

Feasibility Analysis of Water Markets in the Republican River Basin

Background

As required by Neb. Rev. Stat. § 46-755(1), a basin-wide plan (Plan) for the Republican River Basin (Basin) was jointly developed by the Nebraska Department of Natural Resources (NeDNR) and the Natural Resources Districts (NRDs) in the Basin including the Upper Republican NRD, Middle Republican NRD, and Lower Republican NRD, and Tri-Basin NRD (collectively, Basin NRDs). This Plan became effective on March 1, 2019. The Plan is required by Neb. Rev. Stat. § 46-755(4)(b) to maintain Nebraska’s compliance with the Republican River Compact (Compact); an interstate agreement which apportions the waters of the Basin between the states of Colorado, Nebraska, and Kansas.

During the development of the Plan, stakeholders expressed interest in determining the feasibility of establishing a water market in the Basin. Stakeholders stated that a potential water market could incentivize conservation of water with the intended outcome of reducing overall consumptive use. These goals were incorporated into the Plan as Objective 2.6.

Objective 2.6 of the Plan is to “Evaluate the feasibility and potential outcomes of establishing water markets in the Basin.” The two action items described below indicate how this goal is to be achieved.

Action Item 2.6.1: Cooperate in determining the feasibility of water markets in the Basin.

The feasibility analysis will include such considerations as:

- Compact compliance obligations,
- Program costs,
- Regulatory framework, and
- Water user interest.

Action Item 2.6.2: Following the water markets feasibility analysis (Action Item 2.6.1), test conclusions through implementation of a water market program in a pilot area, if feasible.

This report describes results of the feasibility analysis of a potential water market in the Basin which was completed by NeDNR and the Basin NRDs to fulfill Action Item 2.6.1. This analysis included reviewing literature on existing water markets and their feasibility and conducting an interest survey of key water users in the Basin. Information gathered in the literature review was used to evaluate water market feasibility in the context of existing conditions in the Basin. The criteria outlined in the analysis were largely borrowed from *Rapid scoping for water market readiness* (Brozović, 2021), which lists a diverse range of criteria for water market feasibility. Results of the interest survey are included – sufficient participation of water users is a key factor in water market feasibility.

What is a Water Market?

A water market is a platform for trading water rights where the price is determined by market conditions and the trades occur based on supply and demand. There are three types of water trading: **1)** short-term transfers of water that is available for immediate use; **2)** medium-term leasing of water allocations in a manner that enables a water user to plan their use for a period of time; and **3)** permanent transfer of water rights. Water markets can be one of the more complicated economic instruments to design (Wheeler et al., 2017). Regarding water rights, Nebraska has distinct systems of allocation and regulation for surface and groundwater. Under constitutional and statutory provisions, surface water flows are allocated in accordance with the prior appropriation doctrine. Groundwater, in contrast, is governed by the doctrine of correlative rights and the Ground Water Management and Protection Act.

Conditions for Water Market Feasibility

Severity of Water Risk

The severity of water risk is a factor in water market feasibility. The higher the risk to reliable water supply, the more market demand might exist for additional water rights.

Prevalence of drought is a water risk because it leads to a combination of decreased supply and increased demand for water. Lower total precipitation, decreased streamflow, shortfalls in reservoir storage, and higher rates of evaporation decrease available water supplies. Simultaneously, drought and the accompanying heat reduce soil moisture and increase crop water demands. When demand for water exceeds supply, water rights can be curtailed. In a system that is overappropriated, junior water rights may not be filled even in wet years. Groundwater use may also be curtailed due to aquifer depletion.

The Basin has a limited water supply, is naturally semi-arid, and undergoes regular cycles of drought. Surface water in the Basin was determined to be fully appropriated, Neb. Rev. Stat. §§ 46-715(1)(a) and 46-755(1), which required the Basin NRDs to develop Integrated Management Plans (IMPs; see Figure 1) and a basin-wide plan (Plan). Groundwater users in much of the Basin are subject to allocation (see IMPs for each Basin NRD, included in [References](#) section below), limiting the amount of water they can use in a given time period. Users of both surface water and groundwater in the Basin are at risk of having their rights curtailed to maintain compliance with the Compact. Surface water users may see their rights curtailed through administration to comply with Compact requirements, and groundwater users in hydrologically connected areas may see their rights curtailed as well. These factors constitute the presence of water risk in the Basin.

