

Stakeholder Perspectives on Agriculture and Water in the Verde Valley

Water for Agriculture Project
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Preamble

Water for Agriculture is a USDA-funded project to develop and implement an alternative, stakeholder-driven approach to USDA outreach and research funding. The team of natural scientists, social scientists, and engagement practitioners is partnering with five communities across Arizona, Nebraska, and Pennsylvania. In each community, it is bringing agricultural stakeholders together with decision makers, conservation groups, residents, and other key stakeholders to identify priorities for agriculture and water in their community, and implement a community-driven research project. In Arizona, the project is administered by the Kyl Center for Water Policy¹ at Arizona State University. Visit the project website at:

<https://water4ag.psu.edu>

The Verde Valley was selected as the partner community in Arizona because, like many rural communities, it has transitioned from a predominantly agricultural economy to a more diversified economy that includes residential development, arts, healthcare, and tourism. The agriculture sector has evolved as well, with generational ranches and farms alongside smaller, niche farms, ranches and wineries satisfying new market opportunities in agritourism and demand for local food. Local government has embraced agriculture as a key part of the current and future Verde Valley community and economy. By partnering with community members in the Verde Valley to identify and address their priorities around agriculture and water, the *Water for Agriculture* Project can provide insights and recommendations to the USDA to better support similar communities.

¹ An ASU resource, the non-partisan Kyl Center for Water Policy at Morrison Institute promotes research, analysis, collaboration and open dialogue to identify opportunities for consensus to ensure sound water stewardship for Arizona and the Western region. Visit our website: <https://morrisoninstitute.asu.edu/content/kyl-center-water-policy>

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Introduction

This report summarizes the key issues for agriculture and water that Verde Valley stakeholders identified in interviews and surveys over the first phase of the *Water for Agriculture* Project (spring 2018-summer 2019). The interviews revealed that stakeholders widely recognized farming and ranching as important to the history, character, culture, economy, environment, and future of the Verde Valley. They highlighted the challenges and opportunities in agriculture and water from the farm or ranch; to the watershed; all the way to state policy. The results of the stakeholder survey revealed that there are diverse information interests and a wide spectrum of data/knowledge gaps around water and agriculture. No issue or topic emerged with support from a clear majority of participants. Participants expressed the most interest in getting more information about water rights and settlements. They identified the greatest data/knowledge gap as best management practices at the parcel level (for example, for irrigation, pests, weeds, manure, soil, etc.).

The results presented here are valid social science data capturing stakeholder perceptions, concerns, and interests related to agriculture and water in the Verde Valley. This type of social science data can be helpful for identifying persistent questions about biophysical and social dynamics, and answering them with valid scientific processes and empirical evidence, as well as identifying unanswered legal questions. This report is not, however, a factual account of the biophysical, or social-behavioral conditions and dynamics of the Verde Valley, or the legal landscape.

The intent of this report and the *Water for Agriculture* Project is to be forward thinking. The diversity of participants' perspectives, concerns, and experiences is a starting point for identifying shared interests, collaborations, and community-driven research and projects that address community interests. It is not our intention to assign more value or validity to one issue or perspective over any other. Rather, by using the words of stakeholders themselves, our hope is that all voices will be heard; both shared interests and diverging perspectives can be identified and better understood; and community interests can be acted on in a collaborative way.

Study Area

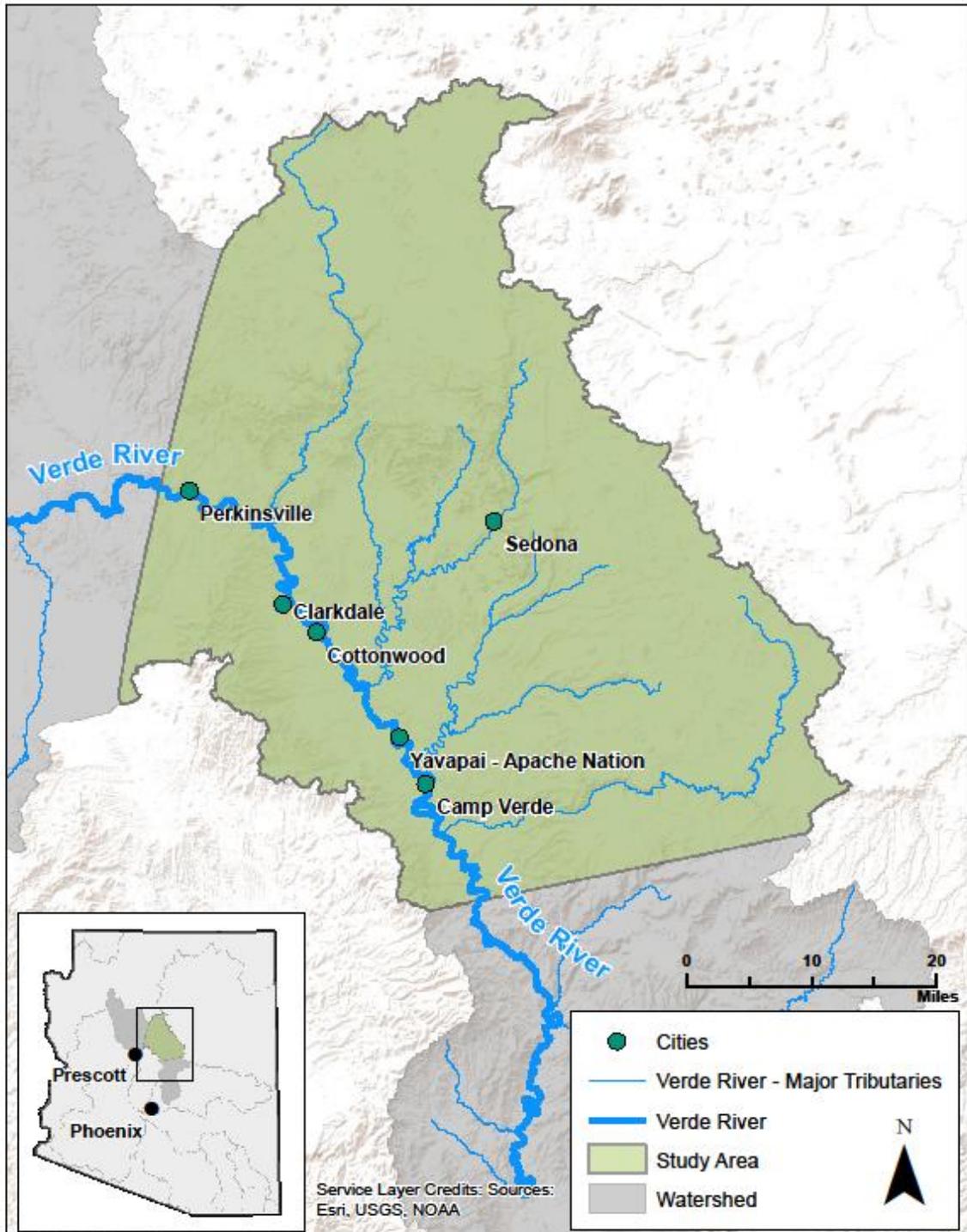


Figure 1. Study Area in the Verde Valley, Arizona

Background: The Verde Valley

The Verde River has allowed for human settlement and agriculture in the Verde Valley over many centuries. Archaeological evidence shows that people hunted, gathered, and traveled through the Valley as far back as 11,000 years ago. The first evidence of agriculture in the Valley dates to approximately A.D. 700, with the arrival of the Hohokam People. The Southern Sinagua People arrived in the Verde Valley around A.D. 1150. They practiced irrigated agriculture until they abandoned the region in 1425. Later, the Yavapai and Apache Peoples arrived, and lived in the Valley as hunter-gatherers. Starting in 1865, Anglo farmers and ranchers began diverting water from the Verde River and its tributaries (Oak Creek, Beaver Creek, Clear Creek) into ditches that delivered irrigation water to their farms and pastures. These pioneers established the communities that are now the Valley's towns and cities, including Camp Verde, Cornville, Cottonwood, and Oak Creek (McCarthy, 2014). Private land (20.2%) in the Verde River Basin is concentrated around these communities, and in a checkerboard pattern in the northwestern portion of the basin. Approximately 72% of the Verde River Basin is federal or public land, held in public trust for the American people (Arizona Department of Water Resources (ADWR), 2009).

Arizona applies the legal doctrine of prior appropriation (also known as “first in time, first in right”) to determine surface water rights. Verde Valley lands that were irrigated by pioneering Anglo farmers and ranchers likely have some of the most senior surface water rights; however, as of yet, no right to use water from the Verde River (or its tributaries) for irrigation or any other use in the Verde Valley has been decreed. A final determination of Verde River water rights will be made in the Gila Watershed Adjudication (hereafter: the adjudication), a complex legal proceeding that began in 1974. The adjudication will catalogue and prioritize all of the surface water rights to the Gila River and its tributaries, including the Verde River.²

The Yavapai and Apache Peoples were forced off their ancestral lands and onto the Rio Verde Reservation by the United States Army in 1872. Soon after, in 1875, they were forcibly removed to the Indian Agency at San Carlos, 180 miles away. They were not allowed to leave San Carlos until 1900. An estimated 200 Yavapai and Apache People returned to their homeland in the Verde Valley. The Yavapai-Apache Nation gained federal recognition in 1934 (Yavapai-Apache Nation, 2016; see also Sheridan, 2012). Today, the Nation has 2,596 members. There are nearly 2,000 acres of Reservation Trust Lands in the Verde Valley (Yavapai-Apache Nation, 2016). This includes irrigated commercial farmland. The Nation is asserting claims for federal reserved water rights in the adjudication.³

² For more information about the adjudication, see: ADWR, 2019; Ferris, Porter & Gammage Jr., 2018; The Judicial Branch of Arizona, 2019.

