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Contents

Introduction

Workshop Background

During the summer of 2024, following a year of scrutiny from media and the federal government over state and local groundwater practices, the members of the Western States Water Council (WSWC) expressed interest in holding a workshop, or series of workshops, to learn from one another how each state is meeting the challenges of groundwater management.

Several states expressed interest in sharing state-specific challenges and solutions, including administrative best practices, conjunctive management, state legislation and litigation, and addressing over-appropriation. **Oregon** wanted to share and learn about different administrative approaches to managing "critical groundwater areas" and other overdrawn basins. This includes discussing what processes are working, what challenges have been encountered, and how to improve tools for groundwater allocation rulemaking. **Nevada** and **Nebraska** were interested in discussing the integrated management of surface and groundwater. Nevada has a Supreme Court decision affirming its authority to do this, while Nebraska has a long-standing, successful system in place. They wanted to share their experiences and learn from others. **California** was approaching the 10-year anniversary of its Sustainable Groundwater Management Act (SGMA) and wanted to offer updates on the litigation and challenges arising from new local agencies being required to manage groundwater. **Idaho** wanted to explore how other states are dealing with the interface between groundwater and surface water under state law, especially in times of crisis. **Nevada** has been considering ways to reduce "paper water rights" that aren't being used to divert wet water and to address over-appropriated basins, as their current forfeiture process is not effective. This was noted a common challenge others could learn from. Several states wanted to learn about strategies for minimizing conflict, such as allowing shortage sharing agreements in overdrawn basins, as it's a growing issue in groundwater management.

The states were also interested in scientific advancements in data needed for effective groundwater management, including the different factual and modeling approaches used. **Nebraska**, for example, has models for every major aquifer and is willing to share its expertise. **Oregon** has faced pushback from the U.S. Geological Survey (USGS) on peer-reviewing their groundwater work and is looking for other opportunities to collaborate with states on this.

Some states also expressed a desire to use a workshop to demonstrate to the federal government that groundwater management is already being effectively handled at the state and local levels. They want to show that a vast network of experts exists within states and that federal assistance should be focused on supporting existing state efforts rather than imposing new regulations. They saw the exchange of information at the workshop as an opportunity to educate the public and the federal government about the nuances of water in the West, particularly regarding groundwater and jurisdiction. This would help explain what states are already doing and what resources they need from the federal government.

Who We Are

The WSWC was established by western governors in 1965 to advise them on water issues in the West. The members of the Council are appointed by the governors. The Council's purpose is "to accomplish effective cooperation among western states in matters relating to the planning, conservation, development, management, and protection of their water resources, in order to ensure that the West has an adequate, sustainable supply of water of suitable quality to meet its diverse economic and environmental needs now and in the future."

Western Policy on Groundwater

States have exclusive and primary authority over the allocation, administration, and management of groundwater within their borders. This authority is supported by historical legislation like the Desert Land Act of 1877 and Supreme Court decisions. The WSWC opposes any federal efforts that would establish a federal ownership interest in groundwater or diminish the states' authority. The regulatory reach of federal statutes, such as the Clean Water Act and the Endangered Species Act, was never intended to infringe upon state or private ownership of groundwater.

States are in the best position to manage groundwater because conditions affecting supplies and demands vary considerably across the West and even within individual states. While the states are willing to work cooperatively with federal partners to address federal needs, they believe this should be done through existing state laws and authorities. See Position #515, State Primacy over Groundwater; and Position #506, Asserting State Primacy on Protecting Ground Water Quality.

Roundtable: State Challenges and Opportunities

The WSWC kicked off the Groundwater Workshop with a roundtable discussion that brought together perspectives from water managers, legal advisors, and scientists from various agencies and states regarding their most pressing groundwater challenges and opportunities. The conversation revealed common themes across the West, despite the sometimes unique legal and hydrological characteristics of each state.

Legal and policy challenges included grappling with conjunctive management, outdated laws, exempt wells, continuing or restricting the allocation of groundwater rights, and compliance with interstate compacts. While states like Nebraska, North Dakota, and South Dakota have long managed their groundwater and surface water conjunctively, other states are in the early stages of grappling with litigation and adequate authority, funding, and science to effectively manage water conjunctively. Idaho's long-standing litigation over conjunctive management has led to large-scale curtailment orders, while Montana's policy on exempt wells and mitigation has been repeatedly debated and failed to result in new legislation in the legislature. Oklahoma's water law, largely unchanged since 1972, is creating conflicts between different water users and hindering effective management. Nevada, Montana, and Oregon have biennial legislatures, and Utah has a very short annual legislative session. This creates challenges to managing orderly updates to laws, policies, regulations, and legal traditions.

Montana, Washington, Oregon, and Idaho identified the cumulative impact of exempt wells for rural or domestic use as a significant and recurring policy challenge, often leading to litigation and legislative gridlock. Oregon is facing the difficult process of implementing its first spatial groundwater regulations in the Harney Basin, while Oklahoma is bracing for potential reduced allocations as new aquifer studies are completed. Nebraska has a long history of litigation related to integrated management and interstate compacts, such as the Republican River Compact, which highlights the need for a robust regulatory framework.

Several states also expressed their water quality and environmental concerns with groundwater. Nitrate contamination was identified as a major concern in multiple states, including Nebraska, Kansas, and Washington. Nebraska is in the initial stages of collaborating with its health department on the land application of industrial sludge/biosolids, while Washington is struggling with how to integrate nitrate monitoring into its groundwater permitting process.

Emerging contaminants, such as PFAS, and Clean Water Act compliance are ongoing concerns. Nevada is facing new challenges with lithium brine mining and the financial and environmental risks posed by bankrupt hard rock mining operations. The state is re-evaluating its bond estimates to accurately reflect the costs of managing contaminated water. Nevada is working to reconcile the implications of the *Sackett* and *Maui* Supreme Court decisions with its state regulations. States emphasized the need for better integration between water quality and quantity management. Historical disinvestment in water quality has impacted states' ability to address pressing issues.

Montana and North Dakota mentioned their public education efforts. North Dakota's "Know Your Aquifer" campaign successfully educated the public and legislators, demonstrating the value of proactive communication. The Montana DNRC is also building its communication workforce to address a widespread lack of public understanding about water rights. The increasing availability of water monitoring and water rights data online is seen as a key opportunity for improving understanding

Metering for better water resource decisionmaking has been a contentious topic in some states, while other states such as North Dakota and Nebraska have embraced and benefited from a pervasive metering culture for many years. Oklahoma noted that metering is now being discussed among irrigators, reflecting a significant change in attitude.

More detailed comments from each state are summarized below.

Arizona
All groundwater in Arizona is protected as drinking water, given the state's limited surface water resources and reliance on groundwater for drinking water systems. Arizona has its own groundwater program, in addition to the Clean Water Act and Safe Drinking Water Act programs. They are interested in hearing and learning from other states.

Idaho
Idaho has faced long-standing conjunctive management issues in the Eastern Snake Plain Aquifer, with extensive litigation stemming from delivery calls by senior surface water users against junior groundwater users since 2005. The aquifer has some unique interactions with the surrounding surface water, and some junior groundwater users also have senior rights to surface storage water. In 2025, senior delivery calls required pumping curtailment orders affecting about 500,000 acres of irrigated land. They recently reached a large settlement agreement. Under a new statute, Idaho is expanding the administrative boundary of their conjunctive management plan to include 13-15 tributary basins, a collaborative effort to ensure all users contribute to mitigation. Public meetings have involved some difficult conversations, with water users understandably resistant to potential reductions in pumping as well as increased costs. Administering water rights based on combined priority dates across a large area is complex, and establishing effective water districts has been challenging. Aquifer recharge with underground injection control wells has become a hot topic, creating tension between those wanting to recharge water affordably, and the concerns of domestic and municipal well users regarding the quality of injective surface water in sole source aquifers.

Kansas
Kansas has two primary concerns: long-term groundwater depletion in the western third of the state, and groundwater-surface water interaction in the central region, where groundwater pumping often impacts senior surface water rights within their conjunctive water rights system. On the water quality side, their primary concern is nitrates in agricultural areas with shallow groundwater. They are encountering emerging issues of naturally occurring sulfate and uranium due to the continued use of groundwater for irrigation.

Nebraska
Managing groundwater and surface water conjunctively can be comparatively straightforward, thanks to the hydrology of the Ogallala Aquifer, state statutes, and lessons learned from past water disputes. They had various compact issues, such as the Republican River Compact, which further emphasized the need for regulations that would address the physical availability of water in aquifers and streams and the ability of the state to meet its legal obligations. Nebraska's LB962 legislation, which integrated surface and groundwater management, has been a successful model for managing a complex system, and its relative peace from litigation over the last six years is a testament to its effectiveness. Nebraska has depended on federal data collection and other essential programs, and is interested in recent developments at the federal level. Nitrate contamination in groundwater is a key concern in Nebraska. A more recent challenge is the land application of industrial sludge, including food waste and biosolids. This practice raises questions about whether these materials are classified as waste or product, and leads to potential health impacts. The water quality and health agencies are collaborating to improve the management and risk assessment associated with this land application.