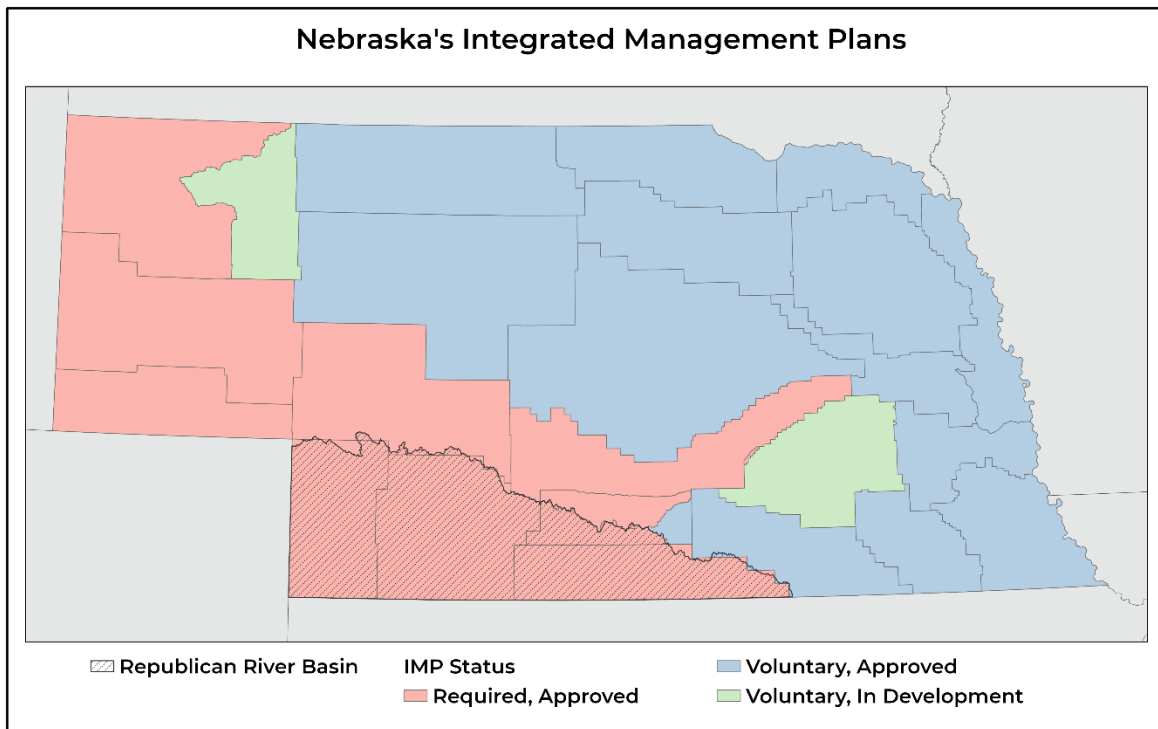


Figure 1. IMP status of Nebraska NRDs. Based on map available [here](#).

Legal Readiness

Water markets can only be established in areas where there is legal readiness, i.e., the local regulations and statutes governing water use allow them. Assuming the water system in question has restricted water use in the form of quantified water rights, the main concern becomes the permissibility of water rights transfers. For a short-term water risk such as drought, allowing the temporary transfer of water rights is an important factor in legal readiness. Transfers between similar water uses (groundwater to groundwater or surface water to surface water) might be relatively simple, but still subject to limitations and restrictions to prevent injury to other water users, conserve groundwater in water-short areas, reduce impacts to stream flow, and other criteria determined by NRDs. By contrast, transfers between different types of water use (groundwater to surface water or surface water to groundwater) can be more complicated and restricted.

Any water market implemented in the Basin cannot injure the ability of the State of Nebraska to comply with its obligations in the [Final Settlement Stipulation \(FSS\)](#) of the Compact. Chapter III of the FSS places a moratorium on new wells in most of the Basin upstream of Guide Rock, Nebraska, with some exceptions. Any transfers of rights or permits for wells cannot use more water than the historic consumptive use. There are also limitations to issuing new permits for surface water rights, and all members of the Republican River Compact Administration (RRCA) must be notified in advance of any new permitting. Nebraska's water allocation must undergo special administration during a Water-Short Year.