³ When the Federal Government reserves land for a tribal homeland, military base or other use, by implication it also secures a water right sufficient for the purpose of the reservation. Such “federal reserved water rights” may be quantified in state court, but they are not generally subject to state laws and rules governing surface water, such as forfeiture.

Yavapai County, which includes the Verde Valley, has seen dramatic population growth over the last 50 years. The county population in 2018 was estimated at 231,993 (U.S. Census Bureau, 2018a) compared with 37,005 people in 1970 (U.S. Census Bureau, 2018b); more than a 500% increase. There are approximately 67,000 people living in the Verde Valley today (Hunting, 2016). The primary source of water for this growth has been well water, with the number of wells increasing exponentially over time (Kyl Center for Water Policy, n.d.). A significant portion of the historically irrigated land has been subdivided for residential development, and continues to be irrigated.

Table 1.

Yavapai County Agricultural Profile, 2017 (National Agricultural Statistics Service (NASS), 2017). Note: the Verde Valley is located in Yavapai County. Because agricultural statistics are calculated at the county level, Verde-Valley-specific data was not available.

Total Producers	1,472
Number of Farms	850
Sell directly to consumers	17%
Family Farms	94%
Per farm average net cash income	\$ -9,333
Land in farms (acres)	821,929
<i>Land in Farms by use (%)</i>	
Pastureland	96%
Cropland	1%
Woodland	1%
Other	2%
Irrigated acres	1% (7,529 acres)
<i>Farms by Size</i>	
Average farm size	967 acres
1 to 9 acres	372 farms (44%)
10 to 49 acres	250 farms (29%)
50 to 179 acres	81 farms (10%)
180 to 499 acres	45 farms (5%)
500 to 999 acres	30 farms (4%)
1,000+ acres	72 farms (8%)
<i>Inventory of top Livestock</i>	
Cattle & calves	48,005
Laying hens	6,596
Horses & ponies	4,702
Goats	933
<i>Top crops by acres</i>	
Forage (hay/haylage)	2,142 acres
Grapes	152 acres
Corn for grain	139 acres
Vegetables	134 acres

There are over 30 irrigation ditches still in operation in the Verde Valley today, which divert surface water to individual agricultural and residential properties. There are approximately 7,529 irrigated acres in Yavapai County, comprising 1% of agricultural land. Yavapai County has 850 farms, the majority of which are smaller scale, or less than 50 acres; nearly half of the county's farms (44%) are less than 10 acres (NASS, 2017; Table 1). The Valley's farms, ranches, and ditch associations have adapted to changing neighbors and markets, and learned to coexist with the Valley's population growth. According to estimates from 2010-2014, agriculture with forestry, fishing, hunting, and mining accounted for less than 5% of employment in the Verde Valley, similar to national and statewide averages (Hunting, 2016). The Valley's farmers and ranchers produce a wide range of products, including beef, barley, corn, hay, horses, pecans, vegetables, wine grapes, and more. Many area producers are members of the Arizona Farm Bureau, Arizona Cattle Growers Association, and/or Yavapai Cattle Growers Association (see Arizona Cattle Growers Association, n.d.; Arizona Farm Bureau, 2018; Yavapai Cattle Growers Association, n.d.).

The United States Forest Service plays an important role in both water and agriculture in the Verde Valley: it manages most of the public land in the Verde River Basin, on the Coconino and Prescott National Forests (ADWR, 2009), and it leases some of that land to local ranchers for livestock grazing. The Forest Service is an agency of the United States Department of Agriculture, which "manages the National Forests and Grasslands for sustainable multiple-uses to meet the diverse needs of people, ensure the health of our natural resources, provide recreational opportunities, manage wildfire, [and] guard against invasive threats" (U.S. Forest Service, n.d.a). There are many laws and policies that govern how the Forest Service manages public lands (including lands leased by ranchers), such as the National Environmental Policy Act of 1969, and the Endangered Species Act of 1973 (see U.S. Forest Service, n.d.b).

About 90 miles south of the Verde Valley, the Verde River flows into the Salt River in the eastern part of the Salt River Valley, more commonly known today as the greater Phoenix area. Irrigated agriculture came to the Salt River Valley in the mid-to-late 1800s (approximately the same time as the Verde Valley), relying on surface water from the Salt and Verde Rivers. Thus, Phoenix-area landholders and water users are also key stakeholders in matters of the Verde River. Like many of the farmers, ranchers, and residents of the Verde Valley, the farmers and residents of the Phoenix area have asserted claims to Verde River water in the adjudication. Most of those claims are asserted through the Salt River Project (SRP), a community-based not-for-profit water and energy company.⁴ Over the last century, Phoenix has become a major metropolitan area. SRP water comprises about one-third of the water supplies for the greater Phoenix area (see Salt River Project, 2019a). Approximately 10% of the water that SRP delivers to shareholders today is for agricultural use (Salt River Project, 2019b).

⁴ In 1910, the Kent Decree established rights to water for irrigating 155,000 acres of farmland in the Salt River Valley (the greater Phoenix area). This decree did not address water claims in the middle and upper Verde. The question of how historic claims in the middle and upper Verde relate to historic claims in the Salt River Valley will be determined in the General Stream Adjudication.

The Verde River is one of the last perennial flowing rivers in Arizona. The average base flow of the river has decreased over time, and there have been fewer high-flow events over time (see United States Geological Survey (USGS), 2019). The cause of declining flows remains unclear because of the complex hydrology of the region, increased use of well water, changes in riparian vegetation since the early 2000s, and the approximately 20-year-drought statewide (see Blasch, Hoffman, Graser, Bryson, & Flint, 2006; National Drought Mitigation Center, 2019; Paretto, et al., 2018). Modeling by USGS indicates that human stresses, including groundwater withdrawals and recharge, contributed to the decline in Verde River flows over the period of 1905-2005. This study projected that flows would continue to decline in the future, over the period 2005-2110 (Garner, Pool, Tillman, & Forbes, 2013).

There are strong economic, cultural, and environmental interests in using and protecting the Verde River and the region's other water resources, including from local governments, the Yavapai-Apache Nation, environmental groups, local irrigators, recreationalists, and SRP (see Whitmire, 2013). The Verde Front is a regional collaborative of government agencies, local governments, conservation groups, and community members that focuses on stewardship of natural and cultural resources, which has been working together since 2008 (see Verde Front, n.d). Other local collaboratives are also focused on various river- and water-related efforts. Balancing conservation objectives with economic development and water rights has become an important goal of these efforts.

Methods

Interviews

From March 2018 to June 2019, we conducted interviews with stakeholders in water and agriculture in the Verde Valley, including farmers, ranchers, ditch managers (current and former ditch bosses, board members, commissioners), government officials, conservation group representatives, educators, consultants, and residential irrigators (50 participants, see Table 2). We identified participants by first reaching out to community leaders in water and agriculture, and successively asking participants to recommend other stakeholders we should speak with (snowball method). We sought to capture the diversity of perspectives in the area, and include a balance of participants from agricultural, environmental, and governance perspectives. Interviews ran between 45 minutes and 3.5 hours. The majority of interviews were conducted with one participant, though some were conducted with two to four participants from the same organization or of a similar perspective. With the participants' permission, the conversations were audio-recorded (all but one interview were recorded). The interviews were confidential.

The objective of the analysis was to identify stakeholders' perceptions, interests and concerns about agriculture and water in the Verde Valley. The recorded interviews were transcribed and analyzed using NVIVO 12 qualitative data analysis software (QSR International, 2018). The analysis was completed by one analyst (Bausch), who read each transcript line by line, applying

relevant codes from a qualitative codebook developed for this project site. The codebook consisted of themes of interests, concerns, and perceptions of water and agriculture. It was developed inductively using a grounded approach to capture stakeholders' perspectives.

Because the interviews were confidential, we have taken precautions to avoid revealing the identity of participants. The quotes included in this report are excerpts from interview transcripts. While we include a general description of that participant (for example, rancher, conservation group representative, local/county government official, etc., followed by a participant ID number, where appropriate), we have redacted identifying information. Some quotes contain strong language, which has not been edited.

Table 2

Summary of interview participants by type. Several participants fall into more than one category, so the sum total of participants listed by category is higher than the total number of participants (50).

Stakeholder type	Number of participants
Farmers	7
Ranchers	8
Residential irrigators	6
Ditch managers	8
Conservation group representatives	9
Agriculture/water consultants/educators	9
Local & county government officials	9
State & federal government officials	6
Total	50

Short Surveys

We developed a short, confidential survey to identify stakeholder priorities for agriculture and water issues and knowledge/data areas of interest, based on the themes that emerged in the interviews. The survey was circulated, either online or in paper format, to all interview participants as well as other stakeholders in agriculture and water identified in interviews or at agriculture/water meetings in the Verde Valley. The data was analyzed in the software Qualtrics XM (Qualtrics, 2019). Of the 59 people invited to take the survey, we received 37 responses (63% response rate). While the survey quantifies priorities, it is important to note that it is a relatively small, select sample of stakeholders who represent different interests and experiences around agriculture and water in the Verde Valley. It is *not* a representative sample of the Verde Valley community at large.