Nevada
Water quality and quantity matters fall under different offices. On the water quality side, they are working to reconcile the *Maui* and *Sackett* decisions, which appear somewhat contradictory. Their drinking water program is focused on recent rules and amendments on PFAS and the Lead and Copper Rule. An increase in lithium brine mining is impacting groundwater resources. Direct lithium extraction involves the pumping of water, removal of lithium, and the brine is reinjected, with implications for Nevada's Underground Injection Control (UIC) program. This represents a distinctly new direction from traditional hard rock mining. In the past couple of years, a hard rock mining operation declared bankruptcy with very little advance notice. The monthly costs for managing fluids to prevent a catastrophic release until the mining bond goes into effect have ranged from $400,000-$500,000, rapidly exhausting the state's interim fluid management account established 20 years ago with $1.4M Consequently, Nevada is re-evaluating its bond cost estimates and the fluid management account to more accurately reflect inflation and the true costs of managing contaminated water during the initial reclamation phases of a mining property. The biennial legislature meets for 120 days, and this short time frame and high turnover of legislators makes it difficult to discuss complex topics in depth. They have 20 water-related bills introduced covering various issues, such as the State Engineer's efforts to modernize, minimizing processing times and streamlining procedures, but with limited resources to do so. In recent years, they have shifted from allocating water to primarily managing change applications and existing allocations, which involves significant conflict mitigation, management, and analysis. Nevada's laws are rooted in tradition and sometimes misinformation. Tools like curtailment by priority, forfeiture, abandonment, and cancellation are not very strong or have not been used. They frequently face legal challenges when attempting to remove unused water from the books. The State Engineer successfully defended its authority to manage surface and groundwater conjunctively. A stakeholder group in the Humboldt River system is working to develop conjunctive management strategies, and is being watched statewide as a potential model. The Nevada Water Initiative, which aimed to update the state's baseline science, highlights the potential of federal funding (e.g., ARPA funds) to support critical water resource projects, while also underscoring the risk when state investment is not sustained. While southern Nevada relies heavily on Colorado River water, groundwater still constitutes 10% of their water resources.

North Dakota
North Dakota's Rockford River is at or near full appropriation, which has prompted a significant exploration of options for managed aquifer recharge. They completed a statewide assessment in 2024, and are delving deeper into specific pilot project locations in the central and eastern parts of the state. They manage their groundwater and surface water conjunctively. In an effort to improve understanding of groundwater and aquifers, North Dakota launched a public education campaign called "Know Your Aquifer" targeting the general public, legislators, and water managers. The initiative included various one-page documents and email updates. It proved to be very successful, garnering considerable positive feedback, and they are now exploring other opportunities for educational campaigns. More information is available on the North Dakota Department of Water Resources website.

Montana
Montana's water quality and water rights are handled by separate agencies. About 4-5 years ago, their Water Sciences Bureau initiated a comprehensive water review involving stakeholders to streamline their water rights permitting process. One of the significant challenges identified was a surge in exempt groundwater use, defined as a flow rate of 35 gallons per minute or less, or less than 10 acre-feet per year. Given Montana's conjunctive management of surface and groundwater, nearly all new groundwater use impacting surface water requires mitigation, which has proven difficult, particularly with the increase in more populated areas. Bills to address this challenge have been introduced in the biennial legislature for the past ten years without success. This year a group of stakeholders including senior water right holders, conservation groups, and the development community sought to develop a compromise bill balancing their interests, but that has fallen apart during the legislative process. Due to some litigation last year curtailing a perceived development loophole in phased subdivisions and combined appropriations, Montana is anticipating an increase in lawsuits. They are hoping to proactively address this issue and are keen to learn from others' experiences.

Oklahoma
Oklahoma's water laws have not been substantially updated since 1972, which contributes to ongoing water conflicts between irrigators, commercial users, and domestic groundwater users. Groundwater is considered private property. The current legislature has introduced 31 water-related bills this session. The state has made progress on its aquifer studies to determine maximum annual yields. They are moving toward a public process that will likely result in reduced allocations for some aquifers. They welcome advice from other states on navigating public engagement through curtailments. The state is also experiencing an unfamiliar drought-flood cycle that has led to an increasing number of discussions with stakeholders having diverse perspectives. They are grappling with how to effectively manage various stakeholders. There is a growing interest in understanding groundwater laws, forming interest groups, developing groundwater management and regulation, and even considering metering, which was once a taboo subject.

Oregon
Oregon's water quality and water rights are managed by separate agencies. Their first groundwater regulations were implemented in the Harney Basin in the 1990s, and the challenges

there have been a difficult and ongoing process. OWRD is adjusting to new groundwater allocation policies. Their biennial legislature has been working to address some significant water challenges, led by bipartisan legislators with a strong water vision. This has resulted in a rapid succession of bills that requires considerable effort to manage. Some aspects of ODEQ's authority and operational procedures under the existing water quality statutes and regulatory framework could be more effective, and the legislature is working on those. There is also a great need to invest in the state's capacity to tackle pressing water quality issues. They are engaging in collaborative efforts to manage areas with significant nitrate contamination.

South Dakota
South Dakota faces a challenge similar to many western regions regarding the availability of water and getting to where it is needed. One of their strengths is that they do conjunctively manage their surface water and groundwater.

Utah
Utah has required groundwater applications since the 1930s. A recent challenge has been the increased number of requests for exemptions from the regulatory process, primarily from energy production, geothermal, and mining interests seeking access to deep aquifers or brines. The legislature has been focusing on this lately. Utah's annual legislative sessions are limited to 45 days, so it is a constant effort to keep up with evolving needs. Utah faces the challenges of managing groundwater in areas where aquifers are not a single large system, and developing groundwater management plans in overdrafted areas that can gain public acceptance.

Washington
Washington is also grappling with nitrates in groundwater and their impact on drinking water. They've encountered some difficulties trying to integrate water quality monitoring into their groundwater permitting process. Their CAFO permit has been appealed due largely to compliance issues. A key aspect of work on the water rights side is balancing in-stream needs with out-of-stream uses, particularly related to ESA-listed salmon species and treaty tribes with unquantified water rights to fisheries and their supporting environments. Conjunctive management of groundwater and surface water is an ongoing challenge. There are ongoing collaborative efforts in the Walla Walla Basin. Several watersheds have in-stream flow rules with specific targets for the mainstem rivers, sometimes leading to closures of new appropriations. Some of the mitigation plans submitted by applicants use groundwater models, and the consulting community has developed a practice of setting error bar thresholds, leading to determinations that pumping impacts to surface water are insignificant if they fall within the model's error bounds. This poses a problem under recent court decisions in 2001 and 2015, which establish a strict 100% mitigation standard (in time, in kind, in place), making mitigation options nearly impossible to achieve. One key challenge is the significant deep groundwater declines over the past 50 years in the basalt aquifers in eastern Washington's agricultural centers. Maintaining data and finding options for irrigators is difficult. One ongoing issue is a permanent permitting exemption for rural housing development established in the 1990s. Despite a court ruling that the exemption is limited to one per development, the state continues to seek new policy solutions.

WestFAST

Bureau of Land Management: Widespread misunderstanding of the impact of well pumping is a significant challenge. It is difficult to intuitively grasp and forecast the consequences, and to determine sustainable levels of groundwater development. One of the key challenges for BLM is providing the appropriate context for the physical and legal availability of groundwater in environmental compliance documents for proposed land uses like energy development and grazing. The complexities of state water management challenges, such as curtailments and over-appropriated basins, are difficult to convey. Another challenge is ensuring consistency across the agency for water right applications and adjudications. The increasing availability of water monitoring and water rights data online, along with remote sensing capabilities, is an opportunity to improve our understanding of groundwater resources and sustainability.

U.S. Forest Service: The USFS plays a crucial role in sustaining the nation's water supply, with 46% of available water supply originating from 193 million acres of public lands in the West, and serving 90% of the population’s public drinking water systems in the West. Understanding these relationships can aid the agency and its partners in restoration, fuels reduction, and post-fire stabilization efforts. Some challenges include the agency's continued lack of a national groundwater stewardship policy, and recent uncertainty related to organization, staffing, and funding to carry out the mission and work of the agency.

U.S. Air Force: Most of the Air Force's owned and operated water supplies in the West are groundwater sources, and they rely heavily on these resources to support their mission, making state groundwater management a high interest topic.

State Presentations

Oregon Groundwater Allocation Rules

Justin Iverson, Groundwater Section Manager at the OWRD, provided an overview of the new statewide groundwater allocation rules approved by their Water Resources Commission. The rules are the result of a two-and-a-half-year process involving a large team of stakeholders, tribal representatives, and public comments. The rules were prompted by the increasing over-allocation of groundwater across Oregon, leading to a rise in dry well complaints and a decline in stream flows. Oregon operates under a conjunctive use system, where groundwater and surface water are strongly interconnected. The summer dry season, combined with peak irrigation, has led to a significant reduction in stream flow, impacting established senior surface water rights and water quality. The new rules aim to achieve three main objectives: (1) promote sustainable groundwater use while upholding the prior appropriation doctrine; (2) base the new changes on Oregon-specific groundwater data, science, and law; and (3) issue new water rights only where sufficient information confirms water availability.

This marks a significant shift from the previous approach, which often required evidence of over-allocation before denying a new water right, with the default that water was otherwise available. The new rules are proactive, focusing on assessing water availability before allocation. Two major changes to definitions in the rules are defining “reasonably safe water levels,” and redefining “potential for substantial interference.”

A long-standing legislative policy from 1955 required the determination of “reasonably stable water levels,” but this term was never formally defined. The new rules establish a definition based on historical data from over 300 wells with at least 25 years of records. The new criteria include: (1) a decline of less than half a foot per year over a five to twenty-year period; and (2) a total decline of 25 feet or less. This test will be used to assess water availability from a storage perspective.

Previously, the rules allowed groundwater right impacts on surface water because they focused on a specific timeframe or a quarter-mile radius from the well to determine the potential for substantial interference. The new rules revise this, stating that when groundwater discharges to a surface water, the surface water availability must be assessed before issuing a new groundwater right. This change means that groundwater availability will now align with surface water availability. The new rules will only apply to new permits and will not affect existing groundwater rights or exempt uses.