Each Basin NRD has its own rules and regulations regarding the transfer of groundwater rights. Tri-Basin NRD allows the transfer of groundwater, including outside of the NRD. Upper Republican NRD allows transfer of groundwater only within divisions called floating townships unless they are from an area of higher stream depletion to an area of lower stream depletion. The URNRD Board of Directors will consider transfers outside of floating townships and when doing so evaluate multiple variables; approval of such transfers are often subject to special conditions imposed by the board. Transfers within a township to an area of higher stream depletion must be offset by a reduction in allocation. Middle Republican NRD allows transfers of groundwater with limitations based on internal differences in allocation. Permanent transfers are not allowed during a Compact Call Year (CCY). Lower Republican NRD does not allow transfer of groundwater or changes in location of groundwater use unless it is on acres contiguous with the donor tract (see Rules and Regulations for each Basin NRD, included in [References](#) section below).

Transfers of surface water rights are permitted with limitations, for example, they cannot diminish the supply available to any other water appropriator. If there are any surface water users with a point of diversion within one mile downstream of a transfer applicant's point of diversion, a waiver of objection must be obtained from the downstream user(s) if there are no tributaries between them which could provide adequate supply. If the land currently under appropriation is in an area determined to be fully or over appropriated, the land currently under appropriation cannot be irrigated with groundwater after the transfer ([457 Neb. Admin. Code Chapter 9, § 001.03F](#)). The potential for surface water rights to be administered for Compact compliance purposes complicates the availability and reliability of surface water rights within the Basin.

The presence of these local, state, and interstate regulations and restrictions on both groundwater and surface water are legal barriers to the feasibility of a water market.

Administrative Readiness

Administrative readiness for water markets requires a strong monitoring and enforcement regime and efficient review of transfer applications. Without adequate resources devoted to the review of transfer applications by the body administering water use, an efficient water market would not be able to function, since water leases are time sensitive. The transfer application and review process should not require the hiring of professional staff or high administrative fees such that it would make small water transfers prohibitively expensive.

The Basin has a strong system of monitoring and enforcement of water rights. State law and the Compact require comprehensive monitoring of consumptive water use and enforcement of water rights. Reservoir levels are monitored. Irrigation wells are metered, some of them remotely. Surface water use is closely monitored. Transfers of groundwater allocation must go through an approval process with their respective NRD. Transfers of surface water would be subject to Neb. Rev. Stat. §§ 46-290-295. Transfers of any type moving further than transferring to adjacent lands would be subject to a number of reviews; field investigation to verify that the water right is not subject to cancellation, a review of the historical consumptive use, analysis of the "loss" associated with the transfer, mapping, publication of the proposed transfer, hearing(s) if there are objectors, and finally a ruling by the director.

If these types of transfers were to become common, or if in the early phases of the project there were a high volume of transfer applications, it is possible that NeDNR would need to hire additional staff to deal with the workload; this would include field staff to conduct investigations, program staff to process the applications, and perhaps even legal resources to conduct hearings.

Heterogeneity of Water Values

Heterogeneity of water values is a key driver of the demand for and participation in a water market. Significant spatial differences in the value of irrigation water create the incentive for transferring water rights during periods when water is in short supply.

There is spatial difference in the value of center pivot irrigated land vs dryland with irrigation potential within the Basin. The University of Nebraska (UNL) releases a comprehensive report on farmland values annually. The report divides the state into eight regions, with the Basin lying in the southern and southwestern regions. The report indicated the difference in value between land that could be irrigated and land that was irrigated by center pivot was higher in the southern region than the southwestern (Figure 2).

