes quasi-judicial decisions about water right disputes. Focusing exclusively on water management and allocation, the Division does not address water quality or cultural dimensions of water in their process of decision-making about water rights. Yet water has great significant within Indigenous cultures in the Great Basin. Joe Kennedy, a Timibisha Shoshone tribal member, said with respect to the expansion of the Cortez Hills mining complex in central Nevada, "Under our religious beliefs, the water in Mt. Tenabo is unique and is connected to specific spirits that reside in the Mountain and in the water. These spirits will suffer greatly, and indeed will likely be eliminated altogether, when this water is lost through the Project's dewatering operations" (Kennedy, 2010).

What follows is a discussion of one water indicator and two accounting practices developed and used by the Division. We direct our attention to three aspects of the political work done by these water indicators and accounting practices: 1) their deployment to make groundwater legible and apportionable in ways that advantage the mining industry; 2) their deployment in ways that reduce the visibility of the mining industry's access to groundwater; and 3) their deployment in ways that enhance the resource-state's (in this study, as evidenced by the Division) perceived objectivity and legitimacy.

INDICATOR: PERENNIAL YIELD

The Division develops an estimate of perennial yield for a groundwater basin, which becomes an official indicator against which the aggregate water rights in that basin are compared. In the Division's own terms, the perennial yield of a groundwater basin is used to determine "the maximum amount of groundwater that can be withdrawn each year over the long term without depleting the groundwater reservoir" (Division, 2023). Values for perennial yield are computed based on information from federal agency water studies, field work conducted by the Division, and modelling, along with a variety of other old and new sources of information that are considered reliable by the Division. While based on estimated values, perennial yield is an official indicator developed and used by the Division to determine whether new groundwater rights are granted and to address how to manage existing water rights, such as designating critical groundwater management basins. According to the Division, "ground-water basins are managed based on the perennial yield concept… the goal is to appropriate water up to the perennial yield of a basin" (Division, 2009).

The Division's adoption of perennial yield makes groundwater legible in ways that facilitate the state's approach to apportionment despite the inherent uncertainty in groundwater. It is well-accepted that groundwater is unpredictable, indeterminate, and elusive by nature (Powis, 2021). Kroepsch and Clifford (2022) identify groundwater as being an inscrutable space, "a space that is made difficult to know by an interplay of biophysical, epistemic, and political economic factors, and whose unintelligibility poses serious consequences for environmental politics and everyday life" (172). Groundwater moves slowly in comparison to streams or other sources of surface water, so there is an extended lag time in which groundwater in Nevada typically responds to pumping impacts: over years and decades, if those waters return at all (Pielou, 1998; Kroepsch, 2018). Moreover, estimating the amount, area, and timing of groundwater recharge is particularly uncertain. All of which is to say that being subsurface, groundwater cannot be readily observed or easily understood, although data-gathering technologies and computer-based models may offer the illusion of a scientifically based reality free of politics (Kroepsch, 2018). In

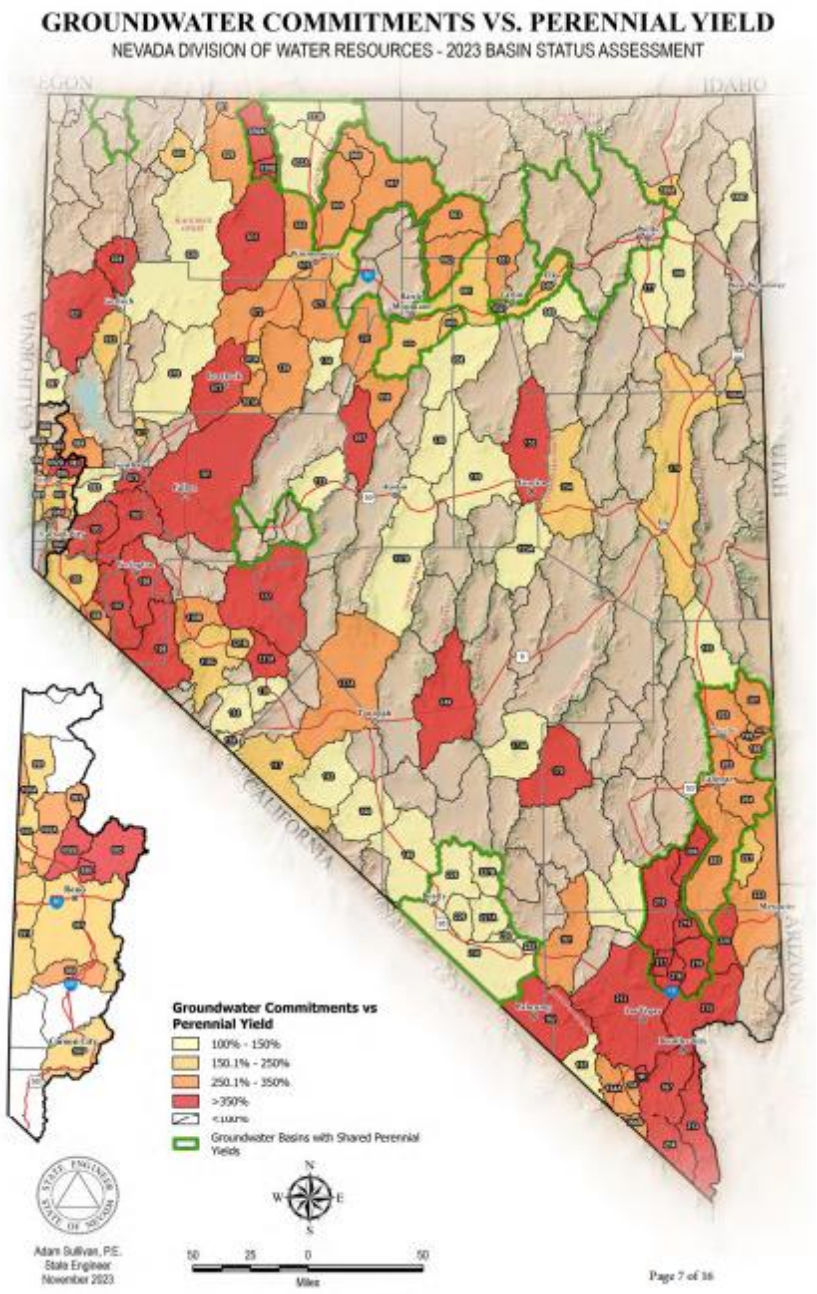
our case, the Division acknowledges that perennial yield cannot account for things that are only partially understood, such as uneven within-basin groundwater distributions, variability in well locations, and complex hydrogeologic conditions (Division, 2023). Despite this, perennial yield remains pivotal to their approach to making groundwater legible and apportionable.