The new rules signify that Oregon is moving away from issuing new water rights and toward managing transfers and other alternative water supply solutions. The state anticipates that water transfers will become a significant tool for meeting demand. Currently they have one basin with an established mitigation program and anticipate developing more such programs across the states. Additionally, OWRD is exploring water reuse and other options in collaboration with the Oregon Department of Environmental Quality. The map of surface water availability shows a

significant reduction in the areas where new groundwater rights will be available, which underscores the shift toward a more sustainable and cautious approach to water allocation.

Following the presentation, participants asked questions regarding how the rules handle surface water depletion, the process for defining sustainability, and how the rules apply to both new and existing water rights.

Does OWRD view pumping as a 1:1 depletion of surface water, or does it account for return flows (e.g., from a septic system)?

- Iverson clarified that the agency operates within the allocation framework. If a surface water source is already fully appropriated, any new impact—even if only partially consumptive—is considered a burden on the system. The division chose to avoid specific impact thresholds (e.g., a minimal percentage impact) to prevent potential disputes and conflicts among consultants and stakeholders.

What was the process and timeline for defining "sustainability" and was it challenging to reach a consensus?

- Iverson explained that the rule-making process took about two and a half years. The process was highly transparent and involved a large Rules Advisory Committee with 35 representatives from various sectors, including irrigators, municipalities, and tribal representatives. The agency presented a data-driven, 40-page paper on their approach, which was peer-reviewed by the USGS. The goal was to define a "reasonably stable water level," and the extensive data on long-term climate responses helped achieve a strong consensus without significant disagreement.

Will the new rules would apply to existing diversions?

- Iverson confirmed that the new rules do not apply to existing diversions or water rights. The primary goal is to prevent the problem from worsening by stopping new allocations in over-allocated areas. The agency is currently using other processes to address over-allocation in specific areas, such as the southeast, where water levels have been declining for decades. These curtailment efforts are a separate, difficult, and ongoing process.

Who determines the allowable amount of stream-flow depletion for new permits?

- Iverson stated that the new rules essentially answer this question. The agency, under the direction of its commission, created these administrative rules. He explained that the previous rules, in place since the late 1980s, had specific thresholds for "*de minimis* impacts," but these were removed in the new set of rules. This change was a paradigm shift driven by concerns from senior water rights holders whose rights were already being curtailed due to over-appropriation. The new rules, therefore, do not set specific thresholds for allowable depletion, instead focusing on preventing any further impact on already strained summertime base flows.

Nebraska Aquifer Monitoring for Water Management

Jesse Bradley, Interim Director, Nebraska Department of Natural Resources, outlined Nebraska's unique and comprehensive approach to water management, with a strong emphasis on aquifer monitoring and the role of Natural Resources Districts (NRDs).

Nebraska is a large, predominantly rural state with a population of about 2 million, half of whom live in the Omaha area. The state is a major agricultural producer, with approximately 20 million cropped acres, half of which are irrigated. Meat production (predominantly cattle) is the largest agricultural sector. There's a significant precipitation gradient from west (12-13 inches annually) to east (36 inches), making irrigation essential for crop production in the western half of the state. The state's unique Sandhills region acts as a major recharge zone for the High Plains Aquifer, with some areas having over 1,000 feet of saturated thickness. Nebraska holds a substantial portion of this aquifer's recoverable storage (two billion acre-feet out of three billion). The vast majority (94-95%) of both surface water and groundwater is used for agriculture. Almost all municipalities rely on groundwater for drinking water, though nitrate contamination is a growing concern. Nebraska is the most heavily irrigated state in the country, with over 100,000 groundwater wells.

Nebraska uses an "integrated management" or "conjunctive management" approach to address the connection between groundwater and surface water. Surface water is managed under a prior appropriation system ("first in time, first in right"). Groundwater is managed by NRDs under a correlative system, where all users in a management area are subject to the same regulations, regardless of when their well was drilled. Created in the 1970s, the 23 NRDs are a cornerstone of Nebraska's water management. These local, elected boards have significant authority and are funded by local property and occupation taxes, which allows them to leverage state and federal funds for projects.

The planning process is tiered and iterative, starting with interstate compacts (e.g., Republican River Compact) and agreements (e.g., Central Platte ESA program), followed by basin-wide plans, and finally, individual NRD integrated management plans. This process involves extensive scientific data, modeling, and stakeholder collaboration.

Nebraska has a robust monitoring network, including over 250 state and USGS stream flow gauges and more than 22,000 sites for groundwater monitoring. The state has invested heavily in a statewide network of groundwater models developed in partnership with NRDs. These models are crucial for:

- Assessing objectives: Measuring groundwater depletion and its impact on stream flow.
- Interstate compact compliance: For example, the Republican River Compact has specific accounting requirements based on these models.
- ESA compliance: Ensuring groundwater development does not exceed baseline levels set in 1997.
- Recharge Projects: The models also help manage proactive projects, such as an initiative in the upper Platte area where irrigation districts are paid to recharge the aquifer by diverting water into unlined canals. This has successfully recharged approximately 300,000 acre-feet of water over the past 15 years.

Nebraska's water management is characterized by a tightly coupled approach to aquifer and stream flow management. The successful collaboration between the state DNR and local NRDs is essential for communication and problem-solving. The extensive use of science, monitoring, and modeling provides the necessary data for making informed, and often difficult, management decisions.

The discussion following the presentation addressed the unique legal framework, the role of local NRDs, and the challenges of balancing local control with statewide goals.

Legal and Regulatory Framework

- **Property Rights and "Takings":** Jesse clarified that unlike surface water, which has a vested property right, Nebraska's groundwater law is different. There is no established vested property right for groundwater, which allows for greater flexibility in management and regulation by NRDs without the legal barrier of "takings" claims.
- **Balancing Local Control:** When asked about the pushback from a "takings" argument, Jesse noted that the system's flexibility allows NRDs to address challenges without that specific barrier. NRDs can decide on allocation levels for existing users and how to balance them, sometimes through regulatory routes, incentive-based programs, or a combination of both.
- **Flexible/Inconsistent Approaches:** A speaker questioned the variability in NRD approaches. Jesse explained that this flexibility is a core feature of Nebraska's system. While all NRDs must meet the same compliance goals, they can choose different methods—some favor regulation and allocation to avoid raising taxes, while others use incentive programs. Conflicts across boundaries are handled with joint approvals from both NRDs.

State/NRD Enforcement and Compliance

- **Compliance Framework:** Jesse confirmed that a higher-level basin planning structure ensures all NRDs work within a consistent framework to meet shared objectives, such as complying with interstate compacts. If voluntary efforts fail, the state has mechanisms to ensure compliance.
- **Enforcement Actions:** NRDs have taken significant enforcement actions for violations. Penalties often involve doubling the amount of water used in excess and reducing the next allocation period by that amount. In extreme cases, such as an estate that illegally piped around a meter, the NRD permanently removed the irrigation rights for over 1,000 acres. These administrative orders can be, and have been, appealed to the State Supreme Court.

NRD Operations and Governance

- **Number of Wells/Acres:** Regarding the scale of NRD management. Jesse confirmed that the Central Platte, Upper Big Blue, and Lower Loup NRDs each manage over 1 million irrigated acres. These NRDs are independently responsible for managing all well owners, setting regulations, and enforcing them.

- **Staffing:** Staffing for these large districts varies. Central Platte NRD has 25-30 staff, while a major urban NRD like Papio-Missouri has over 100 staff due to its large tax base. In contrast, smaller NRDs may operate with only a few staff members.
- **Elected Boards:** NRDs are governed by boards whose members are elected in general elections for four-year terms. The composition of these boards varies, with more agricultural representatives in rural areas and a mix of professionals in urban areas.
- **Local vs. State Control:** Jesse acknowledged that citizens do appeal to the state when they are unhappy with their NRDs' decisions. However, local control is highly valued, and NRDs are incentivized to be proactive to avoid potential legislative action from the state government.

Impact of External Factors

- **Drought and Market Irregularities:** Jesse noted that drought and commodity market fluctuations have a visible impact on water use. Higher commodity prices often lead to increased pumping as producers seek to maximize profits. He cited a specific example where an NRD is implementing a drought-phase trigger to allocate water and reduce pumping.
- **Voluntary Integrated Management:** Jesse explained that NRDs in the state's "voluntary" integrated management areas chose to participate proactively to avoid the more stringent regulations and mandated rollbacks that were imposed on districts required to participate by state law. This desire to "get ahead of the train wreck" is a key motivator for districts' voluntary engagement in the process.

California Sustainable Groundwater Management Act

Jeanine Jones, Interstate Resources Manager at the California Department of Water Resources (CA DWR), presented a summary of California's journey toward groundwater sustainability, with a focus on the Sustainable Groundwater Management Act (SGMA).

Most of California's water supply originates in the wet north, while the greatest demand for water is in the dry south, particularly in the Central Valley, which is the heart of the state's agriculture. While surface water has been regulated since 1914, groundwater was historically considered a local issue. This led to a century of unregulated pumping, resulting in significant problems like aquifer overdraft, land subsidence, and saltwater intrusion. Multiple attempts to pass groundwater legislation failed until a severe drought provided the necessary political momentum for SGMA to pass in 2014.

The purpose of SGMA was to transition California from a state with minimal groundwater regulation to one with statewide local regulation, ensuring sustainability over a 20-year period. CA DWR serves as the state's technical and administrative manager, reviewing and approving local plans and providing support. The Groundwater Sustainability Agencies (GSAs) are local agencies, often formed as joint powers authorities, and are responsible for developing and implementing Groundwater Sustainability Plans (GSPs) for their basins. The State Water Resources Control Board (SWRCB) is the enforcement body. If a GSP is deemed inadequate by

CA DWR, the SWRCB can place the basin on probation and impose its own management plan. Of California's 515 groundwater basins, 94 are designated as medium- or high-priority and are subject to SGMA. These basins account for the vast majority of the state's groundwater use.