Region	Southwest	South
Dryland Cropland with Irrigation Potential (\$/acre)	2,130	4,745
Center Pivot Irrigated Land (\$/acre)	5,340	8,685
Difference	3,210	3,940

Figure 2. 2024 Nebraska Farmland Values and Cash Rental Rates, University of Nebraska. (Jansen & Stokes, 2024)

A 2018 study from the Daugherty Water for Food Center estimated the value generated by irrigation in the High Plains Aquifer region on a county level. The study used an estimate of the additional production generated by irrigation and compared it to local 2007 crop prices. The study found the gross value of irrigation water to be between \$200-250 per irrigated acre in most counties within the Basin, with a value above \$250 per irrigated acre in two counties. This finding suggests the additional value generated by irrigation is relatively uniform across the Basin, and relatively similar to values in southwestern Nebraska as a whole (Perrin et al., 2018).

Demand inelasticity can contribute to heterogeneous water values between water users. For example, water values can differ between perennial and annual crops. Perennial crops, such as fruit trees and vines, can take years to mature, their water demand is less elastic during times of acute water scarcity, because producers cannot forgo irrigation without losing their investment. Producers of annual crops could choose to forgo growing an irrigated crop during a time of high demand and sell or lease their water rights. In the Basin, there are virtually no perennial crops which could serve as inelastic sources of water demand for others to trade with. As shown in figures 3 and 4, a map and pie chart of crop types generated from the USDA Cropland Data Layer, most land area consists of grassland, or annual crops such as corn, soybean, wheat, and others.

A possible contributor to inelastic water demand is the tendency of producers to follow crop rotations in order to maintain soil health and high crop productivity. For example, the Nebraska Corn Board reported that planted acreage of corn in the state has been relatively consistent at approximately 10,000,000 acres for more than a decade, despite price fluctuations. This may indicate that producers prefer to stay in rotation, rather than plant whichever crop would produce the greatest market value per unit of water employed at the time.