Interview Results

The Role of Agriculture in the Verde Valley

Interview participants widely recognized farming and ranching as important to the history, character, culture, and environment of the Verde Valley. Participants acknowledged that today agriculture is no longer a primary driver of the Valley's economy. However, it still factors into the economy through food production, as well as through tourism with wineries, festivals, farmers' markets, farm stays, farm-to-table restaurants, and roadside stands. Many participants described agriculture as contributing to the Valley's quality of life for residents and visitors alike by preserving open space, wildlife habitat, and the rural character of the region. Several farmers and ranchers described environmental stewardship as an essential part of their work. The connections with tourism highlight some of the ways that agriculture in the Verde Valley is adapting to the evolving local economy. Municipal and county plans in the Verde Valley include provisions to protect and promote agriculture, ranching, and agritourism into the future.

"It's [the Verde Valley has] been a huge agricultural area since the Sinagua and probably before..." – Consultant/educator, AZ 9

"They [early Anglo settlers] came here to farm. They were farming for the military at Fort Whipple, and then they farmed for the military that came here to protect them so they could farm. They created their own market. Pretty smart bunch of farmers. Pretty practical bunch. But, I mean, this was the bread basket for all of northern Arizona historically."
– Local/county government official, AZ 5

"Employment opportunities. Supporting local businesses. Feeding a lot of families. We keep the land operating for the public to enjoy. We supplement the wildlife with water, salt, protein, mineral..." – Rancher, AZ 14a

"If you look at a map of the Verde River, it's this green line and also there's a lump of green, and that's where the irrigation is. And there's such a concentration of wildlife in that expanded riparian zone. And so that's another fringe benefit of the irrigation system."
– Ditch manager, AZ 2

"When they [ranchers] provide water for their cattle, they are providing water for the wildlife too. So, yes they're important." – Conservation group representative, AZ 40

"I think it's [agriculture is] important in terms of how the community is structured. I think it's important in terms of local food. I mean, we're in, like, an amazing location to produce local food... I don't think it's going away." – Conservation group representative, AZ 1

"...it's [agriculture has] got an economic role. In the wine industry in particular, it's coupled with tourism... it's [agriculture is] keeping the cost of alfalfa down for people that consume it locally because shipping alfalfa is really expensive... Then you've got the local food kinda phenomenon that's going on everywhere. We've got barley for local beers. That all enhances both tourism and local economies, keeping money in the Verde Valley longer than it would otherwise be."
– Local/county government official, AZ 12

“...some of the agricultural [water] use that goes on here, I don't know how critical it is to the economy of the Verde Valley, [but] to the quality of life and the images we see ourselves, I think it's important... And frankly having agricultural uses, and not having those areas developed into single-family residential is a positive thing as well... Some kinds of agriculture uses a heck of a lot of water. More so than a residential development. Even in that case, I'm not sure I'd wanna see some of those big ranch areas converted into rooftops. Even if it was more beneficial from a water-use perspective. And that, again, is just kind of quality of life. There is more to it than just the crops or food sources that they are producing.” – Local/county government official, AZ 15

“In my mind agriculture is open space. It's non-developed and yet when it comes to like viticulture, we now have created a, a product that can be pulled off of that land, and sold. It brings in outside money so it's just not money that's regenerated or recirculated. It's not in the community, it's outside money that's coming in. It's sustainable because every year you get a new crop, and it leaves that land open for generations so we have something that we can develop in the future should that industry ever fade out and go away. Unfortunately, [if] you build on it, it's never going to be a farm again.” – Local/county government official, AZ 31

Economic Issues: Agricultural costs and profits

Participants identified profitability as a concern across agricultural and ranching activities, especially for smaller-scale operations. Production costs are a challenge: some equipment, maintenance, and inputs are more expensive in the Verde Valley due to low demand, high shipping costs, and/or because smaller-scale producers may not benefit from economies of scale. Part of the challenge is finding a market for a small volume of product at a price point that covers the costs of production. While many producers engage in direct sales at farmers' markets, roadside stands, or through personal networks, some producers find it too time consuming, or not cost effective. Some participants see potential in marketing directly to restaurants, or becoming part of a local food hub or Community Supported Agriculture (CSA) group. However, food safety regulations (for example, Good Agricultural Practices, Good Handling Practices, also known as “GAPGHP”), as well as producers' liability and any potential related financial burden, can be a barrier to participating in such initiatives. It can also be a challenge to guarantee the volume and quality of a product at the time that a restaurant needs a product. Another challenge is cultivating a market for new products, such as crops that require less irrigation (see “Parcel-level Management,” below).

“People can get [a product] that are as good as mine, maybe even better, or at least as good, off the internet a whole lot cheaper than they can get them from me. It's the truth of the matter. (laughs) And I can't afford to produce it much cheaper.” – Ditch manager, AZ 2

“Yeah, there's no money in it. I think the larger guys make money I guess. Smaller guys don't.” – Ditch manager, AZ 26

“If the small growers are gonna make it to the next level, they're gonna have to address food safety. And they're gonna have to see how they can make using food safety profitable.” – Consultant/educator, AZ 9

Labor. Labor presents a challenge for many producers in the Verde Valley. Some participating growers found it difficult to find reliable laborers, while others said they cannot afford to hire outside labor. Labor is especially challenging for labor-intensive crops, such as wine grapes.

“It's not easy [to find farm labor] and it's not getting any easier.” – Farmer, AZ 8

“...trying to find good cowboys has been real tough. Or I even told one guy, ‘You gotta look for cowgirls.’” – State/federal official, AZ 20

“Basically, I'm just a one man operation. If you hire help, there goes your profit... This way you know, if you're paying out of your pocket for labor and then you have things go wrong... that can stress you.” – Farmer, AZ 17

“I think most smaller operations, and when I say small, I mean, you know, we're not talking general land farming but I mean, really can't afford to [hire labor]... So that's one of the misconceptions, you know? People think you're hiring all these cowboys and all this stuff. Just the big ranches do that.” – Agricultural representative, AZ 24a

Irrigated land. Access to land with water resources for agricultural activities is another concern. Only 22.2% of land in the Verde River Basin is privately held (ADWR, 2009), and only some of that land has access to surface-water for irrigation. Participants noted that the cost of land, particularly surface-irrigated land, has risen significantly as residential development and tourism has increased in the region. These factors can be limiting for agricultural producers who are interested in expanding their operation, unless they have outside financial resources, such as their spouse's income, or other livelihood activities. Participants expressed concern that higher land prices, particularly for irrigated land, will likely limit agricultural activities in the Valley, and could have broader implications for food security.

“The other thing is land price around here. Land is so expensive that we are probably not gonna see large tracts of agriculture coming into the Verde Valley.” – Farmer, AZ 8

“...you've been on Page Springs Road? I mean, that is beautiful farmland... and then there's somebody's building a house that's basically taking up five acres of really great ag [agricultural] land. Why don't you [they] put that up there on the hill? But it's their land and I mean, what can I say?... Unless you've been in farming it's really hard to get started. Especially here because of, in Arizona, we're only 14% private.⁵ And of that 14%, what percent has access to, that kind of access to water?” – Rancher, AZ 28

“...with agriculture, to me the biggest threat is if people keep moving in on the best land and demanding to have the water, eventually... our vegetables and our food sources are going to be in Mexico, then we don't have any control over what happens to it and how it's grown. We lose control of our food source. So I think it's always important that if you can do it, ag land should be ag land. But, when it gets so valuable, you can't, it gets sold to be developed.”
– State/federal official, AZ 39

⁵ Fact check: In Arizona, about 18% of land is privately held (see Shumway, 2015).

Next generation. Challenges such as land access and production costs can also make it difficult for newer generations to get involved in farming or ranching in the Verde Valley. Participants newer to farming or ranching in the area noted that there are not many information sources, or networks of producers to turn to for advice about challenges on their farm or ranch. The perception among some participants was that younger people are generally not interested in agriculture because it is difficult, expensive to get started, and it can be difficult to make a living.

“As a small farmer I would say one of the key issues is just really getting up to speed on what you need to know to be successful as a small farmer in the area. How do you tap in or what are the existing networks of people doing it? How can you get some practical mentoring on how to tackle the issues? Mentoring on the land, how to use your water, maybe even what machinery could be useful given the particular situation...” – Farmer, AZ 43

“Unless, you know, your family owns a piece of property they're not gonna do much. Well, and we've seen a couple of young people wanting to start agricultural operations. And they do here, but they just have a hard, I mean, they're working 24 hours a day. And they don't see opportunity to buy their own land, so it becomes... [they] can't afford it...” – Residential irrigator, AZ 4

Motivations. Despite the challenges, for most participants involved in agriculture, their motivation to farm or ranch derived from their personal passion for agriculture, and/or their desire to maintain their family's legacy. While many aim to make a profit, and many support their families and employ others on their farm or ranch, profits are not the primary motivation for a lot of farmers and ranchers in the area.