The central objective of SGMA is to prevent undesirable results, or "the six sins" of groundwater management: (1) chronic lowering of groundwater levels; (2) significant and unreasonable reduction of groundwater storage; (3) seawater intrusion; (4) degraded water quality; (5) land subsidence; and (6) depletion of interconnected surface water. Some solutions to these problems include groundwater recharge, reduced pumping, and improved data. The state is aggressively promoting "Flood-Managed Aquifer Recharge (Flood-MAR)" to capture winter floodwaters and direct them to agricultural lands and recharge ponds. This builds on California's long history of recharge projects. In severely overdrafted areas like the San Joaquin Valley, where long-term overdraft has averaged 1.5 to 2 million acre-feet per year, the only realistic solution is a significant reduction in groundwater use, which could lead to a reduction of 500,000 to 1 million acres of agricultural land. The state is using advanced technologies like InSAR (Interferometric Synthetic Aperture Radar) to monitor land subsidence and has invested a billion dollars over the last decade to fund new monitoring wells, models, and data programs to aid local agencies.

Current Status and Enforcement

- **GSA Formation:** All required GSAs were formed by the 2017 deadline.
- **GSP Submissions:** Critically overdrafted basins submitted their GSPs by 2020, and all other high- and medium-priority basins submitted theirs by 2022.
- **Review and Enforcement:** CA DWR has reviewed all plans, approving about three-quarters of them. The others are in a "fix-it" loop, and a few have been referred to the SWRCB for probation. The SWRCB has already placed two basins on probation and scheduled more hearings. This process marks a significant shift from a hands-off approach to one with real regulatory teeth.

The discussion with Jeanine Jones (CA DWR) and Joaquin Esquivel (Chair of the SWRCB) provided additional details on SGMA implementation.

Cost of SGMA Implementation

- **State Investment:** Jeanine previously mentioned a billion dollars in state investment. She clarified that the total investment, including local agencies, has not been fully tabulated, but some agencies have spent tens of millions on implementation.
- **Cost Drivers:** A significant portion of the cost is attributed to repairing damage caused by decades of overdraft, particularly land subsidence that has damaged critical conveyance infrastructure like canals. This creates an extra financial burden on agencies now responsible for fixing problems caused by past practices.

SWRCB's Enforcement and Probation

- **Legal Challenge:** When asked if there was a legal avenue to challenge the SWRCB, Jeanine explained that the enforcement process for SGMA is still in its early stages.

- **Probationary Period:** Joaquin Esquivel noted that for the two basins placed on probation, there is a one-year period for data collection and reporting before an interim plan can be adopted. No cuts to pumping have been made yet.
- **Proactive Engagement:** SWRCB's preference is for local agencies to take ownership of their challenges and show progress to avoid state intervention. Several basins referred to the SWRCB have successfully improved their GSPs and are now on a path to exit the process before a probationary hearing. In some San Joaquin Valley basins, local agencies are taking responsibility for problems, such as responding to dry domestic wells caused by their pumpers, rather than relying on the state to step in.

Reducing Groundwater Use

- **Voluntary vs. Mandatory Cuts:** During droughts, water reductions often become a business decision for growers. Land fallowing is already occurring, and some farmers are realizing they need to operate within a reduced water budget.
- **Mechanisms for Reduction:**
    - **Budgets:** Many GSAs are setting budgets for water use based on evapotranspiration (ET) without necessarily requiring meters.
    - **Fallowing:** While not strictly mandatory, the state has provided some grant funding for temporary fallowing and a "land flex" program to incentivize transitions to less water-intensive land uses.
    - **Market Forces:** The decline in agricultural land value, especially for land without a reliable water source, is a powerful market signal driving a new reality for growers.
- **Timeline:** The ultimate deadline for achieving sustainability under SGMA is 2040. Agencies are taking different approaches to reach this goal, with some implementing immediate cuts and others following a more gradual path.

Oregon Groundwater Quality Protection

Jennifer Wigal, Water Quality Program Manager at the Oregon Department of Environmental Quality (ODEQ), discussed groundwater quality issues in Oregon, highlighting the challenges of managing interconnected groundwater resources.

Oregon's legal framework for groundwater management is complex and involves multiple agencies with distinct responsibilities. ODEQ is the lead agency for groundwater quality. OWRD manages water rights for both surface and groundwater. The Oregon Health Authority (OHA) regulates drinking water but has no state-level requirements for private domestic wells. The Department of Agriculture manages water quality related to agricultural practices. Other agencies and entities with roles include the Department of Geology and Mineral Industries (DOGAMI) (mining permits and well siting and drilling), Department of Land Conservation and Development (land use, sewer and drinking water distribution systems), and Oregon State University (technical expertise and extension services, hydrogeology, agricultural links to contamination).

The state has a process for setting groundwater values, which has only been partially implemented. The process involves identifying "areas of concern" before officially designating "groundwater quality management areas" when contamination exceeds trigger levels. The current framework emphasizes sampling, education, and grants, but funding and clear agency roles are often lacking. Active legislation is in progress to address these issues and improve interagency collaboration.

Case Study 1: Lower Umatilla Basin

- **Problem:** This 550-square-mile area in Eastern Oregon was designated a groundwater management area due to widespread nitrate contamination exceeding the 10 mg/L Safe Drinking Water Act standard.
- **Sources:**
    - **Irrigated agriculture:** The region has extensive irrigated agriculture, which contributes to nitrate leaching.
    - **Concentrated Animal Feeding Operations (CAFOs):** Large-scale animal operations contribute manure to the system.
    - **Food production industries:** Wastewater from these facilities, which is rich in nitrates, is reused on agricultural lands, further adding to the contamination.
- **Challenges:** The area faces significant challenges due to limited state regulatory authority over private domestic wells, making it difficult to implement solutions for rural residents with contaminated water. The area is also low-income with a large non-native English-speaking population, adding a socioeconomic layer to the management problems.

Case Study 2: Crook County

- **Problem:** In Central Oregon's Crook County, high levels of manganese have been found in private domestic wells. Basin-wide issues include naturally-occurring minerals and decreasing water levels.
- **Sources:** The source of the contamination is currently unknown, but a nearby sand and gravel mine is a potential point source. DOGAMI has a year-long investigation, and ODEQ and OHA are analyzing water quality at domestic wells (2 rounds of testing)
- **Significance:** This case highlights the challenges of addressing groundwater quality issues in private wells where there is limited regulatory oversight and no clear source of contamination.

The Pacific Northwest's prolonged dry summers, combined with increasing demand for water, will likely intensify the need for irrigated agriculture, potentially worsening groundwater quality issues. There are significant economic considerations for businesses to change their operations, and a lack of clear agency authority makes it difficult to provide quick, effective fixes for rural residents. Rural communities are so spread out that municipal systems are often not feasible. The state currently has limited capacity and expertise to address these increasingly complex groundwater problems, underscoring the need for the legislative changes currently under consideration.

The discussion that followed focused on the challenges and collaborative efforts related to protecting groundwater quality, particularly from nitrate contamination.

Regulation of Nitrate Sources

- **Industrial and Agricultural Sources:** Tom Riley asked about the Port of Morrow's role in the Lower Umatilla Basin. Jennifer Wigal confirmed that the port is required to factor nitrate levels into its land application plans. The port is investing in treatment facilities to stabilize nitrogen concentrations, and the Department of Agriculture is developing regulations to track other applied fertilizers.
- **Nebraska's NRDs:** Tom shared Nebraska's approach, where Natural Resources Districts (NRDs) have the authority to regulate producers in "hot" areas with high nitrate levels. This can involve multi-phased regulations that limit fertilizer application timing and amounts, and require consideration of existing water nitrate levels. Jennifer thanked him for the insight, noting a potential statutory model for Oregon.

Addressing Contaminated Domestic Wells

- **Funding:** Regarding funding for the water replacement program, Jennifer explained that a one-time appropriation from the governor's office funded emergency water distribution. She noted a broader philosophical challenge in providing aid to residents who chose to live in areas without paying for municipal water services, and the lack of readily available state mechanisms for such situations.
- **Community Participation:** Participation in the water delivery program was impressive, estimated at around 75%. Jennifer praised the collaborative efforts of state and county health departments and local non-profits, who used various media in both English and Spanish to encourage water testing and delivery program enrollment.
- **Septic Systems:** Jennifer Carr from Nevada shared that her state faces similar challenges with nitrate contamination from septic systems and does not regulate domestic wells. She noted that Nevada is working on converting septic systems to sewers and has a law that requires connection to a nearby sewer system if a septic system fails. Jennifer Wigal acknowledged that septic-to-sewer conversion in Oregon has been a “contentious conversation,” and that proposed legislation to inspect septics faced pushback over concerns about privacy and property rights.
- **Land Use Laws and Infrastructure:** Jennifer Wigal discussed a significant barrier in Oregon's land use laws, which generally prohibit extending municipal sewer and drinking water services outside of urban growth boundaries. This makes it difficult to connect rural homes with contaminated wells. She mentioned that legislative action is being considered to ease these restrictions.
- **Long-Term Outlook:** Both Jennifer Wigal and Jennifer Carr emphasized the long-term nature of these problems, noting that even with a reversal in trends, it will take decades to see safe water in affected aquifers. They also stressed the importance of educating the public about the acute health risks of high nitrate levels in drinking water, particularly for infants.

Montana Aquifer Mitigation

Jake Morhmann, Bureau Chief at the Montana Department of Natural Resources and Conservation (MT DNRC), presented on the state's efforts to develop mitigation banking as a solution to facilitate continued water use and growth in a state where most water is already allocated.