As an indicator, perennial yield renders all basin groundwater into singular, abstracted H_2O, fungible in kind from use to use and place to place. Its use facilitates treating water as if it permeates the ground of each basin uniformly, with wells drilled anywhere in the basin creating similar pressures on groundwater. Even the use of the term 'perennial' in the name emphasises permanency and continuity over time. While an occasional caveat is added, the Division's scientific production and regulatory use of perennial yield promotes a sense that there is a firm understanding and a relatively consistent volume of water available for use in each groundwater basin. For example, in presenting to water users in central Nevada, the Division said in one of their slides that perennial yield provides "very good estimates of water availability" (Division, 2009). Despite the limited scope of what it includes and the rather coarse nature of the estimate, perennial yield is frequently approached as if it is an accurate, objective indicator by which groundwater can be counted and apportioned.

With this said, the Division has not systematically deployed perennial yield as a cap for allocating water rights. In the majority of groundwater basins in the state, the Division has allocated more water rights than there is perennial yield, as shown in Figure 2 (Division, 2023). These basins are referred to as 'overappropriated', meaning that groundwater commitments are unsustainably high. Figure 2 is a map from the Division that illustrates this point, showing basins that are at or over perennial yield in yellow, orange, and red.

In some instances, when the Division has determined the perennial yield and compared it to existing groundwater commitments, it has become aware that a groundwater basin was overappropriated. Yet, the Division has been unable to reduce water rights or stop groundwater pumping, even in instances where this has been known for decades. An example of this in the context of irrigation water use comes from northern Kings River Valley (groundwater basin 030a), along the state's northern border with Oregon. In 1966, a scientific report indicated that all groundwater rights awarded in the Kings River Valley, if exercised, would deplete the valley's aquifer by 300 million m^3 of water by 1973 and that allocation was far in excess of perennial yield (Malmberg and Worts, 1966). In 1971, the Division designated the northern Kings River basin as a critical groundwater area, which according to the internal policy of the Division should mean no new water rights would be issued. Despite this designation, water rights for irrigation and stock watering continued to be issued; 21 water rights were awarded from 1971 to 2000 (Berry, 2009). In 2009, the Nevada State Engineer's office estimated slightly over 78.6 million m^3 of groundwater rights within the basin. This is roughly comparable to the annual allocations over 40 years earlier, when Malmberg and Worts' report identified allocation as being far in excess of perennial yield (Berry, 2009). Groundwater continues to decline throughout the northern and central portions of the valley, where ranching and farming is centred, as water continues to be pumped in excess of the basin's perennial yield. Based on being coded by the Division in red on Figure 2, their estimate as of 2023 is that this groundwater basin is overallocated by more than 350% (Division 2023; Division 2024c). So, while perennial yield has been adopted as an indicator to help the Division make decisions on an objective scientific basis, as we have illustrated, perennial yield has not actually been consistently applied by the Division. This suggests that it may suffice to simply point to an authoritative indicator that is recognised as being scientifically valid. While its existence is important, it may not be necessary that perennial yield be used systematically or consistently to regulate groundwater use. Simply being able to point to perennial yield provides operational flexibility, allowing the Division to decide when and where they use perennial yield in their regulatory actions.

Figure 2. Nevada Division of Water Resources' map of groundwater commitments versus perennial yield.