Motivations for farming: “...it's what you grow up with. You know, you, we all have certain things we're passionate about. They're just, I would say the challenge is probably, number one, there's no guarantees. There's no, there's no right way or wrong way... If you like rolling the dice, you'd love farming... A lot of things can go wrong, but if you have two things go right, it makes you feel pretty good, you know? But probably above all that, it's just one of those few traditional industries that allows you to work right with your family, right with your grandkids and your kids. There's such a diverse amount of things to do that, you don't have to like farming, you just have to like one part of it.” – Farmer, AZ 13

Motivations for ranching: “I do it because I was born into it... You continue your family's legacies... We do make money... but... you're not gonna get rich.” – Rancher, AZ 14a

Parcel-level Management and Irrigation Challenges

The wide range of crops and livestock produced, as well as different irrigation types, scale of operation, and degrees of commercialization (for example gardeners, hobby farmers, commercial producers) meant that there was also a wide range of parcel-level challenges in the Verde Valley. The University of Arizona Cooperative Extension Yavapai County branch was

widely recognized as a key partner and resource for addressing parcel-level challenges (see: The University of Arizona, 2019).

Commercial surface-irrigated farms. Irrigated commercial crops in the Verde Valley include alfalfa, barley, corn, pecans, fruit trees, vegetables, and others. Several irrigated farms also feature commercial livestock production, including beef cattle, horses, sheep, goats, poultry, and eggs. The majority of these farms have access to surface irrigation. Perishability and post-harvest storage were cited as challenges for vegetable and fruit growers. Pests were also mentioned as a challenge, but some pests are also wildlife, such as gophers (which can damage canals and dams, and decrease irrigation efficiency), elk (which sometimes graze on crops and livestock pastures), and starlings (an exotic invasive species that eats crops). Crop diseases, such as curly top virus, are a concern as well.

“...vegetable crops are so perishable... At one point I had almost 2000 pounds of tomatoes... I managed to sell them all but they are so perishable.” – Farmer

“...wildlife intrusion is a concern for farmers. Gophers, pocket gophers, huge concern here...”
– Consultant/educator, AZ 9

Participants widely considered commercial growers to use efficient irrigation practices, such as spacing out irrigation events to maximize efficiency, laser-leveling fields, , and/or adopting drip irrigation systems. While these practices were described as adaptive for an uncertain water future (see “Health of the Verde River,” below), they can be costly. For example, drip irrigation requires investment not only in the drip system, but also in equipment that can pressurize and filter the ditch water. Several participants mentioned alternative water-efficient crops as an opportunity for increasing water savings, such as Hauser & Hauser Farms planting barley as a winter crop, in place of corn or alfalfa in the summer. Wider adoption of these kinds of opportunities has been limited, however, by infrastructure costs and limited or uncertain markets for alternative crops. The Nature Conservancy (TNC) and the Natural Resource Conservation Service (NRCS) were recognized as key partners in parcel-level efforts to increase irrigation efficiency (NRCS, 2019; TNC, 2019; Verde NRCD, n.d.; see also “Irrigation Ditches,” below).

“You're going to have to really be passionate about keeping water in the river to make that choice [to invest in irrigation efficiency]. And by having some support, you know, with funding some of the technology, it makes it a whole lot easier to make that decision. And, you know, I don't know. It's one of those things that some people just don't have the resources to invest, and some people don't think it's a good investment, you know, bankers included.” – Farmer, AZ 13

“I would love to see some test fields of quinoa and millet; do some more dryland cropping that has, well, not necessarily a high yield, but a high yield in dollars, you know?... Teff's another good one... or okra is another good, you know, some dryland crops that require less irrigation.”
– Conservation group representative, AZ 11

Vineyards. Wine grapes can be considered “new agriculture” in the Verde Valley. They do not tend to do well on lands that were historically irrigated; these lands experience higher humidity levels and more frequent frosts due to their proximity to the river and/or its tributaries, which can damage the grapes. Thus, vineyards have mostly been planted on lands that were not previously cultivated. While some vineyards are irrigated with surface water, most are irrigated with well water. To offset well-water use, some vineyards have participated in the Verde River Exchange Program, run by the local non-profit organization Friends of the Verde River (see Friends of the Verde River, 2019). Vineyards that use well water as their primary water source are a new water demand, but many stakeholders saw them as preferable to housing development, the likely alternative land use. Participants largely considered wine grapes to be a water-efficient crop: once established, they have a low water demand, and most vineyards have drip irrigation systems. Vineyards are closely associated with tourism because of wine tasting. Parcel-level concerns for vineyards included managing soil pH, as well as managing the impacts of weather events (such as April frosts and summer monsoons) on berry production. The costs of materials, such as barrels and bottles, as well as machinery maintenance, can be higher in the Verde Valley than other wine-growing areas, in part because of the relatively low acreage in the area, and therefore lower demand for such materials and services. Wine grapes can be susceptible to crop diseases, and require a lot of labor, which can be difficult to find. In the policy realm, regulations on wine distribution in Arizona limit wineries’ capacity to expand production while still having the ability to directly distribute their product via tasting rooms and wine clubs.

“Since we have calcaria soils, we deal with high bicarbonates in the water, which affects vine uptake. We end up having to modify our water with certain acids... The two biggest growing concerns we have by far in Arizona are spring frost... April's kind of the frost month. You know, you get new growth and then you have this potential of a cold snap, and you could freeze that brand new growth. And that happens every year... the second major growing concern we have is monsoon rains. July, August is our rainy season, and that is right once our grapes are ready, so we got a whole bunch of sugar, the berries are really engusted. You could engust the berries to the point where they actually break, then you can have bunch rot.” – Wine Grower

“There's a lot of disease problems here. Pierce's disease in grapes. Texas Root Rot that also impacts grapes.” – Consultant/educator, AZ 9

“ [The] Verde Exchange Program... is a small step in that direction of, of putting a connection between surface water users and groundwater users. And showing people how they're connected... We get surface water on a yearly basis, people that are gonna fallow a field, or convert their field to another crop that uses less water. And that's you know, so many acre feet of water that we've saved for the river. And then we've got people that pay an offset fee for their groundwater use. And that money is used to provide the incentives for the people who are using less water: the surface water users.” – Conservation group representative, AZ 10

“The Arizona Department of Liquor Licensing and Control really affects this a lot... the rules and regulations do affect how we look at farming. Like for instance, they, the laws are changing, and we may or may not be able to buy bulk wines from each other. So let's say you have a bumper crop and you grew so much extra wine and you have a market for it because the state laws don't

allow you to sell it. I mean that radically alters the kind of the landscape of how much do I plant, how much water do I use? What is my marketability of this agricultural product?” – Wine Grower

Irrigated small parcels. There are hundreds of small parcels (five acres or less) with access to ditch irrigation in the Verde Valley, particularly in Camp Verde. Most of these parcels were once farms or ranches that were subdivided for residential development. These parcels may include residential lawns and gardens, or pastures for livestock (horses, cattle, goats, etc.). Participants described the owners of small parcels as mostly newer residents from places like California, the Midwest, or urban contexts in general, where water management and climate are very different from the Verde Valley. For small parcels, participants identified the issues of over-irrigation (in terms of both quantity and frequency), high-water-use vegetation (especially Bermuda grass), and mowing lawns to a low, unhealthy height. For those with livestock, participants cited the challenges of compacted soils and the need for manure management, which can lead to slow water infiltration, high runoff, and lower water quality in ditches, the Verde River, and its tributaries (see “Health of the Verde River,” below). The way an individual landowner manages his or her parcel and irrigation may have a small impact on the overall system; however, the collective impact of these landowners’ management practices may be significant. Several participants identified these parcels as a key opportunity for improving water-use efficiency, crop management, and water quality through education about best management practices.

“I don’t think agriculture is growing. In fact, it’s going the opposite direction, where they sell off farms and ranches, maybe become subdivisions... If they become subdivisions that retain their surface water rights, or claims, and even though they may take like a third of the land out of production with driveways, houses, parkscape... the irrigation surface water use goes up, because they really don’t manage as well as farmers... Residential folks, at least when they move into an area where there is flood irrigation... they really waste water.”

– Conservation group representative, AZ 3

“...what happens these days to some extent is that these agricultural diversions that were started as agricultural diversions, and always were agricultural diversions, are now converting to residential properties, which are using the water to plant Bermuda grass, and weeping willows, and very high consumption crops in essence, which are also mowed every week, you (laughs) know, which increases their consumption. So, you’ve got the highest consumption crops now being planted in great parts of the river that used to be ag [agriculture], and that were more seasonal at that time when they were ag, or that had a more predictable amount of water that they’d be using...” – Local/county government official, AZ 12

“...surface water use on small acreages, where a lot of landowners have Bermuda and they just know that they have a constant flow of water. And we don’t necessarily know how to irrigate efficiently. Where, you know, you have the water, doesn’t mean you need to use it all the time. So, just sort of... lack of knowledge of how to use the water more wisely down in Verde for the private landowners that don’t, produce, you know... that aren’t ag [agriculture] producers.”