Montana is a headwaters state, with mountains in the west and plains to the east. The valley fill aquifers in the west are typically narrow, long, and have a major river flowing through them, range from a few to thousands of feet thick, and are highly complex. Well depths are typically less than 100 feet. The plains aquifers feature relatively flat sedimentary stratigraphy, with sandstone and limestone aquifers, and well depths of hundreds to thousands of feet deep (e.g., a recent groundwater permit application for 5,000 feet deep seeks to access an aquifer less connected to the surface water.) Most groundwater is primarily for domestic supply, with some limited irrigation.

Montana conjunctively manages groundwater and surface water, treating them as a single, connected resource. The state's water law is based on the prior appropriation doctrine ("first in time, first in right"). Most surface water has been fully or over-appropriated for decades, meaning new consumptive uses are largely prohibited because they would impact senior surface water rights. An exception exists for "exempt wells," which are limited to 35 gallons per minute and up to 10 acre-feet per year. While individually small, the cumulative effect of a growing number of exempt wells is starting to have a noticeable impact on surface waters. For example, in the rapidly growing Gallatin Valley, approximately 10,000 exempt wells are depleting the Gallatin River by 15 cubic feet per second (CFS) at a constant rate, which is a significant portion of its low-flow.

Montana has been exploring the challenges and opportunities of mitigation. Any new water use must be mitigated by retiring or changing an existing water right. The mitigation has to match the depletions allowing water to be returned to the system at the same rate, in the same location, and at the same timing throughout the year. Timing is the most challenging aspect. New municipal uses are year-round, while available mitigation water rights are typically seasonal irrigation water rights.

Morhmann defined mitigation banking in the context of Montana's needs:

- **Mitigation:** The process of offsetting a new depletion by retiring or changing an existing water right. It requires a perfect match in the rate, location, and timing of the depletion.
- **Mitigation Banks:** "Banks" that acquire existing, "wet" water rights, change the timing from seasonal (e.g., for irrigation) to year-round, and then sell "credits" to new users, such as for domestic or municipal use.
- **Water Trust:** A "parking place" for water rights to prevent forfeiture, as used in Washington State.
- **Water Markets:** Transactional platforms (e.g., an "eBay of water rights") for buying and selling water rights.

Morhmann outlined three potential technical solutions for mitigation banking:

1. **Shallow Managed Aquifer Recharge (MAR):** Diverting surface water into infiltration basins to recharge an aquifer. The water slowly returns to a stream at a constant, year-round rate. This is relatively inexpensive and passive to manage.
2. **Deep Managed Aquifer Recharge (MAR) / Aquifer Storage and Recovery (ASR):** Injecting water deep into a valley-fill aquifer. The water returns to the surface at a constant rate, changing the timing from seasonal to year-round. This is more expensive but can be a solution for complex hydrogeology.
3. **Surface Reservoir Storage:** Utilizing existing reservoirs to store seasonal water and make it available year-round for new uses. This is a potential solution for areas with existing reservoir infrastructure, though it may require difficult negotiations with existing water user associations.

A mitigation bank could acquire 10,000 acre-feet of water, and then sell credits for different uses (e.g., domestic, stock, irrigation) at tiered prices. This could generate significant revenue for infrastructure and long-term maintenance. A 10,000 acre-foot bank could last for 50-150 years based on current growth rates in areas like the Bitterroot Basin, providing a long-term solution for growth. MT DNRC is aiming to have a policy package ready for the 2027 legislative session. This package will address legal changes, incentives, and pilot projects. The state is collaborating with grassroots organizations in basins like the Gallatin and Bitterroot to develop pilot MAR and reservoir-style mitigation banks.

The discussion that followed delved into the specifics of Montana's proposed mitigation banking program, clarifying its purpose, management structure, and operational details.

Purpose and Management of the Bank

- **Primary Goal:** The mitigation bank is being developed as a future tool to facilitate growth in areas where new water uses, including exempt wells, will no longer be permitted. Legislation is in progress to close off large basins to exempt wells, and the bank would then become the only way to support new development in these areas.
- **Who Will Run the Bank?** This question remains unanswered. The state is exploring different models:
    - A state-run initiative.
    - Independent banks run by other organizations with state incentives.
    - Fully independent private entities, with the state's role limited to policy and regulation.

Water Rights and Pricing

- **Water Source:** The water rights for the bank would need to be secured upfront. This could be done by purchasing existing water rights or using rights already held by an organization (e.g., a local water trust). In the case of state-owned reservoirs, the state may be able to renegotiate existing contracts or buy back credits.
- **Compensation:** The original water right holder would be compensated for their right, which would then be permanently owned by the bank. The right would be removed from public ownership records to ensure the water is available indefinitely for mitigation purposes.

- **Cost of Credits:** Jake provided an example of a credit costing approximately $1,000, which he considers a reasonable price for Montana. He noted that prices for similar programs in other states like Washington range from $2,000 to $10,000, but he doesn't believe Montana has the demand to support that price level. The price would likely be determined by each individual bank, not the state.

Metering and Enforcement

- **Metering Requirements:** Metering and reporting would be a definite requirement for new water users who purchase a mitigation credit.
- **Current Status:** Despite past attempts to require metering, it is not currently a statewide requirement. While some water rights have metering requirements, the collected data is often not utilized or made publicly accessible.
- **Legislative Action:** There is an irony in the current legislative session: funding was approved for a measurement database, but a mandate for metering was denied. The state recognizes the need for accessible data and is moving to make existing data usable, anticipating public demand for it.

Nebraska Groundwater Quality

Steve Goans and Hillary Stoll from the Nebraska Department of Environmental Quality (NDEQ) provides a comprehensive look at groundwater quality issues and management strategies in Nebraska.

Nebraska's key groundwater contaminants include nitrates, iron and manganese, arsenic and uranium, and per- and polyfluoroalkyl substances (PFAS). Nitrates are a long-standing issue in Nebraska, with about 15% of private domestic wells exceeding the 10 mg/L drinking water standard. A recent study, which included free testing for 29,000 domestic well owners, aimed to optimize resources and outreach to address this problem. Iron and Manganese are common, particularly in eastern Nebraska. Manganese has a secondary maximum contaminant level (MCL) for aesthetic reasons (50 ppb), but the EPA's health advisory is 300 ppb. An incident in West Point with levels of 1000 ppb prompted a voluntary sampling program and public advisories for infants. Arsenic and Uranium are naturally occurring contaminants that are a concern for both public and private water systems. The City of Lincoln is expanding a treatment plant to address rising arsenic levels. Nebraska's Superfund program has identified over 990 facilities that may have used or produced PFAS. Recent sampling revealed that three public water systems exceeded the MCLs for certain PFAS compounds.

Nebraska's groundwater quality management falls under a mixed regulatory framework. The state collaborates with NRDs and the university system to manage the Nebraska Groundwater Clearinghouse, a database that compiles water quality data from various sources. Approximately 18% of Nebraskans use private domestic wells, which are not regulated by the Safe Drinking Water Act. The state conducts outreach and offers resources, such as a reverse osmosis rebate program, to help well owners. Nebraska recently updated its regulations for groundwater under direct influence (GUDI) to align with federal standards. The presence of

Giardia or Cryptosporidium is still conclusive evidence of GUDI, but the presence of other single indicators now triggers an engineering review rather than an immediate conclusive determination.

Steve Goans discussed several innovative approaches and case studies:

- **"Reverse Maui" Cases:** These are situations where surface discharges impact a drinking water source. In one case, a meat processor's discharge into a small stream with a 20-year time of travel to a community's well required the facility to meet drinking water limits. They ultimately moved their discharge to a larger river for dilution.
- **Interbasin Transfers:** Moving water from one basin to another may require an NPDES permit if the water quality differs. In a case in southwest Nebraska, extensive hydrological and water quality analysis determined a permit was not needed for a specific transfer.
- **Large Septic Systems and Treated Wastewater:** To address high nitrate levels from rest areas and other facilities, the state has experimented with adding a sawdust layer as a carbon source for denitrification. This method was also successfully used at a fish cleaning station to manage high nutrient loads. In a collaboration with California, Steve helped design a system where treated wastewater was introduced into a pond with a sawdust layer to encourage denitrification before seeping back into a river for eventual use as drinking water. This provides an innovative way to recycle water while addressing public perception issues.
- **Managing Water Loss:** They have made complex calculations to quantify the amount of water lost from streams due to water quality control measures, such as a complete retention lagoon for a small town's wastewater treatment.

The discussion that followed covered a range of topics related to groundwater quality, including nitrate and PFAS contamination, and the role of agricultural practices.

Nitrate Contamination and Agricultural Management

- **Nitrate Sampling and Awareness:** Nebraska's free nitrate sampling program distributed free test kits, significantly increasing awareness of high nitrate levels in private wells, leading to greater participation in a state rebate program for reverse osmosis systems.
- **Disposal of Nitrate:** Nebraska has concerns about the disposal of nitrate-rich wastewater from reverse osmosis units, which is a potential issue for downstream water bodies.
- **Collaboration and Incentive Programs:** Nebraska works with the EPA on issues like animal waste application. Jesse and Hillary highlighted the Nebraska Nitrogen Reduction Act, a five-year pilot program that incentivizes farmers to reduce fertilizer use. The payment rates vary based on the level of nitrate contamination in the area, and there has been significant statewide interest.
- **Farmer Education:** Regarding nitrogen contamination in groundwater transfers, Steve addressed the complexities of interbasin transfers and noted that the state provides training to farmers on best practices for nitrate application, timing, and water management to reduce inputs and increase profits.