Although the Division defines perennial yield as pertaining to a single groundwater basin, at times they expand the boundaries that perennial yield applies to. Examples of this are shown in Figure 2, with the areas having green boundaries being "groundwater basins with shared perennial yields". This figure, which was developed in 2023, indicates where the Division has aggregated basins to recompute perennial yield. When this is done, instead of applying perennial yield to a single groundwater basin, the perennial yields of multiple groundwater basins are recalculated. The cumulative perennial yield of multiple basins has been used as a justification for approving additional water rights for the mining industry, which could not have been granted based on a more rigorous application of perennial yield limits for a single groundwater basin. For example, in 1989, the Division decided to grant new groundwater rights for Santa

Fe Pacific Mining Inc. in the Kelly Creek Area (groundwater basin 066), which is northeast of Winnemucca, Nevada. There were local water users who protested the mining company's water rights application, who testified in a Division hearing that the entire basin had been designated as a critical groundwater basin, which meant strict restrictions on what its waters could be used for. These other water users also asserted that "the previous actions of the State Engineer [the Division] denying applications for underground water appropriations for agricultural purposes were inconsistent with later approvals by the State Engineer of underground appropriations for mining purposes" (Division, 1989: 3). Based on research done more than two decades before the ruling (Eakin et al., 1966), an expert witness for the mining company insisted that by encompassing a larger portion of the Humboldt River Basin, there was as much as 35,524,277 m^3 of unappropriated groundwater available in the combined groundwater basins. Despite the concerns expressed by existing water users and the uncertainty inherent in the recalculated estimate of perennial yield, the Division accepted this expert's testimony and ruled that the mine could appropriate new groundwater rights within the Kelly Creek Area basin (Division, 1989). By recognising the mine's witness as a credible scientific expert, the Division made groundwater legible in a way that granted mining industry access to groundwater, but which excluded other water users.

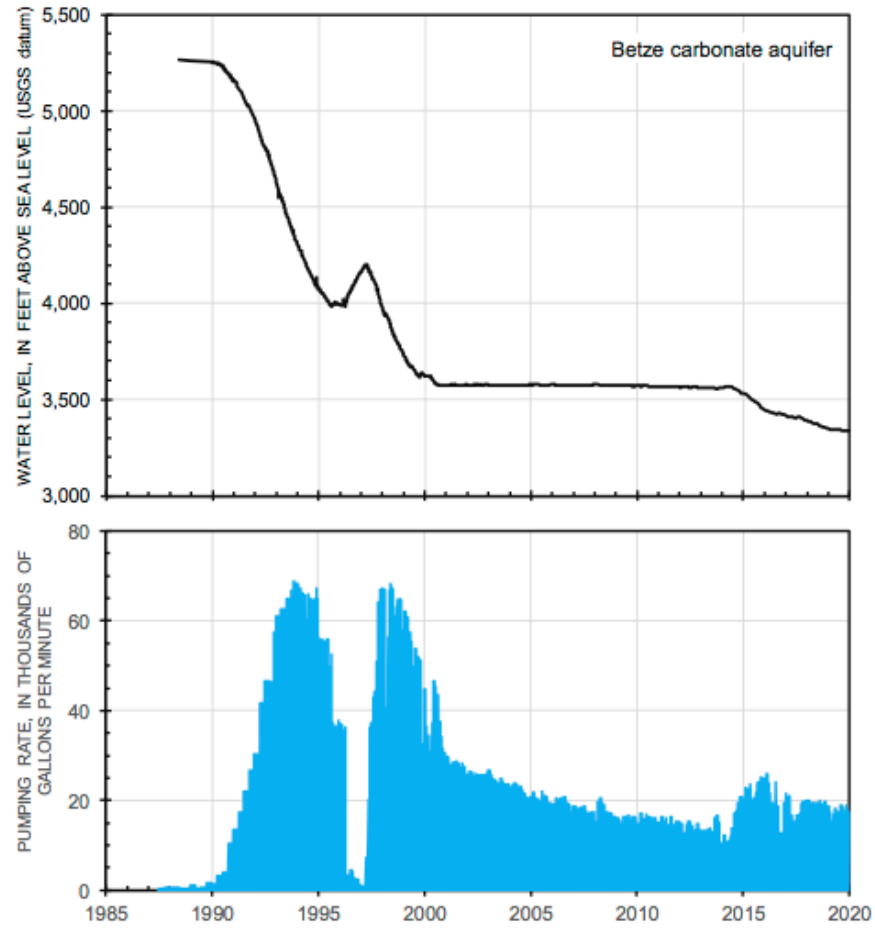
As recently as January 2024, the Nevada Supreme Court addressed the Division's scientific capacity with respect to applying perennial yield, ruling in a consolidated case that the Division had the "statutory authority to combine multiple basins into one hydrographic 'super basin' based on a shared source of water" (Sullivan et al. v. Lincoln County Water District et al., 2024). Although the 2024 case did not directly involve the mining industry, the Court underscored the Division's scientific capacity and administrative authority in choosing to administer perennial yield for seven groundwater basins as a single superbasin (Sullivan et al. v Lincoln County Water District et al., 2024). The ruling acknowledged that the Division "has the implied authority… to jointly administer across multiple basins based on the interconnected source of water" (Sullivan et al. v. Lincoln Country Water District et al., 2024: 16). There was no indication in the ruling of the uncertainties associated with estimating groundwater and they avoided discussing the political work involved in allowing the Division to change spatial boundaries. The Nevada Supreme Court instead focused on the need to apply "the best available science" in ways determined by the Division, reinforcing their objectivity and legitimacy while enhancing the security apparatus of the resource-state.