– State/federal government official, AZ 29

“Another facet... is trying to convert some of that Bermuda grass land into something that, that humans can eat.” – Consultant/educator, AZ 9

“Up here, we're still in a very archaic process of, ‘I wanna water as much as I want, whenever I want.’ And it's pretty disconnected from the science of actual good practices. I mean Bermuda grass, if that's what you're growing for your lawn, doesn't need [that much water]. We have people that put on knee high boots for their irrigation, and you know, go out and put a real big drink on their property. It's kind of fun. It's kind of recreational on a really hot day to go out and open your gates. And we have other people that have over time adapted to well-regulated sprinkler systems. And the farmers, of course, they're doing it for a living. They're doing everything to be economical. But even then, I think it's taken the influx of some resources that have been leveraged through federal or state or private philanthropic grants, that have given them a leg up to make things better, too.” – Consultant/educator, AZ 23

“...there's always a, you know, a balancing act to, to keep water available for everyone, and ag [agriculture] tends to use a lot less water than, you know, on a 10-acre field, we use a lot less water than a 10-acre, 10 subdivision, or 10 houses. You know, they irrigate every three or four days, you know? We're on probably a two-week schedule...” – Farmer, AZ 13

Livestock and grazing. Ranchers and farmers with livestock described a variety of parcel-level challenges. For those with livestock on private land, manure management was an issue. Some have addressed this by composting animal waste and reusing it onsite, or hauling and spreading it on other fields. The ongoing drought has significantly impacted ranchers with grazing permits on public lands. Because of low precipitation, dirt water tanks that capture water for livestock and wildlife on grazing lands have not refilled to sufficient levels, leading to water shortages for livestock and wildlife (for example, elk). Grasses are not replenishing at the same rate, which means less forage for livestock and wildlife. In response, the Forest Service, often in a joint decision with the permittee, has reduced the number of days livestock are permitted to graze in some pastures, based on available forage and/or available water. Ranchers have adapted to drought conditions by relying more on groundwater, and/or bringing drip tanks or trick tanks to pastures where their livestock are grazing. In 2018, because less forage was available, some ranchers opted to keep their livestock on private land and feed them purchased hay, while others sold part of their herd, a decision described as “heartbreaking.”

“I wanna be a really good neighbor, so we haul the manure and spread it, I mean, which we need to anyway for, [because] manure creates new grass. But no, I would not impose a feed lot on my new neighbor. That just wouldn't be good.” – Rancher, AZ 28

“We live on dirt tank catches from runoff monsoons... This year [2018], well, starting last summer the monsoons were pretty pitiful. Didn't put down a lot of water, so we didn't get any runoff. We didn't get any snowfall. So our tanks didn't rejuvenate. So they're running at super low levels. A lot of them are dry. We have contractors up there cleaning the edges of the tanks that we're permitted to. So the cows are, cows and elk can get to the water... Everybody says we're just living for the livestock. We're actually helping the wildlife too. They don't have to struggle through four foot of mud to get a drink.” – Rancher, AZ 14a

“... a lot of the guys up there [in another state] had their, you know, quite a sizeable ranch. And they farmed, they hayed. So they could grow their own hay. Here, they don't have that. They have no place to put their cows [during a drought]. They have to sell them off. And that's a big hit for them. And then you hate to see that happen because people think, oh it's just a cow, you know,

what's her value? Her value is she knows the country... We've gotta work with them [ranchers] and help them out... Because I feel that they're helping the environment out.”
– State/federal official, AZ 20

Irrigation Ditches: Social organization, infrastructure maintenance, and water access

Participants described the area’s irrigation ditches as essential to the Verde Valley’s agriculture and water system; they affect not only water delivery, but also social organization and water education. Surface water users are organized into cooperative ditch companies or ditch associations. Some, but not all, are formally constituted with an elected management board, which is responsible for operating and maintaining ditch infrastructure so that it delivers water to all their shareholders. Maintenance is almost constantly required, and includes clearing vegetation, trash, and silt from the ditch, as well as repairing the dam from damage caused by, for example, flooding or gophers. Ditch boards collect shareholder fees, communicate with shareholders about changes on the ditch, hold annual meetings, coordinate with other ditches, and in some cases, develop irrigation schedules and mediate water disputes. Some ditches are updating the original infrastructure with more time- and water-efficient technologies, such as installing automatic head gates, and lining segments of their ditch. These updates, however, can be costly. Several ditch associations have collaborated with the environmental non-profit The Nature Conservancy (TNC) to engineer and finance these projects. The ditches that are not formally constituted tend to have just a few members who organize amongst themselves to maintain their ditch and finance improvements as needed.

“Weekly this guy and I walk the ditch to clear out any brush that's fallen in, to make sure there's no gopher holes, repair gopher holes, things like that. Just regular, yearly ditch maintenance. Last year... they had to shut the ditch down for a few weeks and hire back help, and clean it out. Luckily there's people on the ditch that know how to run it, so, so the ditch association pays those people to, to do that big maintenance. And then once a year, the crew is hired to totally clean out, you know, make sure everything is, all the brush is cut back and all of that stuff. So, but then they also keep a reserve of... money for emergencies. So, for instance, if that had washed out, they have a little handful of money that they can get the ditch back up and running.” – Rancher, AZ 28

“Somewhere in there was the last big flood, I think. You know, and you have to go back and repair the dam and there are times that, you know, several hundred feet of the beginning of the ditch was just filled in. You know, you have to go out go and clean that out... Sometimes you have summer storms that will come up just enough to kind of wash the top off and then you don't have enough water. You have to go back up and repair the dam a little, you know. And then but as long as we can, you know, keep it full most of the time we can keep a full ditch of water, you know, and there's everybody works. You know, you can't all irrigate at once but kind of spread it out. It works out pretty well.” – Ditch manager, AZ 34

“...some of the ditch projects need to be, you know, the ditches need to be improved. I mean, they're old. They were dug in the 1870s and, my gosh, there's so much improvement that could be happening there. So, you know, ditch improvements, you know, public education, you know, water infrastructure funding, those are just a few.” – Farmer, AZ 13

“[When] something goes wrong with your water, you call the city of [redacted], for instance. You know? ‘My water's out.’... But, our association, all that we do is we collect the dues, because we have to repair, keep repairing it... We live there. We have our careers. We're always, you know, we're busy. This [managing the ditch] is not our job. We don't get paid for it. So that's the trick, is to try to make these people understand that, that they're part of the ditch, what they use... they're responsible for that. You know, you have to keep it clean... We've been having issues with people dumping in there [the ditch]... we get trash out of there on our grates all the time.” – Ditch manager, AZ 26

“As you float down the river... that, in and of itself, has created a nightmare for people. You look at the ditch companies... never did they have to clean out behind the, you know, the head gate there... And now it's just, you know, plastic bottles, it's sandals, it's clothes... It's everything under the sun that they have to go in and three or four times a year, and get them, you know, back on there and bucket it out, because it's just, it's plugging the head gates.” – Local/county government official, AZ 22

“Being a small town, you know, compared to some of the service areas in the other, in the, down in the [Salt River] Valley, you know, our service area... it's small, so our yearly budget is small compared to other places. So, in order for us to make, continue making improvements on the ditch, I think, funding is a problem. That's why TNC [The Nature Conservancy] was monumental in helping us...” – Ditch manager

Coordinating shareholders. Participants widely described how coordinating, communicating, and collaborating with ditch shareholders has become more challenging as the number of shareholders has increased over time (the result of subdividing agricultural properties). Participation in ditch meetings and ditch maintenance has declined. Newer shareholders often mistakenly think the ditch is a water provider, and sometimes have unrealistic expectations for water delivery. Many participants felt that residential shareholders tend to irrigate more, and more often, than necessary (see “Small irrigated parcels,” above), which can lead to water shortages for downstream users. Some ditches have an irrigation schedule to help avoid shortages, though not all shareholders follow it, and it can be difficult to enforce. Water shortages can have severe economic impacts for commercial farms and ranches. On several ditches, farmers and ranchers have taken on management roles to ensure that they get the water they need, when they need it, to grow their product(s). On some ditches, it has also become more challenging to come to agreement about ditch finances and infrastructure changes.

“...we used to get people who would come and they'd say, ‘Oh the irrigation. That's neat. What can I do to help?’ And now they say, ‘We paid a lot of money for this now where the hell is our water?’ As if it's my job to make their water there.” – Ditch manager, AZ 2

“...the concerns that I've heard from water users in saying, ‘Oh don't confuse me with all of this stuff, I want my water, I want it when I'm supposed to get it and the ditch boss better provide it for me. And I'm paying money for that, so it's mine.’ And if you have no snow pack and no runoff, it's tough to produce that.” – Local/county government official, AZ 38

“...the feedback that I get from the ditch is that it's a lot of politics, a lot of cranky people... I would think that all of these people would have a collective interest in the ditch, rather than a, ‘No, this is my ditch, this part right here.’ It's like, well, yeah, but if that guy's part doesn't, isn't maintained, then you get nothing... And maybe that's, that's our American, like, in a fallacy of our individuality; you know, we like to think we're independent, but really, somebody else has to make our shoes for us kind of a thing (laughs).” – Rancher, AZ 28

“...when the whole [redacted] Ditch... had five farms, I think they managed that really well. I think they all knew what was right, but... when you go from five farms to [hundreds of] people, you lose control, even with somebody running the ditch, it's hard to stop somebody from taking water on a Tuesday when they know it's not their turn.” – Farmer 13

“There's, I don't know, eight or nine main ditches in the Verde Valley... And you know, a lot of the lands have been broken up into small two-acre, five-acre little ranchettes. And, a lot of people don't really commercial farm anymore. They're growing Bermuda Grass... they certainly have a right to use the surface water on their lands. But the ditches all operate, they don't coordinate their operations very much. They open their ditch in the spring. They let it run full and anybody can take water anytime they want. As much as they want. There's no, yeah, there's no regulation of how much. Generally speaking, there's some exceptions, but yeah.”
– State/federal official, AZ 18