PFAS Contamination

- **Treatment and Funding:** Regarding how public water systems are responding to PFAS contamination, Steve noted that PFAS treatment is still an emerging field, and there are challenges with residual disposal. High PFAS levels are not common in Nebraska, but in affected areas, solutions often involve connecting to municipal water, using bottled water, or drilling new wells. The state has funding from the Infrastructure Investment and Jobs Act to help with this.
- **Biosolid Sampling:** Regarding biosolid sampling from wastewater treatment plants, Steve confirmed that while the agency hasn't done extensive sampling, a project with the university is underway to evaluate PFAS in influent, effluent, and biosolids from 17 plants. The results of this study are not yet available

Roundtable: Conjunctive Management

This roundtable discussion, prompted by a question from Teresa Wilhelmsen (Utah), explored the degree of active implementation of conjunctive management—the coordinated use of groundwater and surface water—across various Western states. Michelle Bushman moderated the discussion, and noted that conjunctive management may take place along a spectrum. At one end may be states that recognize the interconnectedness of groundwater and surface waters, but are constrained by separate laws. In the middle of the spectrum may be states that have begun to merge the management of both resources, through laws or policies or local plans. At the other end of the spectrum may be states that manage groundwater and surface water as a single, fully connected resource.

State-by-State Overview

- **Idaho:** Mat Weaver shared that Idaho is on the single resource end of the spectrum, with a common priority date for surface and groundwater rights across much of the Eastern Snake Plain. A 2007-2008 methodology, which has survived numerous legal challenges, governs this. Recent orders curtailed junior groundwater rights, affecting over 500,000 acres, due to a shortfall of 64,000 acre-feet. This led to a settlement agreement and a renewed mitigation plan.
- **Montana:** Jake Morhmann explained that Montana's permitting process recognizes a statewide connection between groundwater and surface water, a result of legal challenges post-2007. However, the state does not actively regulate this connection after permits are issued, making it difficult for senior surface water users to curtail nearby groundwater users.
- **Oklahoma:** Sara noted that Oklahoma is on the opposite end of the spectrum, with separate laws. Groundwater is considered private property, while surface stream water is public, with no priority relationship between them. While the connection is acknowledged, no action can be taken to manage them conjunctively.
- **Oregon:** Justin Iverson stated that Oregon practices conjunctive management from an allocation standpoint, but rarely regulates groundwater users in response to surface water calls. While they would have previously considered themselves a fully conjunctive management state, he now feels they do very little in terms of active, conjunctive regulation.
- **Utah:** Mark Stratford noted that Utah recognizes all water as public property, which suggests strong conjunctive management, but a lack of data makes this difficult to implement. The state primarily uses groundwater management plans to prevent future overdrafts rather than for true conjunctive management.
- **California:** Joaquin Esquivel highlighted that California is relatively new to this due to the passage of SGMA in 2014. The law requires GSAs to manage for “undesirable results,” including impacts on interconnected surface water. However, data issues and the vastness of the state's basins present ongoing challenges.
- **Kansas:** Earl Lewis mentioned that Kansas is on the single resource end of the spectrum with a system that has recognized both surface and groundwater under the same permitting act since 1945. They manage minimum desirable stream flows, and a recent order shut off over 400 water rights (half of which were groundwater) due to low stream flow.

- **Nebraska:** Jesse Bradley described Nebraska's “integrated management” system, where groundwater rights have no priority. In designated “fully appropriated” basins, junior groundwater users become responsible for all mitigation, which provides a strong incentive for NRDs to proactively manage their basins to avoid this designation.
- **Nevada:** Cathy Erskine stated that Nevada is in the very early stages of conjunctive management, with a recent Supreme Court decision affirming the State Engineer's authority to manage basins conjunctively. However, this is still tied up in court, and stakeholder discussions are ongoing in specific basins like the Humboldt River.
- **Washington:** Matt Rakow explained that Washington's 1971 Water Resources Act mandated conjunctive management, but implementation has varied. While the state considers surface water impacts for new permits, it lacks the authority to regulate between water users unless a basin is adjudicated by a Superior Court.
- **North and South Dakota:** Jennifer Verleger described North Dakota as a fully managed state with public water, pervasive metering, and complex models. In contrast, South Dakota lacks metering and data, and its two water quality monitoring networks are managed by different groups.

Common Challenges and Opportunities

- **Data Deficiencies:** Several states, including California, Utah, and South Dakota, identified a lack of data on groundwater-surface water interaction as a major barrier to effective management.
- **Litigation and Collaboration:** In Idaho, extensive litigation ultimately led to collaborative settlement agreements. Jerry noted that despite the conflicts, stakeholders generally work cordially to find solutions.
- **Political Will:** Mat Weaver from Idaho mentioned that having strong political support from the governor's office was crucial for the initial implementation of large-scale curtailment.
- **Federal Legislation:** Paula Cutillo raised a question about the proposed Water Rights Protection Act, which would prevent federal agencies from recognizing a groundwater-surface water connection unless state law does. She noted that this seems to run counter to the direction many states are heading.
- **Domestic Exemptions:** Jerry highlighted a growing issue in Idaho where the cumulative impacts of many small domestic wells are becoming significant, suggesting that homeowners will eventually need to contribute to mitigation efforts. Montana, Washington, and Oregon are facing similar challenges.
- **Metering:** North Dakota and Nebraska noted the importance of metering, which is a key part of their successful management, but is often a contentious and difficult topic in other states.
- **Groundwater report:** Tony mentioned a New York Times article that criticized states for not adequately managing groundwater, suggesting that updating a report on state efforts could provide a better understanding of the challenges and solutions being pursued.

Roundtable: Aquifer Science

This roundtable discussion focused on the current state of aquifer science across various Western states. The conversation highlighted the critical role of data, modeling, and communication in managing water resources.

Current Scientific Methods and Tools

- **Integrated Hydrologic Modeling:** Montana is heavily investing in integrated hydrologic modeling, a shift from having hydrologists focused on individual permits to a unified team working on a single, comprehensive model. Similarly, Idaho, after using multiple models in the past, now collaborates on a single model to ensure all stakeholders are invested in the process.
- **Aerial Electromagnetic (AEM) Mapping:** Kansas and North Dakota are using AEM mapping to get a more accurate understanding of their subsurface geology. Kansas plans to expand this statewide, and North Dakota has conducted multiple flights over the last five to seven years.
- **Geomagnetic Resistance Mapping:** California is using this technology to characterize groundwater basins and identify areas with high recharge potential.
- **Data Consolidation and Access:** Nebraska, with its 23 NRDs, is committed to investing in data, including a recent $25 million investment in resistivity surveys. Oklahoma is focused on making its statewide water monitoring network data publicly accessible through its "Oklahoma Hydro Net" project.
- **Satellite and Remote Sensing Tools:** Nevada is working to scale a new tool called Climate Engine, which provides access to satellite and remote sensing data to streamline reporting and analysis for users.
- **Downhole Geophysical Tools:** Oregon has invested in advanced downhole tools like electromagnetic flow meters to precisely measure flow in wells. This has led to a tighter definition of "commingling wells" and, in some cases, more complex regulatory challenges.

Confidence, Gaps, and Challenges

While all states acknowledge that models and science are imperfect, many expressed a growing confidence in their ability to understand their aquifers. Kansas noted that 30 years of consistent metering and monitoring data have been transformative in building public trust and making informed decisions.

- **Data Gaps:**
    - **Data Interoperability:** California and Nebraska highlighted the challenge of making better use of existing data, which is often siloed and in different formats.
    - **Monitoring Networks:** Washington and South Dakota lack comprehensive, telemetered monitoring networks, relying on seasonal or less frequent measurements. This creates significant data gaps, especially in areas with high irrigation use.
    - **Groundwater Quality Data:** Arizona and Oregon both noted a lack of consolidated, statewide groundwater quality data, making it difficult to identify and address contaminant issues on a global scale.
- **Gaps to Prioritize:**

    - **Decision Support Tools:** California and Kansas want to prioritize developing user-friendly decision support tools and “digital twins” to help managers test hypotheses and make data-driven decisions.
    - **Data Consolidation:** Trevor from Arizona wants to prioritize creating a consolidated, statewide view of contaminant issues.
    - **Groundwater-Surface Water Interactions:** The complexity of characterizing perennial stream connections remains a challenge for Nebraska's conjunctive management efforts.

Public Communication and Trust

- **Building Public Trust:** Earl from Kansas emphasized that it took 10 years of consistent data presentation to build public trust in metering data.
- **Effective Communication:** Montana and Oregon recognized a need to improve their public communication efforts. Montana is hiring marketing and communication staff to translate technical data into easily understandable information, and Oregon found that concepts like groundwater age-dating are highly effective for public engagement.
- **Transparency:** Oklahoma's focus on making data publicly accessible through its Oklahoma Hydro Net aims to help communities plan and make informed decisions.

Funding and Collaboration

- **Funding is Key:** Oklahoma noted that funding is a critical factor for conducting aquifer studies and determining maximum annual yield.
- **Collaborative Models:** The Snake River Aquifer, the Republican River Basin, and the Upper Colorado River Basin were all cited as examples where collaboration on a single model was crucial for moving past litigation and making progress.
- **Partnerships:** Idaho and Washington rely on partnerships with organizations like the USGS and Bureau of Reclamation for model development and monitoring, often on a cost-share basis.
- **Innovation:** Nevada's Climate Engine tool, developed by the Desert Research Institute, shows how collaboration with universities can lead to innovative tools that improve data access and understanding.

Peer Review of State-Produced Scientific Reports

- **The Challenge:** Oregon raised a concern about a growing trend in legal disputes where consultants publish their conceptual models in peer-reviewed journals to lend them more credibility, while state reports, which are internally reviewed, are not held to the same standard.
- **Potential Solutions:** The discussion acknowledged this challenge in other states, and Michelle raised the question of whether states could potentially peer-review each other's reports. However, she noted that this might not be a perfect solution due to differences in state hydrogeology and models.