Discussion about the Division using 'the best available science' was also central to legislative bill AB 387, described in the Introduction. In this 2023 bill, which did not get enacted, proponents paired the Division with the provision of 'the best available science', advocating that the Division's water decision-making should change as the science changed. But the bill's opponents, led by the mining industry, had a different idea. They proposed an amendment to AB 387 to constrain how the Division could deploy scientific data in its decision-making and to require notification of "members of the water community" before changing the spatial boundaries of groundwater basins (Barrick/Nevada Gold Mines et al., 2023). Although neither the amendment nor the legislative bill were passed by the legislature, the mining industry's amendment would likely have kept perennial yield as a key indicator and made sure that their own mining experts could directly weigh in on 'scientific advances' before the Division made decisions about water quantification.

A final point is that the Division's reliance on perennial yield does not indicate areas where there is massive groundwater use or where there is now (or will be) dramatic declines in groundwater levels as a result of mining operations. A 2010 supplemental environmental impact statement done by the US Bureau of Land Management (BLM) examined the cumulative impacts of groundwater use from three of the mines in an area referred to as the Carlin Trend, in groundwater basins north of the Humboldt River between Battle Mountain and Elko, Nevada. Cumulative average groundwater pumping rates during 2006 for these three mines was reported at 176,022 l/min, and groundwater levels were expected to decline by 427 to 579 metres by the time mining operations stop (BLM, 2010). A more recent report from mining consultants (Jones et al., 2021) illustrates that an even more precipitous decline in groundwater

has been measured in this area. As shown in Figure 3, after the initial mines began in the Carlin Trend about 1990, groundwater has declined in the aquifer surrounding these mines by an average of 610 metres, and massive groundwater pumping by the mines has ranged from about 64,352 to over 246,052 l/min since 1998 (Jones et al., 2021). As a point of comparison, if exported to New York City, groundwater pumping rates from this one mining area of Nevada would provide a consistent supply of water for 200,000 to 800,000 residents based on 2021 consumption rates (NYC Environmental Protection, 2023).

Figure 3. Average groundwater pumping rates (lower) and groundwater level declines (upper) associated with the Betze Carbonate Aquifer in the Carlin Trend Mining District.



Source: Jones and Baggerman, 2021.

However, massive changes to the groundwater system are not readily apparent from recent materials produced by the Division about their application of perennial yield. For example, the Division map in Figure 2 does not indicate the extreme magnitude of changes to groundwater in the Carlin Trend area. None of the seven groundwater basins around the mines are shown as being of extreme concern (which the Division defines as having a ratio of the magnitude of groundwater commitments relative to perennial yield as higher than 350%). Based on the Division's application of perennial yield as an indicator, only three groundwater basins are shown as being of high concern (the second highest ratio), two other basins are shown as being of medium concern, while two basins are shown as not being of concern and as still having groundwater available for new water right appropriations (Division 2023). Although the Division considers "a significant decline in the static water level" to be "an undesirable result" that may be

associated with exceeding perennial yield (Division, 2018: 6), their application of the perennial yield indicator has not prevented these huge losses of groundwater from mine dewatering. In this case, the Division's application of perennial yield diverts attention away from both the sheer magnitude of groundwater affected by mining and the massive declines in groundwater levels that have resulted from mine dewatering.

This section illustrates through a variety of examples the types of political work done by perennial yield as an indicator. The examples from Figure 2 and in the upper Kings River groundwater basin show how perennial yield is used to make groundwater legible (aspect #1), yet the Division does not actually apportion water rights based on the perennial yield. Despite ignoring their own indicator, the Division does not seem to have suffered a loss of legitimacy or to have had their objectivity questioned (aspect #3). Simply being able to point to an authoritative indicator that is recognised as being scientific may increase the Division's operational flexibility while maintaining its authority. In the example from the Kelly Creek Area groundwater basin, groundwater was made legible and apportionable based on testimony about perennial yield from a mining company's witness that the Division recognised as credible and scientific. This resulted in a mining company being granted access to groundwater, while other longtime residents and water users were excluded (aspect #1). In a recent Nevada Supreme Court ruling, the Division's scientific capacity and legitimacy were emphasised, whether it applied perennial yield to a single basin as intended or recombined basins into a superbasin and recalculated the perennial yield on that basis (aspect #3). A year prior, legislative bill AB 387 also raised issues about the appropriate boundaries in which to apply perennial yield and resulted in discussion of the capacity of the Division and role of science in groundwater allocation (aspect #3). In the final discussion about the Carlin Trend mining area, we found little relationship between groundwater basin overallocation based on perennial yield and areas where massive groundwater use by mines had occurred for over three decades. In this case, using perennial yield reduced the visibility of the impact to groundwater levels and diverted attention away from the enormous loss of groundwater due to mine dewatering (aspect #2). The Division's approach to applying perennial yield as an indicator did not prevent groundwater levels from decreasing by over 600 metres.