“So, the ditch can only convey a certain amount. And the challenge becomes these small, residential users who are unscheduled, take water whenever they want. And so, you've got all these people taking water to flood-irrigate lawns and they're all taking it whenever they want. And then, you have a large farm that needs a large block of water... What happened kind of in the '80s—'70s to '80s—a lot of these developments went in the '90s. The farms were really struggling because, instead of five farms taking turns, you have [hundreds of] people not taking turns... you don't always know what your neighbors are doing 'cause there's not an enforceable schedule.”
– Conservation group representative, AZ 1

Maintenance on a small ditch that is not formally constituted: “We've been trying to get organized where we can maybe not have so much of an association, but just kind of a- a committee or whatever you call it. To have better control... we did about I don't know, probably [redacted] dollars' worth of work on the pipeline and ditch this year. To increase the water flow cause the water flow kept dropping... So, we went in, started cleaning, and all that. We went to other users and said, you know, we put in X amount of money. You know, we have rights to [redacted] percent of the water. You guys have rights to [redacted] percent... So, you know, would you guys be willing to kick in [redacted] percent?... [Some] users have been real cooperative. And willing to, and one we haven't heard nothing back from. He's an absentee owner. So we haven't heard nothing from him.” – Rancher, AZ 27

“...without water, we're, we can't survive. And that's the difference between us [and our neighbors]...that we need the water to produce [our agricultural product]... It's a business... They're not commercial businesses. So, they water, they keep their grass green...I mean, a lot of them have little gardens and things like that. You know? But nobody else, nobody in the area that I know of, produces anything.” – Ditch manager, AZ 26

“...there's certain days they [ranchers] gotta get the water that they're allotted, and by God, that's it, you know? It's siphoned out at certain times to different individuals. And if you mess with that, well... it can put you out of business. But see, it's a, it's a hidden danger because of all these people over there... You know, if all these wells are sucking down the aquifers and the top water

and the, you know, the surface water and the lower, you know, underground water, you know, it's gonna affect all these ranchers. Because the flow's gone, and that affects the people all down the road.” – Agricultural representative, AZ 24b

Expansion areas. Participants described how the surface-irrigated area has expanded beyond historic boundaries, potentially increasing surface water demand. This has occurred over time by various means, such as property owners expanding the area they irrigate; ditch companies giving more shares to existing members to increase revenue, or in exchange for ditch maintenance efforts; and developers building subdivisions partially on historically irrigated land, and partially on historically non-irrigated land. Until surface water rights are determined in the adjudication, there is no effective safeguard or authority to stop this from happening. What makes someone a shareholder on most ditches is paying the ditch fees; a shareholder does not need to have a historic water rights claim to have water delivered. Moreover, property sellers in the Valley make assertions about surface water claims that are rarely confirmed (and difficult to confirm) by real estate agents or buyers. Buyers pay a premium for properties with surface irrigation (in other words, ditch access), and in theory, a senior water rights claim. While many properties on ditches do have senior claims, some do not, but are advertised as having irrigation access, and sold at a premium value. When the adjudication is settled, these lower-priority claimants are at risk of not having the kind of water rights they paid for. Participants noted that this system has allowed for increased numbers of ditch shareholders, increased water demand on ditches, and decreased water availability for downstream users with senior claims (see “Health of the Verde River,” and “The Adjudication,” below).

“As far as we're concerned, if you're paying your ditch fees, you're gonna get a bill from the ditch, and you've got a water right.” – Ditch manager, AZ 30a

“...you also have properties that, maybe, as the family grew and went through the generations, they divided the property... and then each of those parties needed to irrigate and so, they expanded their use. Well, they did that because there was enough water coming down the ditch, and it's not being monitored, or the ditch commissioners, themselves, the organized bodies, were willing to allow it, in some cases, encourage it and just revenue, monetize it...”
– Consultant/educator, AZ 23

“The ditch company is responsible for what water goes down the ditch to different points, but there has to be some somebody that, if you're taking water and you don't have water, and that's the way it is, there's nobody to really, that enforces that today... It's hard to know who's... taking water, you know. It's just, they don't know unless somebody tells them and then they can tell them, ‘hey you know, you gotta stop it.’ It doesn't happen.” – Farmer, AZ 17

“You know, a landowner can put whatever they want on their claim. And then, they give it to the real estate agent, the real estate just regurgitates what's in the claimer. And then, it's couched as if it's got a water right. And it's the real estate community, I think, needs to become a little more informed and a little more responsible frankly, in providing a more realistic picture of what's happening on a piece of property. You know, you can't use the word accurate, because there's not

necessarily adjudication yet. But, they tend to go, (laughs) on the other side of tending to support and say that there's a water right when there really may not be.” – State/federal official, AZ 18

“I'll have someone purchase a fairly large, pricey piece of property and come in and think that they have irrigation rights and I'll have to tell them, ‘Well the ditch might let you (laughs) irrigate and probably will continue to, but that doesn't mean that you have those historic rights.’ And so I think the lack of education on some of those things, for people who are purchasing what they think are secured water rights is, it's interesting for sure.” – Consultant/educator, AZ 16

Livestock Grazing on Public Lands

Many ranchers in the Verde Valley lease grazing allotments on public lands, mostly from the U.S. Forest Service, in the Prescott National Forest and Coconino National Forest. This means they frequently interact with multiple government agencies, including the Forest Service, the Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Bureau of Land Management (BLM), and the Arizona Game and Fish Department. Federal policies that apply to public lands in the Verde Valley include the Antiquities Act (1906), the Endangered Species Act (ESA, 1973), and the National Environmental Policy Act (NEPA, 1969).

Ranchers discussed having positive experiences and productive relationships with government agency officials. However, many related frustrating experiences (in many cases dating back several or more years), and felt that some government policies and/or officials had limited their capacity to sustainably manage natural resources and grow their businesses. For example, some ranchers described cases in which an agency official (often characterized as being from outside of Arizona) had made a management decision, or applied a guideline in a way that the rancher felt was not appropriate for the local context. In some cases, a rancher felt that a government official had based a decision on her/his personal values rather than scientific evidence, sometimes to the detriment of the watershed, wildlife, livestock, and/or the rancher's bottom line. A few described cases in which a government official had over-reported grazing utilization, presumably in an effort to reduce the amount of time that livestock could stay on a particular pasture, or remove livestock from that pasture altogether. Others described interactions with agency officials and environmental activists who assumed the rancher was not protecting the environment or managing natural resources on public lands. Some ranchers were concerned that policy changes, and/or legal action directed at them or at the Forest Service could put them out of business, as has occurred in other parts of Arizona (see for example, Center for Biological Diversity, 2015, 2019; Kenworthy, 1998; Neary, Medina, & Rinne, 2012). An agency official explained that growing ranchers' businesses, “is not the role of the Forest Service...we regulate their [ranchers'] use and have to balance their needs with the needs of the land and other stakeholders.”

“...Instead of being science-based, it's emotionally-based decisions. You know, and-and a science-based decision I can accept, but when it's an emotional-based decision, that's, you know... [For example] We had a biologist that wanted all the cattle off the creek, and so they

used the loach minnow to get us off the creek... [The biologist said], 'I'm an environmentalist.' Well, you know, I'm probably one of the first environmentalists because without the environment, I have nothing. You know? I have to work with the environment in the environment... I mean, we manage the watershed... they don't realize that if we don't manage the watershed, then we don't nothing." – Rancher

"They [government agencies] think there are conflicting interests [between ranching and wildlife]. I don't think there are conflicting interests to hold up water for everybody in the uplands. But I imagine that they [agencies] are... probably juggling a lot more issues and hopefully keeping the legal considerations in mind as well. Which I'm not completely convinced that they do. The Forest Service, the BLM... they're not slow to try to say, 'Your cows can't be here.'" – Rancher

"Everyone tries to avoid the Forest Service. At least, that's what I've heard because they micromanage and they don't take into account, you know, the expense they're putting the common man through." – Agricultural representative, AZ 25

"The biggest care for anybody... is that the political powers could do something to ruin all of us. You know, we're scared... and we don't really have any control over that." – Agricultural representative, AZ 24b

Sharing public lands. Using public lands to graze livestock also means sharing the land with other users, particularly recreationalists (such as hikers, four-wheelers) and tourists. This poses additional challenges for ranchers, such as erosion, trash, and pasture gates being left open. Some felt they were being held to higher standards of land stewardship than recreationalists were, and in some cases felt blamed for damage from recreational activities. Government officials also recognized these challenges, and the need for management changes on their end. The Forest Plan for Coconino National Forest was updated in March 2018 (see U.S. Forest Service, n.d.c). Officials saw the 2018 plan as allowing more flexibility for adaptive management than the 1987 plan.