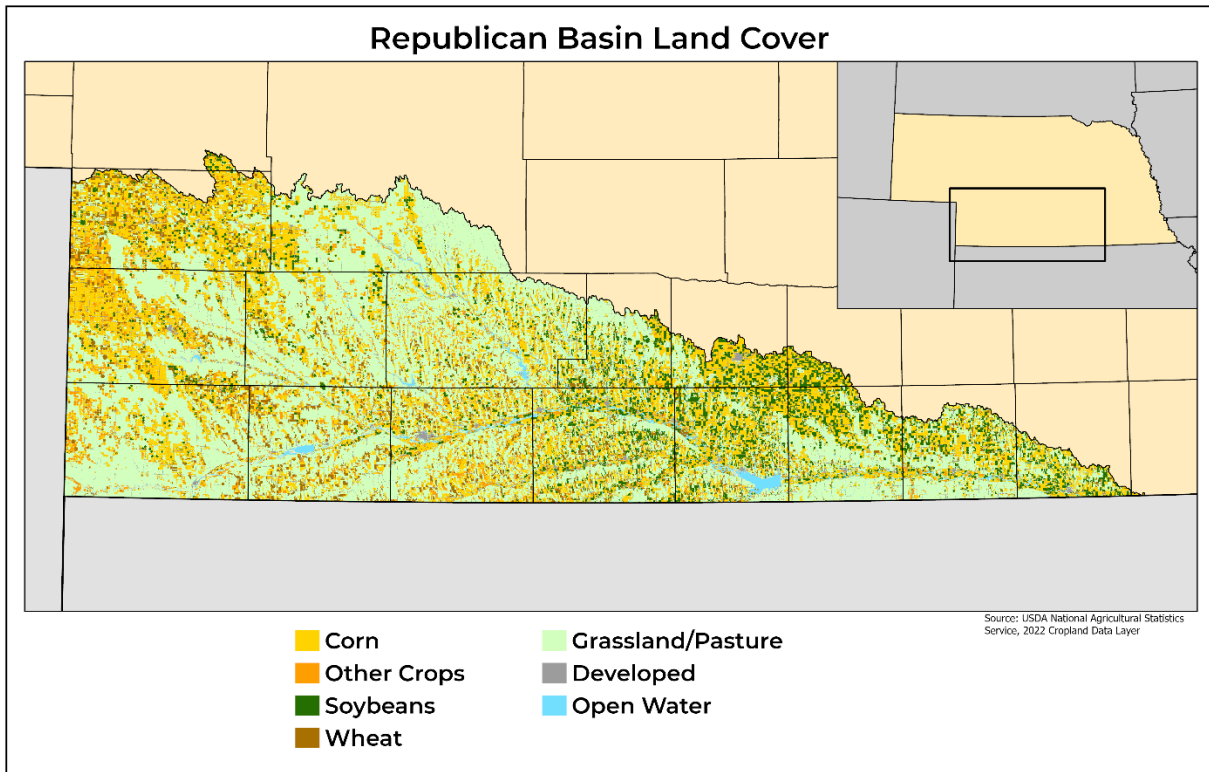


Figure 3. Source: USDA National Agricultural Statistics Service, 2022 Cropland Data Layer.

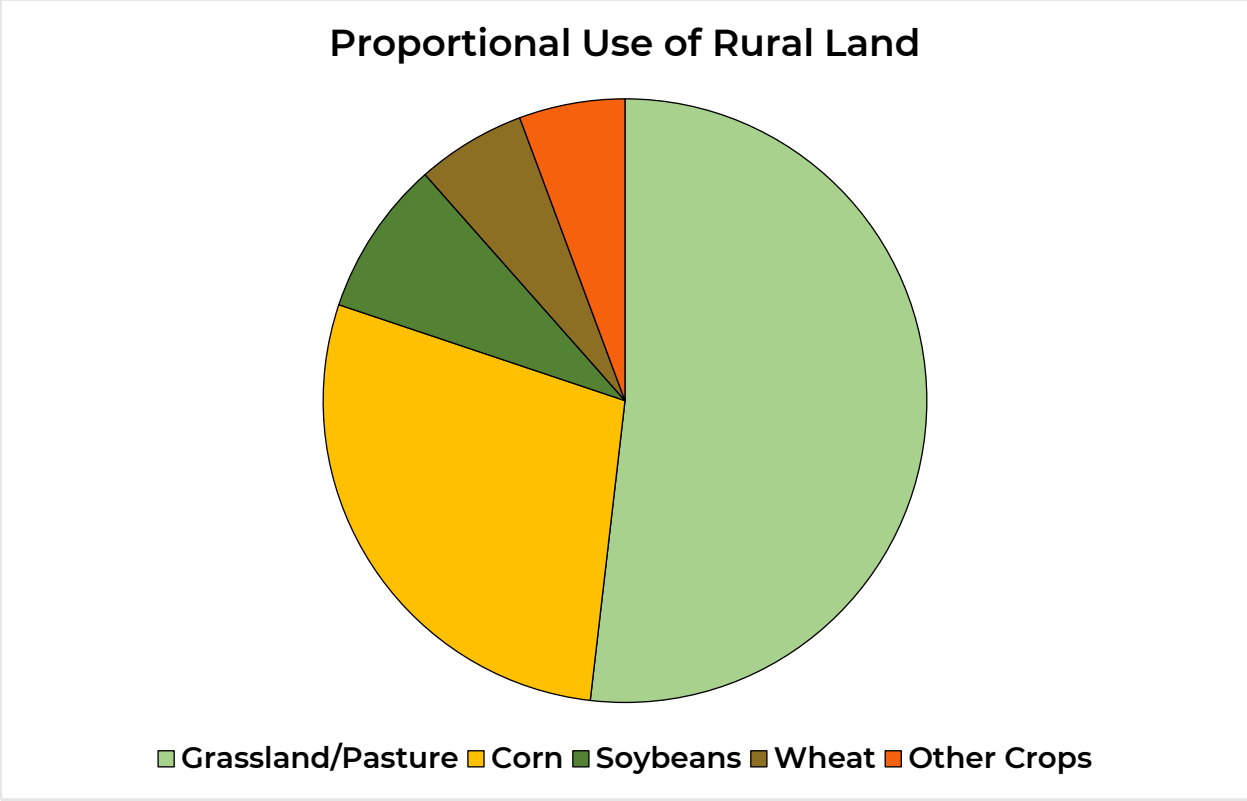


Figure 4. Source: USDA National Agricultural Statistics Service, 2022 Cropland Data Layer

Infrastructure Readiness

A comprehensive and efficient distribution system is needed for a water market to function. Without a canal and distribution system serving enough water users there cannot be a market for surface water. Likewise, groundwater users who wish to trade allocations must have the necessary well and distribution systems. Constructing new water conveyance systems can take a long time and is generally cost-prohibitive.