ACCOUNTING PRACTICES: DESIGNATING WATER RIGHTS AS TEMPORARY AND NON-CONSUMPTIVE

The Division engages in accounting practices that count water rights in different ways. Here we examine specific accounting practices that make groundwater legible and apportionable in ways that make it easier for mining companies than for other water users to pump groundwater and move it where and when they want (aspect #1). We also discuss how these accounting practices reduce the visibility of mining access to groundwater (aspect #2). These approaches to water quantification are rooted in the politics of decision-making by the Division and have political implications.

When an application for a new water right is initially made or a change to an existing water right is filed, the Division considers the category of use. Under prior appropriation, all uses must be designated as beneficial, which means the user must not waste water and must meet the requirement of "being in the public's interest", which is determined by the Division. Mining companies have been able to get water rights for multiple water use categories, including irrigation and livestock watering, along with various types of mining water uses. More specifically, the Division separates mine water use into different categories: mining, milling, and dewatering. Mining includes water used during excavation; milling refers to water used in processing the ore; and dewatering refers to pumping groundwater away from mining operations.

The Division has determined that each of these three types of mining uses are considered 'temporary', which is another way of saying that they count mining, milling, and dewatering water rights as existing only while the mine is operating. Designating these uses as temporary is a political act of quantification for at least two reasons. First, the 'temporary' designation is primarily for the mining industry and is not

readily available for most other types of water use, such as manufacturing or irrigation, which may use water for similarly lengthy periods. This 'temporary' designation for mine water uses is also at odds with the reality that many major mines in the state operate for multiple decades, as indicated in Figure 3. Second, the impacts of groundwater pumping from massive mine dewatering are far from temporary, because there are material effects to groundwater that can take many decades to be realised. As shown in Figure 3, dewatering in the Carlin Trend mines sometimes involved pumping at rates above 227,125 l/min, which has led to a 610-metre decline in groundwater since 1990. There are implications to dewatering's depletion of groundwater at the mining operation site, as well as impacts on groundwater where the pumped water is released or re-injected in the ground. These force major changes to vast landscapes, often across multiple groundwater basins, over very long periods of time. These actions and their implications influence the political, economic, and social landscapes as well as the physical ones.

The Division makes another type of political decision that is specific to mining-type uses through its accounting practice of designating a water right as 'nonconsumptive'. The first two uses, mining and milling, do not often involve large amounts of water, and the Division generally considers these uses similar to most other types of water use in that they are a consumptive use of water, which means they reduce the amount of water available for other water users (Nevada Division of Water Planning, 1998). According to the Division's approach, because they are designated as consumptive, mining and milling uses are officially counted as water rights and are tallied within a groundwater basin. For example, mining and milling are often counted when assessing all the allocated water rights against the perennial yield of a basin.

However, in most cases, groundwater from mine dewatering is considered non-consumptive, meaning it is a use that does not actually consume water (Nevada Division of Water Planning, 1999; Division, 2023). Being both temporary and non-consumptive, the Division does not account for dewatering in the same way that other categories of water use are counted. These are decisions by the Division that have political implications. In some cases, water produced through mine dewatering is not counted or acknowledged because it is released to go back into the ground (Division, 2013, 2015, 2017). However, such reinjection or infiltration is typically done far from the mine operations, often in a different groundwater basin, and there can be significant losses during the process. As such, dewatering may deprive senior water users of flow in the groundwater basin of origin (Kroepsch, 2018). If, on the other hand, water produced from dewatering is exported to another groundwater basin to be used for crop irrigation, the Division counts dewatering as an irrigation use, despite the water originating from a mining operation (Division, 2013, 2015, 2017). This latter accounting practice has at least two implications. First, this makes the amount of water attributed to irrigation appear higher than it might otherwise be, diverting attention from mining's impact to groundwater and water rights while causing an increase in the ratio of irrigation water in comparison to mining. Second, it has contributed to a type of 'water ranching', in which mining companies are incentivised to purchase ranch lands so that the groundwater available from dewatering can be put to irrigation use. Thus, the impacts from these water accounting practices can ripple outward to affect land tenure and use decisions.

It is also worth noting that the Division has issued confusing explanations and seems to apply their analyses differently from year to year. For example, in the past, the Division biennially produced statewide pumping reports by counties for different water uses (Division 2013, 2015, 2017). In their report from 2013, the Division included a footnote that identified the estimated amount of groundwater that was reinjected after being pumped from mine dewatering. They noted that this was not accounted for in their table for groundwater pumped throughout the state. The footnote also provided an estimate of the groundwater pumped from mine dewatering that was used elsewhere for irrigation. They counted this portion of mine dewatering as irrigation water. However, in the Division's 2015 and 2017 tables, there were no footnotes or indications if and where groundwater produced by mine dewatering was included or excluded, how much was considered consumptively used by irrigation, and how much was

discounted as being put to temporary and/or non-consumptive uses (Division 2013, 2015, 2017). Such inconsistencies serve to further reduce the visibility of mining access to groundwater.

The accounting practices of designating groundwater in mining, milling, and dewatering operations as temporary over the entire life of the mine serves to politicise water allocation, as does designating dewatering water rights as non-consumptive. This is not the same treatment that other water users receive (aspect #1). Water rights being designated as temporary or non-consumptive has counted water in particular ways, thus affecting how groundwater is made legible and apportionable (aspect #1). Moreover, these accounting practices have been deployed in ways that obscure this inconsistent treatment, making mine water allocation confusing for those not in the Division or mining industry and reducing the transparency of mining access to groundwater (aspect #2).