"We get gates left open, cattle get scattered out. Then I get a call from the Forest Service. You're not gonna be in compliance if you don't have your cattle in the right pasture..." – Rancher

"The [low] amount of waters we have now, the more of the public tearing up more country with their four wheelers and all that. You know, they get in the drainages where the water runs to these tanks, and they're running up and down with their four wheelers, and they're just killing the vegetation out. So pretty [soon], you get a big monsoon or a big snowfall that melts, runs off, it just fills that tank plumb full of mud. Not to mention the erosion and everything that they blame on the cows... is coming from the public and their little toys [ATVs]. However, when we hire our subcontractors to go in and clean tanks with their rubber-tired backhoes and loaders and whatnot, if they, as their going in, go off the track just a foot where they flagged for an archeology study... we get fined. But yet the four wheelers can do it. The people recreating can do it... People actually trying to help are the ones paying the penalty." – Rancher

"I believe more needs to be done but a shift in public thinking is the real issue that can affect policy change. Yes, we regulate what the grazing permittee —rancher on public lands—can and cannot do. I say it all the time, we regulate the permittees, telling them to use areas at a specific

use level and yet the general public runs amuck, driving their ATVs, UTVs and Razors wherever and whenever they want, and no it isn't fair... We do hold them, the ranchers to a higher standard... I don't like it either and know it isn't fair... More education is needed, more compliance from the general public is defiantly needed but we also need more 'boots on the ground' to help with the information and enforcement." – State/federal official

Health of the Verde River

The vast majority of participants described the Verde River and its tributaries as critical for quality of life, wildlife, economic development, and/or irrigated agriculture. While some participants considered the river healthy today, or healthier now than in the past, others were concerned about the river's current condition. The river's health was widely discussed in terms of surface water flows and riparian vegetation. Some discussed issues related to water quality, but this was not a priority concern for most participants.

"The river is kind of the foundation of our life here." – Local/county government official, AZ 31

"...the health of the Verde River and the health of the economy are tied together."
– Local/county government official, AZ 12

"To me that's what defines it [the Verde Valley]: this green belt... It's because of the broad flood plain of these irrigation canals that provide it for here, and all that irrigated acreage... That's why the river's so important to me. Because without it all that dies too and the whole identity [of this community] withers and goes away." – Local/county government official, AZ 5

"...our ditch boss has told me that the flow has been slowly creeping down over the years... So again, back to water supply, what does that mean for the future for us? But it's still a lot of water and again in my lifetime, I doubt there'll be a problem, but in this situation it's not just a metaphor, literally a couple of my kids might take over that farm and that business someday, and we rely on that water. If that water is gone, our business is gone. Our livelihood."
– Farmer, AZ 36

"Obviously the conversation [with farmers] about water security and the future of the Verde comes out because they, their livelihood is based off of agriculture. So, if their water supply diminishes, they also want to be able to continue to irrigate."
– Conservation group representative, AZ 41

"There's a lot of native fish species that depend on the flows in the river. It's also migratory bird habitat, so just maintaining the riparian habitat along the river is also important."
– Conservation group representative, AZ 42

"If you look at old, old photographs, only thing that was on that river was cottonwoods. A lot of this other stuff, these willows and the salt cedar and all that stuff, it wasn't there. There was no place on this river you couldn't have got to [by] horseback or afoot. Now there's so much of that stuff growing up, you can't get to it." – Ditch manager, AZ 30a

“The river was healthy when we had managed grazing [on the river]... Today, it’s plugged up with vegetation. It’s a jungle... The river is the least healthy that I have seen it in my lifetime.”
– Rancher, AZ 21

Water quality: “...it’s kind of a flow thing that you, when your flows get pretty minimal in the summer. And it’s not necessarily point source pollution, it tends to be associated with run-off events and stuff... Then of course, you know, it’s a big deal here in the local economies in terms of recreation.” – Conservation group representative, AZ 3

Flows. Nearly all participants agreed that protecting and maintaining flows in the Verde River was an important goal. Many expressed concern that the Verde River could eventually go dry. This would negatively affect the river’s capacity to support irrigation, wildlife, recreation, and other functions. Participants identified several factors affecting river flows, including groundwater pumping (related to residential growth in the Verde Valley and in the hydrologically connected Big Chino/Prescott area), drought, climate change, riparian vegetation (more below), and ditch diversions for irrigation (more below). Some participants recognized the Verde River Exchange Program (run by Friends of the Verde River) as a demonstration of an alternative way to approach water management in the region, which could help sustain river flows while also supporting economic growth.

“We do not want to dry up the Verde River. I don't want to dry up the middle Verde. I don't want to dry up the upper Verde. I just, these are all concerns we have... We just want it to continue to flow.” – Local/county government official, AZ 35

“...[Let’s] say it never rains ever again... [There is] not an issue with regards to availability of water for people in the Valley. But...there’s a connection between that system [climate] and the [Verde] river such that whatever we do, we want to make sure that we do things most efficiently and effectively as possible, and take into consideration every means possible to ensure that we can maintain the flow of the river.” – Local/county government official, AZ 22

“...there’s a God-damn (laughing) drought going on... You know, I mean, it’s natural that every river’s down when there’s a drought going.” – Agricultural representative, AZ 25

“There are natural things impacting the river. I think we are starting to really see the effects of a 20-year drought on water flows today. And there is not much we can do about that. But groundwater pumping in the Verde Valley... you know what the proliferation of wells has been like here over the last 60 years.” – Local/county government official, AZ 15

“We have this issue of increasing groundwater pumping and climate change that’s reducing the input into the [river] system.” – Conservation group representative, AZ 1

“...ground water is the only source of water for the cities, the towns, new development, businesses, homes... and so as the area grows, the amount of groundwater pumping grows... Pumping interferes with flows, base flows in the river. So it affects the river, and the health of the river. And whether it has water in it affects the local economies, because well, because most people want to live in the area and visit because there’s a river... All of the existing water users and those who depend on both surface water and groundwater resources and the river are affected

by that. But they're also not affected immediately. It's a long, it's sort of a long term, slow thing.”
– Consultant/educator, AZ 33

“The more groundwater they draw over there [in Prescott/Big Chino], the less that'll flow into the Verde River, which is the water supply for here... There's twenty some ditches here in the Verde Valley that deliver water to agricultural properties... they need water for their interests... On the other side of the county [Prescott] it's more about growth...” – Consultant/educator, AZ 9

“Obviously one of the biggest issues that not only ag [agriculture] is facing, but really everyone is facing in the Verde Valley is... this issue of continued growth and the need for additional groundwater pumping. And the effects that will have over time to the flow in the Verde River itself. And there is a disconnect between the risk associated with continued growth on groundwater pumping and the very real future impacts that are going to be felt by that river.”
– State/federal government official, AZ 18

“We've just been, forever, been able to just buy a piece of property and come punch a well... You can do that right now. You can call your well driller right now, and punch a well. But for the surface water rights, there's been this... long perpetuated myth that the surface water is not connected to the groundwater, and our policy, and our law, encourages that...”
– Consultant/educator, AZ 23

“If I go out there one day and I open the head gate for the [redacted] Ditch and there's no water, guess where we go get our water? We start pumping now. Now you're in some real serious shit. You start turning on a pump that's moving 15 CFS down through a canal bank, through a canal, you're making an impact... at that point the problem becomes irreversible. You can't go back once you start sinking these major wells to provide for those who have historic water rights use.”
– Local/county government official, AZ 5

“...there are others that say it's gonna dry up anyway no matter what we do. So they don't see any reason to conserve it because it's not like, the river's, to those people, the river is not something that they feel they can do anything about because they see, they don't understand where the water comes from... If the river is, is fed by rain, and they've heard that the rain is going to be less because of climate change, then the river will dry up. So you know, there's nothing we can do about it. So there's a big, you know we have to think about how we educate people about where the river, what the river source is, and what those threats are. And how they can influence the, the future of the river.” – Conservation group representative, AZ 10

“I think we just need good, sustainable water management. I think that, you know, this pilot offset program, the Verde River Exchange, is an example of how you can have economic growth and could, like, recognize that there's a limit to the water we're gonna have to work with. And so we, we can't do things the way we always did them.” – Conservation group representative, AZ 3

Riparian vegetation. Many participants expressed concern about the amount of vegetation on the banks of the Verde River, which has increased over the last twenty years. They pointed to the Forest Service's 1998 decision to exclude livestock from riparian habitat on Forest Service land as the turning point at which the Verde River evolved to have a narrower stream channel

and more riparian vegetation, especially trees.⁶ For some participants, particularly ranchers, ditch managers, and long-term residents, the growth in vegetation was an indicator of declining river health. Their concerns included the presence of invasive species; how the vegetation affects the volume and speed of river flows; and the possibility that the vegetation could increase flood damage. Several participants also cited the decline of two endangered species—the loach minnow and spikedace—as evidence of declining riparian health. They noted that the 1998 decision to remove livestock from riparian areas on Forest Service land was made in part to protect these species, despite that the impacts of grazing on the river were not assessed in the NEPA (National Environmental Policy Act) evaluations conducted for this decision (see Neary, Medina, & Rinne, 2012). In contrast, some participants considered the riparian vegetation of today to be important wildlife habitat, to improve streambank stabilization, and to be scenically beautiful (see “Health of the Verde River,” above). Others acknowledged that it is difficult to know what the riparian habitat was like before human intervention, and saw a need for collaborative approaches to address the issue.