Water Quality and Aquifer Recharge in California

Jennifer Carr (Nevada) posed a question to Joaquin (California) about the tension between California's urgent need for aquifer recharge (driven by drought and flood cycles) and the

challenge of maintaining water quality, where contaminants could persist in aquifers for long periods. Joaquin explained that California is actively balancing these competing needs through a combination of policy and regulation:

- **Streamlined Permitting:** In 2017, California created temporary groundwater recharge permits, which simplify the process and allow for a less extensive environmental review during high-flow events. This program authorized 1.2 million acre-feet of recharge in 2023.
- **Flood Flow Diversion:** An executive order, now codified in legislation, allows water to be diverted from rivers during flood stage for recharge without a water rights permit.
- **Water Quality Protections:** To mitigate water quality risks, these flood permits come with protections, such as restrictions on recharging on lands with recent pesticide or fertilizer applications. Consultation with Regional Water Quality Control Boards is also integrated into the process.
- **Data and Monitoring:** Joaquin acknowledged a significant data gap regarding ambient groundwater monitoring and post-recharge water quality impacts. Preliminary data, however, suggests that in some cases, recharge can "freshen" groundwater.
- **Balancing Act:** The goal is to develop better tools and incentives to guide recharge to suitable locations. Joaquin emphasized that, for now, balancing water quantity and quality is largely a project-specific effort due to data limitations.

Next Steps

This final discussion centered on future plans for the WSWC groundwater workshops and webinars. The feedback highlighted a strong desire for continued collaboration, opportunities for deeper dives into specific topics, and the creation of resources that facilitate peer learning and inform policy-making.

Forum Format and Frequency

- **Value of In-Person Meetings:** While the full-day format was long, participants consistently expressed appreciation for the opportunity to meet people from other states and hear about their unique challenges and successes.
- **Future Options:** The WSWC has an open slot for a potential in-person groundwater workshop at its Fall meetings in San Pedro, California. Online webinars, both presentation-style and discussion-based, were also suggested as a viable option.
- **Integrating into Council Meetings:** There was a suggestion to integrate more dedicated roundtable time into regular council meetings to avoid the need for separate, full-day workshops, as the current discussions often feel rushed.

Proposed Future Topics

- **Exempt Wells:** Justin (Oregon) and Trevor (Montana) specifically mentioned that a deeper dive into the various types of exempt uses and how different states are managing them would be highly beneficial. This topic is particularly relevant in areas experiencing rapid population growth.
- **Groundwater Management Districts:** Julie (Oklahoma) expressed a strong interest in learning about the structure and function of groundwater management districts in other states, as Oklahoma is facing challenges in defining boundaries and is looking for models to inform its legislature and agricultural groups.
- **"Gnarly and Hard" Issues:** Jennifer (Oregon) and Earl (Kansas) suggested focusing on specific, challenging problems that other states may have already solved. This could involve deep dives into topics like metering, policy strategies, or scientific approaches that have worked.
- **General Open Updates:** Justin also appreciated the general updates and suggested that a forum for these, perhaps at a different time, would still be valuable.

Opportunities and Resources for the Future

- **WSWC as a Resource:** The discussion highlighted the WSWC's potential to serve as a central repository for state-specific information.
- **Compendium of State Efforts:** Joaquin (California) proposed creating a compendium or report for Western states, similar to an ECOS report on PFAS, that details where each state stands on its groundwater journey. This would provide a standardized, consolidated resource for legislatures and governors, showing them what other states are doing and providing a basis for advocating for change. Jennifer (South Dakota) mentioned a report she is working on with Michelle that details the structure of water appropriation divisions in each state, which will be a valuable resource for newer members. We should continue to create these reports, documenting similarities and differences in state water practices.

- **Catalyst for Change:** Tony and Joaquin noted that having this information readily available can be a catalyst for change. It can empower legislatures to question why they lack certain authorities and push for more active groundwater management, as seen in a recent Texas Senate Committee hearing.
- **Peer Learning:** Jerry (Idaho) and Jennifer (South Dakota) emphasized the high value of peer learning and roundtable discussions, especially with the turnover of state employees. They stressed that these opportunities should not be allowed to die, as they are crucial for providing new members with historical context and for all members to learn from each other's successes and failures.

Appendix A: Workshop Agenda

WSWC Groundwater Workshop

Lincoln, Nebraska
April 22, 2025

8:00 am	Welcome and Introductions
8:15 am	**Roundtable Discussion: Big Picture Challenges and Opportunities**
9:00 am	**Groundwater Allocation** Oregon Groundwater Allocation Rules – Justin Iverson, Groundwater Section Manager, Oregon Water Resources Department
9:45 am	**Aquifer Monitoring** Nebraska Groundwater Models – Jesse Bradley, Interim Director of Nebraska Departments of Natural Resources and Environment & Energy
10:30 am	**Groundwater Sustainability** California Sustainable Groundwater Management Act (SGMA) – Jeanine Jones, Interstate Resources Manager, California Department of Water Resources
11:15 am	**Protecting Groundwater Quality** Oregon – Jennifer Wigal
12:00 pm	Lunch Buffet
1:00 pm	**Aquifer Mitigation** Mitigation Banking in Montana – Transitioning seasonal senior water rights to year-round mitigation credits through managed aquifer recharge – Jake Morhmann, Bureau Chief, Montana Department of Natural Resources and Conservation
1:45 pm	**Groundwater Quality** Nebraska – Steve Goans, Deputy Director, Water Programs, and Hillary Stoll, Engineering Section, Nebraska Department of Environment and Energy
2:30 pm	**Roundtable Discussion on Conjunctive Management: Recent Developments, Challenges, and Opportunities**
3:15 pm	**Roundtable Discussion on Aquifer Science: Recent Developments, Challenges, and Opportunities**
4:00 pm	**Discussion: Thoughts, Next Steps**
4:30 pm	Adjourn

Appendix B: Workshop Questions

- How are states managing groundwater across jurisdictional boundaries?
- How are states managing overallocated groundwater basins?
- How are states addressing variability in aquifers across the state?
- Who is investing in aquifer science?
- Who is using their own models, academic models, USGS models? How robust/reliable are the models for meaningful decisionmaking purposes?
- Who is metering and reporting groundwater use, and how well is that working?
- What other tools are states using to monitor, manage, or report on groundwater quality and water supply? How well does the state/public trust these tools to be accurate?
- Which states are actively managing groundwater and surface water conjunctively (e.g., as a single source of hydrologically connected water)? What does that look like?
- Do other states have exempt groundwater uses that were presumed *de minimis* at the time of authorization as exempt, but are having a cumulative impact on senior water rights?
- What administrative tools are states using to manage groundwater?
- How are states handling local cooperative shortage sharing agreements?
- How involved are states in creating an environment where groundwater users can work together to solve challenges in their basin?
- Which states are collaborating with neighboring states to manage shared groundwater resources?
- For states curtailing groundwater pumping for senior water rights, how are they managing the timing given the delay for the cone of depression to recover? Or managing the timing considering seasonal vs. year-round uses?
- How are states engaging with the public on groundwater policies, education, groundwater protection and conservation, etc.?
- How are states dealing with nitrates and other contaminants (geologic or anthropogenic)?
- How has the *Maui* decision impacted water quality management?

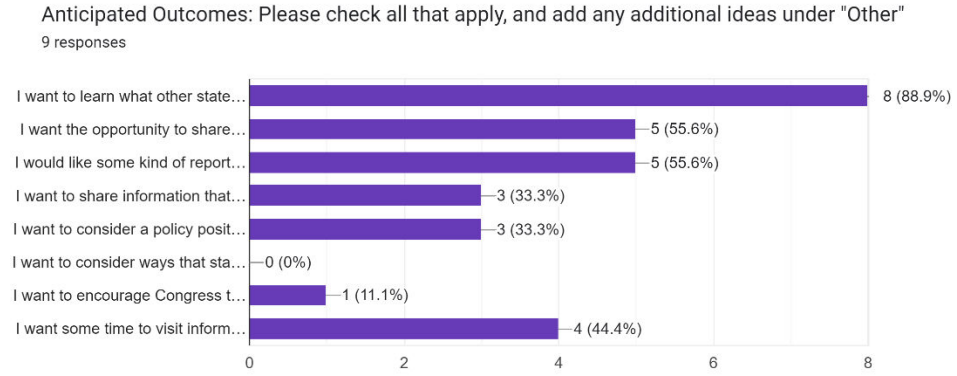
Appendix C: Workshop Participants

Trevor Baggiore, Director, Arizona Water Quality Division
Joaquin Esquivel, Chair, California State Water Resources Control Board
Jeanine Jones, Interstate Resources Manager, California Department of Water Resources
Jerry Rigby, Idaho Council Member, Rigby, Andrus & Rigby Law, PLLC
Mathew Weaver, Director, Idaho Department of Water Resources
Earl Lewis, Chief Engineer, Kansas Department of Agriculture, Department of Water Resources
Trevor Watson, Water Resources Deputy Division Administrator, Montana Dept. of Nat. Resources & Conservation
Jesse Bradley, Interim Director, Nebraska Department of Natural Resources
Steven Goans, Deputy Director, Nebraska Department of Environment and Energy
Justin Lavene, Assistant Attorney General, Nebraska Attorney General's Office
Tom Riley, Owner, Riley Consulting LLC
Cathy Erskine, Senior Policy Advisor, Nevada Department of Conservation and Natural Resources
Jennifer Carr, Administrator, Nevada Division of Environmental Protection
Hannah Singlton, Southern Nevada Water Authority
Patrick Fridgen, Director Planning and Education, North Dakota Department of Water Resources
Julie Cunningham, Executive Director, Oklahoma Water Resources Board
Sara Gibson, General Counsel, Oklahoma Water Resources Board
Jennifer Wigal, Water Quality Program Manager, Oregon Department of Environmental Quality
Justin Iverson, Groundwater Section Manager, Oregon Water Resources Department
Nakaila Steen, Natural Resources Engineer II, South Dakota DANR
Mark Stratford, Legal Counsel, Utah Division of Water Rights
Leslie Connelly, Manager, Water Quality Program Strategic Planning, Washing Department of Ecology
Matt Rakow, Washington Department of Ecology
Tony Willardson, WSWC Staff
Michelle Bushman, WSWC Staff
Christopher Carlson, USFS
Lauren Dempsey, USAF
Paula Cutillo, BLM