CONCLUSIONS

Even with its strong connection to the Division, Nevada's mining industry does not always achieve its goals in water matters. In a 2015 Nevada Supreme Court decision involving water right appropriations for the proposed Mt. Hope molybdenum mine in central Nevada, a subsidiary of a mining company (Kobeh Valley Ranch or KVR) and the Division failed to convince the Court that it was correct to grant new water rights for the mine. This litigation in 2015 involved mitigation planning, a new and different type of indicator used by the Division in water administration. The decision in this case was predicated on problems the Court had with the way the Division applied evidence in assessing the indicator:

> Therefore, contrary to the State Engineer's [the Division], KVR, and amici's assertions, KVR's pumping would not merely impact existing water rights; the *very* evidence *upon which the State Engineer relied demonstrates that KVR's appropriation would cause the complete depletion of the source of existing water rights*. The Legislature did not define exactly what it meant by the phrase 'conflicts with' as used in NRS 533/370(2), but if an appropriation that would completely deplete the source of existing water rights does not 'conflict with' those existing rights, then it is unclear what appropriation ever could (*Eureka County v. Nevada State Engineer*, 2015: 8).

While the Division's ruling advanced the interests of the mining company, the subsequent Supreme Court decision called into question the Division's approach. It is rare that the legitimacy and objectivity of the Division is called into question or that a mining company's access to water rights is rendered more visible. The case also sheds some light on how a water indicator connected the resource-state and mining industry.

The indicators and accounting practices we have examined in this paper are central to many decisions made by the Division and, as we have described, they facilitate mining companies in legally securing and moving vast quantities of groundwater. This brings us back to the Division as an apparatus of security within the resource-state. At one level, administering water rights is about administering security, as approval contributes to the promise of security in places where access to water makes many things possible. While there are numerous instances in which the mining industry has gained security through the Division's system of water allocation, this has not been the case for many other water users or for communities affected by mining.

We have shown how the work that a resource-state engages in through defining, allocating, and exerting control over water rights is necessarily political. Water indicators and accounting practices are important sites where this political work of the resource-state is evident. In this article, we have focused on three aspects of the political work done by water indicators and accounting practices: 1) how they help make groundwater legible in ways that facilitate industry access to groundwater through means unavailable to other water users; 2) how they help reduce the visibility of mining access to groundwater; and 3) how they help enhance perceptions of the resource-state's objectivity and legitimacy. Organising the political work of indicators and accounting practices with respect to these aspects proved to be useful

in our study, and we expect that these aspects may be relevant beyond our study of mining and water rights in Nevada.

We found that, as an indicator, perennial yield is a key means by which the resource-state makes groundwater legible, yet the Division fails to apply it consistently or transparently in apportioning water rights. While it is not uncommon for the Division to not apply, ignore, or not act on perennial yield indications, the Division has not seemed to suffer a major loss of legitimacy or have its objectivity questioned as a result. In other words, while the existence of the indicator is important, it has not been used systematically or consistently in regulating groundwater use. This suggests that some of the political work done by an indicator happens when it is generated and when its importance is communicated, especially if it becomes an official indicator. Having indicators and accounting practices helps the resource-state be seen as objective, enhances its legitimacy, and helps its scientific capacity be recognised. We expect that in some instances, it may suffice to simply have an authoritative indicator, such as perennial yield, that makes water more legible and is recognised as scientifically valid as long as it is occasionally used. Simply being able to point to an authoritative indicator that is recognised as being scientific may also increase the resource-state's operational flexibility as well as maintaining its authority.

Finally, it is worth drawing attention to how water indicators and accounting practices facilitate the mining industry's access to groundwater and how they served to reduce the visibility of mining access to groundwater (part of aspects #1 & 2). In our study, this occurred when the knowledge of a mining company's witness on perennial yield was recognised as being scientific and superior to residents' longstanding local expertise and, as a result, the Division granted water rights to the mining company. This also occurred when the Division designated mining water uses as temporary and/or non-consumptive and did not account for these in the same way as most other water rights, thus reducing the visibility of the mining industry's use of water and advantaging those in the mining industry. Overt favouritism, in which one user is given preferential treatment but the next is not, may seem counter to the approaches typically taken by the resource-state, particularly if they are trying to maintain a sense of objectivity and legitimacy. However, when deploying accounting practices and indicators, certain parties or uses can be counted as being important and preferable while others may not. This aligns with Bowker and Star's (1999) ideas about the political work done by classification systems. We expect that this may be relevant in situations beyond Nevada and urge other researchers examining the politics of water quantification to further interrogate the role of indicators and accounting practices in generating favourable conditions for certain users and in reducing the visibility of favoured users.

REFERENCES

Adams, P.C. 2021. Language and groundwater: Symbolic gradients of the Anthropocene. *Annals of the American Association of Geographers* 111(3): 677-686.