The Basin has a well-developed system of irrigation canals to deliver surface water to appropriators. There are four active irrigation districts, seven private canals, and 225 individual surface water irrigation pumps within the Basin. Reservoirs and dams used by irrigation districts are routinely inspected by the NeDNR division of dam safety. There are many monitored groundwater irrigation wells in the Basin, as well as rural and municipal water supply systems. The presence of these systems demonstrates infrastructure readiness for a potential water market.

Survey Results

In May of 2023, NeDNR and the Basin NRDs, in conjunction with the UNL Public Policy Center (PPC), conducted a survey of Basin stakeholders to determine interest in water markets (Appendix A). The survey asked participants to describe the nature of their water use, their knowledge of water markets, and their interest in a potential water market.

In total, 21 of those surveyed responded. Their responses were compiled in a report (Appendix B). The majority of survey participants were primarily groundwater users. Expressed familiarity with water markets varied widely among the respondents. The majority of survey participants (55%) were not willing to support a potential water market in the Basin, while one third (35%) were willing to do so. An additional group (10%) was undecided. Half of those surveyed (50%) believed a water market would increase the consumption of water in the Basin, another half (50%) believed a water market would have no effect on the consumption of water. None of the respondents (0%) believed that a water market would decrease the use of water within the Basin.

Respondents to the survey were allowed to leave written comments regarding their thoughts and recommendations for a water market. Multiple commenters expressed doubt that a water market was legally feasible. They also expressed concern that a water market would create a financial incentive to consume more water by providing additional value to unused or underused water rights. Commenters who seemed more favorable to the idea of a water market emphasized that it should be transparent and tested in a small area before being expanded.

Examples of Real-World Water Markets

Central Platte NRD Groundwater Exchange Program, Nebraska

Central Platte NRD is located in the Platte River Basin. In 2016 a formal, NRD-run groundwater market was piloted. Called the “Groundwater Exchange Program”, it established a virtual market for the temporary leasing of rights to irrigate. Due to the constraints involved with transferring water within the NRD, a consultant, National Economic Research Associates (NERA), was hired to create a trading platform. The platform NERA created could check each trade for compliance with NRD regulations and accept or reject the trade. Some regulations placed on trades by the NRD included:

- No adverse effect on streamflow
- No moving water west
- No net transfers from one Groundwater Management Area to another

The program was extended through the 2017 growing season but was ended afterwards due to a relative lack of willing buyers for water. The program cost \$105,000 with NeDNR cost sharing 50%.

Diamond Valley Groundwater Market, Nevada

The Diamond Valley is a small basin in central Nevada overlying an isolated aquifer (Figure 5). The area is home to about 26,000 acres of irrigated land, mostly cultivated hay and alfalfa (Nevada, 2019). Being in an arid region, the groundwater recharge rate is naturally low, and pumping has severely depleted the water table (Zeff et al., 2016). The rate of groundwater depletion in the valley had long been the concern of the Nevada State Engineer, who regulates water use in the state.

In 2015, the state engineer declared the valley a “Critical Management Area.” Under Nevada law, this empowered the state engineer to curtail consumptive use of groundwater by irrigators to a sustainable level, requiring a decrease by as much as 64% (Zeff et al., 2016). Water users in the basin were given 10 years to develop and support a Groundwater Management Plan to reach a sustainable level of water use and remove the Critical Management Area designation. Nevada groundwater rights are based on prior appropriation. If water users were unable to agree on a plan, the state engineer would begin sharply curtailing water rights based on strict priority. This would leave most junior rights holders completely cut off and even some domestic wells would be restricted (Nevada, 2019).

Most water users eventually agreed to support a Groundwater Management Plan which would establish a groundwater market in the Diamond Valley. Under the plan, an annual allocation for the basin was created and divided into shares, with shares being distributed according to a formula which acknowledged seniority. This allocation and the resulting shares would be reduced by an increment each year until the amount reached a level considered sustainable by the state engineer (Nevada, 2019). Shares of the allocation can be used, traded, sold, or banked for future use. The goal is to create an incentive to conserve water by giving monetary value to parts of their allocation that water users can save, while drawing down the total consumptive use of the entire basin.