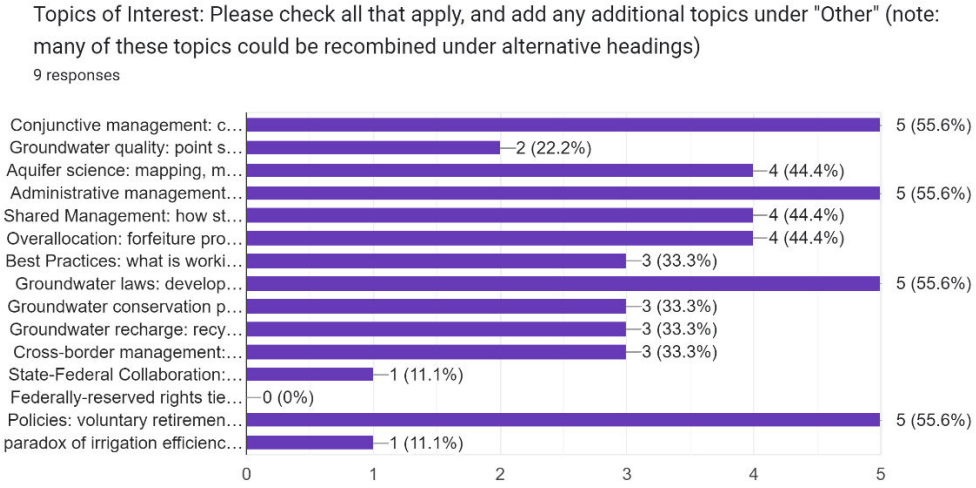
Appendix D: Groundwater Workshop Subcommittee Survey Results (Summer 2024)

Topics and Outcomes

The Subcommittee's primary interest in the workshop is overwhelmingly for states to share information with each other and to have some time to visit informally with each other. There is some interest in generating a report from the workshop, in considering a policy position, in using information from the workshop to help educate the public/federal government about what states are doing, and in encouraging Congress to fully fund existing programs that are useful in addressing challenges.



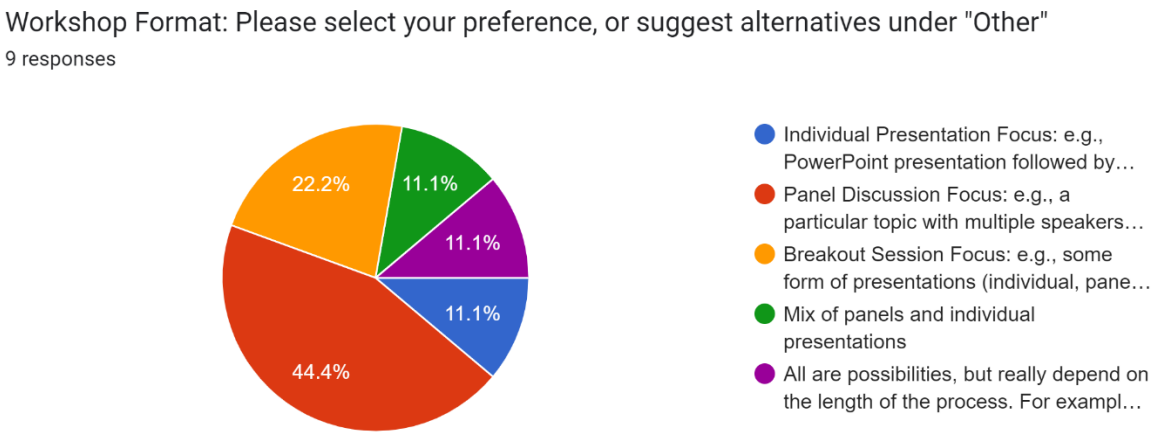
The most popular topics from the Subcommittee are: (1) **Conjunctive management**: challenges, developments, successes, curtailments, agreements; (2) **Administrative management areas**: reporting, assessments and decisionmaking, permit moratoria, closed basins, intentional mining, subsidence, recovery; (3) **Groundwater laws**: developments in state legislation, court decisions, new implementation of old laws; (4) **Policies**: voluntary retirement of rights, conservation programs, nonpoint source reduction programs, management through drought; (5) **Aquifer science**: mapping, monitoring, modeling, funding; (6) **Shared Management**: how state and local entities share groundwater management responsibilities; and (7) **Overallocation**: forfeiture procedures, unused paper rights, domestic wells, seasonal ag converted to annual housing developments.[1]



Duration and Format

[1] This is a large number of topics for one workshop. We may wish to hold a second in-person workshop, or move some of these topics to a virtual webinar series.

Most of the Subcommittee members felt that the workshop deserved a full day or multiple workshops/webinars to maximize the benefits to the states. There were mixed results on the preferred format, and it might depend on the topic and speaker(s); for example, some presentations may be better on an individual basis, while discussions/comparisons between states (e.g., a discussion of "best practices" or perspectives on a shared issue) might work better with a panel.



There was some interest in holding breakout group discussions. We might hold a breakout session to do a deeper dive into a particular topic/issue, to consider language or principles for updating WSWC policies/new policies, or to discuss topics to highlight in a report.

There was also interest having some time for informal discussions. We might incorporate some breaks between sessions, or plan a shared lunch to facilitate time for conversations.

Potential Webinar Series

It may be appropriate to host some individual presentations via Zoom recordings[2] either before or after the meeting for some of the topics of interest with slightly less support from the Subcommittee, but likely still of interest to the broader group: (1) **Groundwater conservation programs**: funding, policies, personnel, challenges, *and the paradox of irrigation efficiencies that lead to greater consumptive use*; (2) **Groundwater recharge**: recycled water, land application, injection wells, storage, recovery, water rights accounting, water quality oversight; (3) **Cross-border management**: how states, local entities, tribes, etc. manage groundwater across jurisdictional boundaries; (4) **Best Practices**: what is working well, what is not; and (5) **Groundwater quality**: point source and nonpoint source pollutants, state protections, programs, domestic wells.[3] These recordings could be posted to our website for later sharing and viewing, similar to our WestFAST series of webinars.

[2] These can be posted to our website for future sharing and viewing.

[3] Notably, this Subcommittee was assembled in the Legal Committee and did not initially include Water Quality Committee members; we may want to intentionally do more outreach to the Water Quality Committee and elevate this as part of the in-person workshop to incorporate both quality and quantity folks in the discussion.

Appendix E: Summary of Subcommittee Workshop Recommendations

WSWC Groundwater Workshop Planning Calls
September 6th and 11th, 2024

Subcommittee Participants
Jeanine Jones (CA)
Mathew Weaver (ID)
Anne Pakenham Stevenson (MT)
Jesse Bradley (NE)
Justin Lavene (NE)
Melissa Flatley (NV)
Raquel Rancier (OR)
Annette Liebe (OR)
Jennifer Wigal (OR)
Jennifer Zygmunt (WY)

Summary of Workshop Recommendations

Information sharing prior to the workshop - Would like a draft report ahead of the workshop to identify some things WSWC already knows, and a survey to fill in some of the gaps. We can't cover everything at the workshop, but it would be great to be able to reference information beyond what is on the agenda as states communicate with each other. A summary of this survey/report could be the starting panel at the workshop.

Conjunctive Management – Which states are actively managing surface water and groundwater conjunctively? What does that look like? Curtailments to protect senior water rights? Treating groundwater and surface water as a single source, including for hydrologic basin water budgets and managed aquifer recharge? What is working and what isn't? What administrative tools are states using? What reliable technical information is available, with analysis to support using it?

Aquifer Science – Would prefer a targeted discussion rather than just a grab bag of tools. Who is investing in the science?

Modeling Aquifers – What modeling efforts are states undertaking? What decisions can those models support? How are states gathering enough data to determine what the aquifer's safe yield is? Are they mostly just estimates? Which states are using their own models, academic models, or USGS models?

Water quantity allocations – What are states already doing in terms of new permit/water right constraints? Who is metering/reporting groundwater use, and how has that worked (or not)? How are states handling the timing of groundwater curtailments given the delay for the cone of depression to recover and the impacts that response time has on other water users?

Policy – What statutes, regulations, or other information guides the state engineer or water resource manager when adopting groundwater management plans? What motivates water users in a hydrologic basin to work together cooperatively to address water shortage realities?

Water quality – How are states are dealing with nitrates, nitrogen in groundwater? Particularly with increased development in rural areas facing wastewater challenges, or in areas coping with non-point source fertilizer. GWPC is focused on best practices for UIC programs, but it would be good to hear what they are doing. *Maui* groundwater panel/webinar would be helpful to hear how other states are managing.

Federal water quality resources – would like to educate federal agencies more on what states are doing, highlight in a report the state authorities and activities, and show where federal resources could best support and elevate these state efforts.

Potential speakers –

- Oregon could find speakers to talk about groundwater management, curtailment, and water quality issues
- California could find a speaker to talk about SGMA implementation; the California DWR also released a recorded webinar to help Groundwater Sustainability Agencies address the depletion of interconnected surface water in their Groundwater Sustainability Plans
- Dan Yates, National Ground Water Protection Council
- Rich Niswonger USGS HQ Science Center ("best practices" on modeling aquifers from USGS perspective)
- Jesse Bradely noted that Nebraska has good lessons to share on their extensive network of groundwater models, policies and strategies on long-term sustainability, management pool, examples where water users work together (and some that don't)