Barrick/Nevada Gold Mines et al. 2023. Proposal for Amending AB 387 to the Nevada Senate Natural Resources Committee. 11 May 2023. https://www.leg.state.nv.us/App/NELIS/REL/82nd2023/ExhibitDocument/OpenExhibitDocument?exhibitId=69080&fileDownloadName=AB387AmendmentProposal.51123.pdf (accessed 13 May 2024)

Berry, K.A. 2009. Fleeting fame and groundwater: Isolation and water in Kings River Valley, Nevada. *Water History* 1: 59-74, https://doi.org/10.1007/s12685-009-0006-3

(BLM) US Bureau of Land Management, Elko Field Office – Nevada. 2010. Final supplemental environmental impact statement – South Operations Area project amendment cumulative effects. April 2010.

Birkenholtz, T.L. 2015. Recentralizing groundwater governmentality: Rendering groundwater and its users visible and governable. *WIRES Water* 2: 21-30.

Bowker, G.C. and Star, S.L. 1999. *Sorting things out: Classification and its consequences*. Cambridge, MA: MIT Press.

Bridge, G. 2014. Resource geographies II: The resource-state nexus. *Progress in Human Geography* 38(1): 118-130.

Campero, C. and Harris, L.M. 2019. The legal geographies of water claims: Seawater desalination in mining regions in Chile. *Water* 11: 21, https://doi.org/10.3390/w11050886

(Division) Nevada Division of Water Resources. 1989. Ruling #3606 on appropriating water from the Kelly Creek Area groundwater basin, Humboldt County, Nevada, http://images.water.nv.gov/images/rulings/3606r.pdf (accessed 15 December 2023)

(Division) Nevada Division of Water Resources. 2009. Presentation on Diamond Valley Water Resource Management. March 19, 2009. Eureka, Nevada.

(Division) Nevada Division of Water Resources. 2013, 2015, 2017. Nevada statewide groundwater pumpage by county and manner of use in 2013, 2015, and 2017, https://water.nv.gov/mapping.aspx?mapping=Water%20Use%20And%20Availability (accessed 14 January 2024)

(Division) Nevada Division of Water Resources. 2018. Summary of statutory procedures for filing claims of vested rights, making application for a water right and a summary of fees of the State Engineer, https://water.nv.gov/Documents/SE_Procedures_Fees_Brochure.pdf (accessed 26 April 2024)

(Division) Office of the State Engineer. 2022. Order #1189A. Adopting rules to allow multiple points of diversion for mining, milling, and dewatering operations within a portion of the Crescent Valley Hydrographic Basin (04-054), Lander County, Nevada. 13 January 2022.

(Division) Nevada Division of Water Resources. 2022. Hydrographic abstract for 139 Kobeh Valley, https://water.nv.gov/HydrographicAbstract.aspx, (accessed 31 January 2023)

(Division) Nevada Division of Water Resources. 2023. *2023 Basin status map series,* http://water.nv.gov/documents/2023%20Basin%20Status%20Map%20Series.pdf (accessed 10 January 2024)

(Division) Nevada Division of Water Resources. 2024a. *Groundwater monitoring sites and measures* [Geodatabase], https://data-ndwr.hub.arcgis.com/maps/14e43de0156c4335962772da545d1443 (accessed 12 January 2024)

(Division) Nevada Division of Water Resources. 2024c. *Groundwater commitments and availability for 030A Kings River Valley – Rio King SubArea,* https://water.nv.gov/DisplayHydrographicGeneralReport.aspx?basin=030a (accessed 13 January 2024)

Eakin, T.E.; Lamke, R.D. and Everett, D.E. 1966. *Hydrologic reconnaissance of the Humboldt River Basin, Nevada*. US Geological Survey, Water Resources Bulletin #32.

Eureka County et al., v. Nevada State Engineer. 2015. No. 61324 & 63258. Supreme Court of the State of Nevada. 18 September 2015.

Fernandez, S. 2014. Much ado about minimum flows… Unpacking indicators to reveal water politics. *Geoforum* 57: 258-271.

Flavelle, C. and Rojanasakul, M. 2023. As groundwater dwindles, powerful players block change. *New York Times* November 24, 2023, https://www.nytimes.com/interactive/2023/11/24/climate/groundwater-levels.html?searchResultPosition=2

Flores Fernández, C. and Alba, R. 2023. Water or mineral resource? Legal interpretations and hydrosocial configurations of lithium mining in Chile. *Frontiers in Water* 5, https://www.frontiersin.org/articles/10.3389/frwa.2023.1075139

Foucault, M. 1991. Governmentality. In Burchell, G.; Gordon, C. and Miller, P. (Eds), *The Foucault effect: Studies in governmentality,* pp. 87-104. Chicago, IL: University of Chicago Press.

Golonka, S. and Solis, J. 2023. Follow the money: $2.8 million in combined legislative campaign spending from minor industries. *Nevada Independent*, https://thenevadaindependent.com/article/follow-the-money-2-8-million-in-combined-legislative-campaign-spending-from-minor-industries (accessed 16 December 2023)

Gordon, C. 1991. Governmental rationality: An introduction. In Burchell, G.; Gordon, C. and Miller, P. (Eds), *The Foucault effect: Studies in governmentality,* pp. 1-52. Chicago, IL: University of Chicago Press.