Some senior water right holders have objected strongly to the Groundwater Management Plan, arguing that it violates their legal right to prior appropriation. They argue that the state is responsible for over appropriating the basin and they are being unfairly injured for the actions of the state and junior water users. Others have argued the plan takes too long to lower allocations, allowing over-pumping to continue for decades (Rothberg, 2019). Some water users challenged the validity of the Groundwater Management Plan in court, appealing it to the Nevada Supreme Court. In June 2022, the court ruled that the plans in areas that are losing groundwater quickly can deviate from prior appropriation (Stern, 2022).

Encouraging water users to trade water rights among themselves is not the only strategy the state of Nevada has taken to reduce groundwater overuse. In 2023, the Nevada Legislature granted \$15 million in funding to allow local water authorities to purchase and permanently retire groundwater rights in the basin on a voluntary basis. The program, called the “Voluntary Water Rights Retirement Program”, saw more applicants than it had funding. If all sales go through, about 30% of the Diamond Valley groundwater yield will be retired (Solis, 2024).

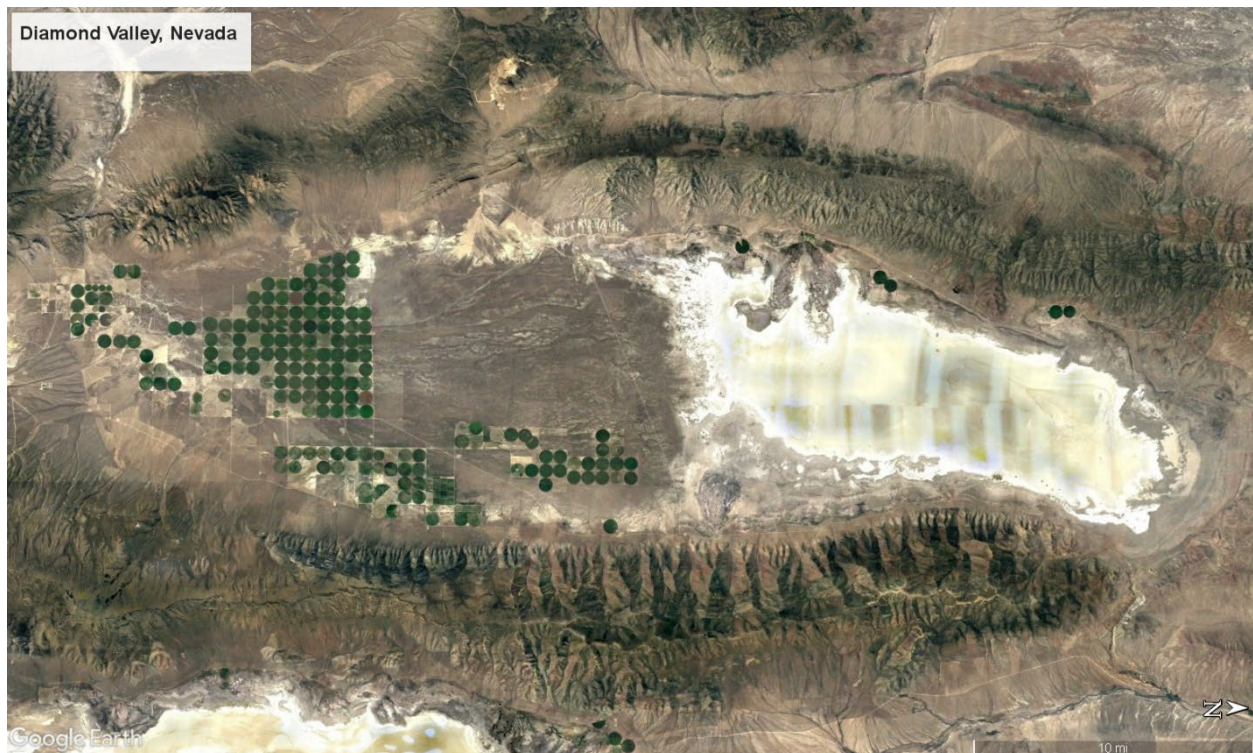


Figure 5. Diamond Valley, Nevada. Source: Google Earth, Landsat.