Harrison, S. 2001. The historical development of Nevada water law. *Water Law Review* 5(1): 148-182.

Holifield, R. 2009. How to speak for aquifers and people at the same time: Environmental justice and counter-network formation at a hazardous waste site. *Geoforum* 40: 363-372.

Jamasmie. C. 2021 Nevada takes title as world's top mining destination. *Mining [dot]Com* https://www.mining.com/nevada-is-the-worlds-new-top-mining-destination/ (accessed 23 February 2021)

Jepson, W.; Budds, J.; Eichelberger, L.; Harris, L.; Norman, E.; O'Reilly, K.; Pearson, A.; Shah, S.; Shinn, J.; Staddon, C.; Stoler, J.; Wutich, A. and Young, S. 2017. Advancing human capabilities for water security: A relational approach. *Water Security* 1: 46-52, https://doi.org/10.1016/j.wasec.2017.07.001

Jones, M.A.; Baggerman, J. and Halford, K. 2021. Groundwater-flow model of the Carlin Trend basins, Nevada. Report prepared for Nevada Gold Mines LLC by John Shomaker & Associates Inc. and Halford Hydrology, LLC.; Albuquerque, NM. On file at Nevada Division of Environmental Protection.

Kennedy, J. 2010. Declaration of Joe Kennedy regarding the Cortez Hills Project. Comments on the Draft Supplemental Environmental Impact Statement of the Cortez Hills Mine Expansion Project from Great Basin Resource Watch and Western Shoshone Defense Project. 4 October 2010.

Kroepsch, A.C. 2018. Groundwater modelling and governance: Contesting and building (sub)surface worlds in Colorado's Northern San Juan Basin. *Engaging Science, Technology, and Society* 4: 43-66.

Kroepsch, A.C. and Clifford, K.R. 2022. On environments of not knowing: How some environmental spaces and circulations are made inscrutable. *Geoforum* 132: 171-181.

Kunkel, K.E. 2022. *State climate summaries for the United States 2022. NOAA Technical Report NESDIS 150.* https://statesummaries.ncics.org/chapter/nv

Malmberg, G.T. and Worts, G.F. 1966. *The effects of pumping on the hydrology of Kings River Valley, Humboldt County, Nevada, 1957-1964*. State of Nevada Department of Conservation & Natural Resources, Water Resources Bulletin #31.

Martin, J.V. 2021. Between Schylla and Charybdis: Environmental governance and illegibility in the American West. *Geoforum* 123: 194-204.

Mejia, J. and Aliakbari, E. 2022. *Annual Survey of Mining Companies 2022.* Fraser Institute. Canada, https://www.fraserinstitute.org/sites/default/files/annual-survey-of-mining-companies-2022.pdf (accessed 15 January 2024)

Nevada Department of Taxation. 2022a. *Annual report.*

Nevada Department of Taxation, 2022b. *Net proceeds of minerals bulletin.*

Nevada Division of Water Planning, 1998. Water words dictionary.

Nevada Division of Water Planning, 1999. Nevada state water plan.

NYC Division of Environmental Protection, 2023. New York City Water Consumption Data, https://www.nyc.gov/site/dep/water/history-of-drought-water-consumption-page (accessed 12 December 2023)

Pennington, N. 2022. Central Nevada Regional Water Authority Groundwater Monitoring Program Annual Report for Fiscal Year 2022-2023, November 30, 2022.

Pielou, E.C. 1998. *Fresh water.* Chicago: University of Chicago Press.

Powis, A. 2021. The relational materiality of groundwater. *GeoHumanities* 7(1): 89-112.

Rothberg, D. 2023. What environmental bills passed, failed in the 2023 Nevada Legislature. *Nevada Independent,* https://thenevadaindependent.com/article/what-environmental-bills-passed-failed-in-the-2023-nevada-legislature (accessed 12 January 2024)

Schorr, D.B. 2005. Appropriation as agrarianism: Distributive justice in the creation of property rights. *Ecology Law Quarterly* 32(3): 3-71.

Shamberger, H.A. 1991. *Evolution of Nevada's water laws as related to the development and evaluation of the state's water resources, from 1866 to about 1960.* US Geological Survey and Nevada Division of Water Resources, Water-Resources Bulletin 46.

Sullivan, Adam (Division of Water Resources) v. Lincoln County Water District et al., [consolidated case]. 2024. Nevada Supreme Court Case #84739.

Spitz, K. and Trudinger, J. 2019. *Mining and the environment: From ore to metal*. CRC Press.

US Bureau of Labor Statistics, 2023. Nevada labor force data, October 2023, https://www.bls.gov/eag/eag.nv.htm (accessed 15 December 2023)

Valladares, C. and Boelens, R. 2019. Mining for mother earth. Governmentalities, sacred waters and nature's rights in Ecuador. *Geoforum* 100: 68-79, https://doi.org/10.1016/j.geoforum.2019.02.009

Visher, M. and Patterson, L. 2022. *Major mines of Nevada 2021: Mineral industries in Nevada's economy.* Nevada Bureau of Mines and Geology Special Publication P-33.

Welden, F.W. 2003. *History of water law in Nevada and the western states*. Background Paper 03-2. Research Division, Legislative Council Bureau.