Murray-Darling Basin, Australia

The Murray-Darling Basin extends across four states in southeastern Australia, comprises over 1 million square kilometers (386,000 square miles), and has a population of approximately 2 million. The basin generates 40% of Australia's agricultural income and accounts for three quarters of irrigated land within Australia (Cruse et al., 2004). The basin has one of the most mature and well-developed water markets in the world. Surface statutory water rights are defined in diversions per irrigation season (Grafton et al., 2012).

In the 1980s it became apparent that surface water had been overappropriated and there was a push to separate these water rights from the land they were attached to. This development began the establishment of water markets (Grafton et al., 2012). Key to the success of the water market was the agreement of states within the basin to make water rights exclusive, divisible, tradable, and recorded in public registers. Some state governments allowed the trading of water rights across state borders. However, entitlement and allocation systems differ by state, and this has made trading across state borders difficult (Cruse et al., 2004). Multiple public water exchanges exist which function as public notice boards and sometimes as clearinghouses to facilitate trades of water rights. Various irrigation districts exist in the basin – trading is also restricted for reasons such as hydrological limitations to water movement and the environmental impact of changing water supply and use patterns (Qureshi et al., 2009).

Permanent water products are referred to as entitlements – these are generally divided into high security, general security, and low security classes (Seidl et al., 2020). Temporary water products are referred to as allocations – there are allocations for surface water and groundwater. There are also leases, from 1-5 years, and carry-over space (parking/water forwards) from 1-5 years (Seidl et al., 2020). Some states in the basin allow carry-over, others do not. Most employ some mix of higher and lower security rights, with high security entailing a mostly guaranteed annual quantity, and lower security being filled based on available supply.

The temporary trading of water rights is much more common than permanent trading (Qureshi et al., 2009). A hard cap was placed on extractions in 1995. The cap was set at a level where rights exceed actual long-term availability. Scarcity created a financial incentive to use previously unused water rights, driving down actual supply (Grafton et al., 2012). Those with higher marginal use value of water buy from those with lower marginal use value. One large beneficiary of trading is perennial crop producers (e.g., orchards, vineyards), who whose crops would have potentially died if they were not able to secure water through the market.

Some financial entities hold water rights as an investment. Environmental groups have also purchased water rights for the purpose of conservation and providing water to wildlife. The share of water rights held by non-landowners was estimated at 12% (Seidl et al., 2020). This trading of water by non-landowners as well as the increased liquidity of water rights as a private property right have led to the basin's water markets being increasingly used as a stock market.

Conclusion

Following a review of scientific literature on the nature of water markets, analyses of water markets throughout the world, and a survey of stakeholder interest, NeDNR and Basin NRDs do not plan on conducting a water market pilot program. Such a program was determined to be infeasible due to the following reasons:

- Statutory and Compact compliance barriers such as limitations on transfers and consumptive use.
- Limited interest from Basin stakeholders as determined by the interest survey.
- Limited interest in and discontinuation of an NRD-wide groundwater market in a different basin.
- Unclear case for water conservation.

While some factors in the Basin which would be conducive to a basin water market were identified through this analysis, significantly more limiting factors which would make a basin water market infeasible were also identified. One such factor is that the legal constraints on transferring water rights in the Basin are complex and would increase transactional costs. Basin stakeholders also expressed limited interest in a potential water market, and none expressed a belief that one would lead to a decrease in overall water use. A formal groundwater market in a different Nebraska basin similarly received little participation and was closed. Real-world examples of water markets studied did not show clear evidence they are effective for reducing overall water use. None of the real-world examples of water markets were similar enough to the Basin that their success could be an argument for establishing one there.

Water rights are closer in nature to real estate than a security. They are cumbersome to trade and traded infrequently, with buyers and sellers thinking in terms of years when making decisions. Trades that do occur within the Basin are often arranged through real estate agents or small markets such as a single canal system or areas within an NRD. It is possible that this organic market activity satisfies all the demand within the Basin. This status quo is a viable alternative to a pilot program under Action Item 2.6.2.

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