“...the big problem with the river now is it's just you know, so grown up with trees and everything... that has to be taking up a lot of water... [In the past] they had cattle running on the river, you know, which would keep down a lot of the little growth and then of course that was stopped several years ago... that's led to this: grown up like a jungle... It needs to be a much bigger and more concerted effort to try to get rid of all the invasive species... I think it's probably cut down on the water in the river... But you know, if it just keeps growing it's going to take more and more water out.” – Ditch manager, AZ 34

“The riparian area that's up there now is so expansive, compared to what it was, pre-development times... the single largest pumper of water up in that valley is the riparian area.” – Local/county government official, AZ 22

“The biggest threat too is the flooding... there's been flooding because there's so much vegetation down in the ditch. Salt cedars, paradise trees, and, and, and a huge amount of, of just brush too... so what happens is that [if] there's a big flood, and there's a big, you know, a big influx of water, it'll knock so many trees down, and then they jam up at the bridges and cause major flooding.” – Ditch manager, AZ 30b

“It's gonna be bad because the, the creeks are so overgrown... when it floods this next time it's gonna be a disaster.” – Long-term resident, AZ 14b

“The local Southwest Center for Biological Diversity, summarily and single-handedly with the Forest Service, annihilated the spikedace out of the Verde River. All by themselves by pulling cattle. That's a management change in which you are required to do a NEPA. They said, ‘Oh. We're not changing. We're sending it back to nature, and so we're not required to do a NEPA.’

⁶ In 1997, Forest Guardians and the Center for Biological Diversity filed complaints against the U.S. Forest Service Region 3 (which includes Arizona’s Verde Valley), alleging it had failed to complete an Endangered Species Act (ESA) Sec. 7 consultation for livestock grazing effects on watersheds and riparian habitat affecting four listed species: the loach minnow, spikedace, spotted owl, and southwestern willow flycatcher. In 1998, Forest Service Region 3 agreed to exclude livestock from at least 99% of habitat for the four species on federal land for the duration of an ongoing grazing consultation, which was completed in February 1999. Despite efforts to protect the loach minnow and spikedace, their numbers have continued to decline (Neary, Medina, & Rinne, 2012).

Bullshit. The law is succinct... That [river] water's still there. It is in the banks and being aspirated out by 4,000 trees per acre as opposed to the historic eight. Gee, where's our water going? That's an illegal diversion of water for the downriver stream users... So are we really out that water? Or is it just not measured because it's not free flowing?" – Rancher, AZ 32

"We can build a fence so our cows can drink in the Verde, but we can't put them on there because... the spikedace was their reasoning... Once the cows were off the Verde, the following year and since then, they've not been able to find those spikedace, because spikedace need a very wide, shallow riverbed... And now the riverbed is very channelized and deep. And shaded." – Rancher, AZ 28

"...now it's [the stream is] just choked out. I mean, there's just, there's so much growth in there... which doesn't make sense because, I mean, their habitat for like the loach [minnow] and stuff is low, slow-flowing ripples. Wide [banks]... They've taken all the cattle and stuff out, and they've choked it down to where the water is like, it's running faster and deeper, and that doesn't fit the habitat for what they're trying to protect." – Rancher, AZ 27

"Livestock cannot graze in an unregulated way as what happened in the first part of the last century. I suspect that the amount of vegetation that used to line the banks of the Verde and other rivers and streams was more than most would think possible. Humans have greatly altered the landscape and without photographs or some account of the area pre-settlement we really can't judge. I don't like to put the blame on plants for sucking all the water out of the system. Humans broke it and we need to work together to fix it." – State/federal official

Ditch diversions. Participants explained that surface irrigation not only depends on there being water in the river, but that irrigation diversions also affect river flows. Ditch diversions help deliver surface water for irrigation (See "Irrigation Ditches," above, and "The Adjudication," below). Many diversions were constructed to divert most of the river's flow, which means that in certain places, especially during the summer, the diversions can significantly reduce flows in stretches of the river. Several participants noted that when this happens, it affects downstream users (for example, other ditches), wildlife, and recreational uses in terms of water quantity and quality. Low or depleted flows can correlate with higher bacteria levels in the river. Many participants highlighted that some irrigators and ditch companies have increased efficiencies, which has improved river flows (see "Parcel-level Management" and "Irrigation Ditches," above). Some argued, however, that agriculture is unfairly blamed for declining flows, and expected to reduce water use, despite that other factors (including drought, increased groundwater pumping, and increased riparian vegetation) also impact flows.

"...there's a lot of places because of the irrigation ditches in the Verde Valley where the waters just diverted [water], and it used to be that just the whole river would be diverted in order to water a property, but not that much water is needed." – Conservation group representative, AZ 42

"...between April and July, there is no rain. And the river just keeps going down and down; and so, we have sections of the river that have less than 10% of their natural flow. Sometimes they have less than 5% of their natural flow, so it's reducing that consumptive use during the summer months that's critical." – Conservation group representative, AZ 1

“June and July are the critical months. It’s when the river gets really low, and that’s when the demand is extremely high for our summer crops... We [the ditch] used to divert out a huge amount of water... we would divert all we could and then we would turn the water back into the river, you know, and take just out of the ditch what we needed... When we changed all of our methods and started not spilling water that way, we only diverted out of the stream what we needed. I think it really helped the [downstream ditch], and, you know, we hope that they pay that forward and help the next ditch...” – Farmer, AZ 13

“...ditches, especially if they’re an open diversion what they would do is they would just run a ton of excess water. That way they’re for sure satisfying all their users and you know, Joe Schmo doesn’t yell at the ditch boss that he’s not getting enough water.”
– Conservation group representative, AZ 41

“...agriculture is using surface water directly out of the river, and they’re dewatering large stretches of river, and instead having that water in their ditch system... Dewatering a river is really bad for fish... There is a correlation between E. coli and the temperature of the water... and then the monsoons are responsible for the high spikes... where the ditches are dewatering the river the dwell time of, of exceeding E. coli is much, much longer than it is in other stretches. The reason that becomes then a public issue is that... [the] county, the City of Cottonwood, others, Town of Camp Verde, want to have parks on the river... they need to now say to the public at certain times you really shouldn’t swim in this water; you shouldn’t let your dog swim in it. That’s a hard thing to say when you’re trying to get people to recreate (laughs) in it, you know?”
– Local/county government official, AZ 12

“...what people don’t understand about water is surface water is affected by groundwater. If people are sucking it dry with a straw over here it’s going to affect that surface river water, but they’re blaming it on agriculture.” – Agricultural representative, AZ 25

“...you’ve got [environmental activists] who’s, you know, ‘Save the Verde, we don’t have very much Verde River water’... If it really is development in the upper Verde or pumping down in Prescott, or whatever, then let us know that. But if it’s just, the water is being used by the vegetation, or being held up enough so it can soak into the ground, then be aware of that and be okay with that... because we do have water rights in the Verde...” – Rancher, AZ 28

Restoration concerns. While all participants were generally in favor of conservation, the idea of river restoration raised concerns for some participants, particularly long-term residents and ranchers. These included feeling unfairly blamed for degradation, and fear of being tasked with paying for restoration projects and/or facing legal action from environmental groups such as the Center for Biological Diversity (which has occurred in the Verde Valley and other parts of Arizona; see for example: Brown 2015; Center for Biological Diversity, 2015). Some expressed a different sense of what makes the river healthy and enjoyable for recreation than what the river is currently managed for.

“...[R]estoration sounds like what the environmentalists want, bigger [river] flow for fish... Yeah restoration with that gets hairy... [T]he environmentalists are going ‘well we can’t have cows coming in there and drinking and pooping.’ They forget that birds poop too (laughing)... [Ranchers are] so concerned you know, about this restoration stuff because these guys become very extreme and then they want like it was back in Columbus’ day... But the river has ebbed and

flowed historically because of droughts and good years and bad years and stuff, and that's what a lot of those guys don't understand, the environmentalists, they want the steady flow that isn't normal... Restoration has a connotation that okay we're going to pick somebody that wrecked this area and we're going to make them pay to restore it and that's scary because they will pick agriculture every time... that's hundreds of thousands of dollars to restore an area along a river if it's really damaged you know, prove it's damaged but it's involving lawsuits and hundreds of thousands of dollars with legal fees and restoration.” – Agricultural representative, AZ 24a

“You should probably go down to the fork and read what this river and this area was like when the settlers moved here. Before the malaria. There's a reason why the old timers cleaned it up. That's what so many people don't understand now... The old timers didn't do things out of whimsy. They did it for a reason.” – Long-term resident, AZ 14b

“What I don't understand, going back to the riparian area, is there's so many miles of creek that the public does not have access to, that can stay as natural as it can be. What is wrong with cleaning up or allowing cattle into the creek to minimize and manage the creek? They want the whole damn thing to go back to riparian but yet there are areas of this creek that humans would only backpack into.” – Consultant/educator, AZ 14c

The Adjudication: Unsettled water rights claims

Participants widely acknowledged that the ongoing Gila River Adjudication has important implications for farmers, ranchers, and other water users and property owners in the Verde Valley. Farmers and ranchers likely have some of the most senior surface water rights in the region.⁷ While the adjudication remains unresolved, they and other claimants can essentially use as much water as they want. However, newer, or lower-priority claimants (including those with wells that pump Verde River subflow) can use water in ways that negatively affect those with older, or more senior surface water claims. Until the adjudication process is complete, historic claimants—including farmers and ranchers—have very limited recourse for asserting their priority access to water other than coming to informal agreements with neighbors and other water users (see “Irrigation Ditches,” above).

Until the adjudication is resolved, the farmers and ranchers interviewed for this project largely felt they had done what they could to secure their water claim(s). Most landowners, including farmers and ranchers, filed a statement of claimant form with ADWR soon after the

⁷ In Arizona, surface water rights are governed by the doctrine of prior appropriation, meaning that the first person to appropriate water from a stream for a beneficial use has rights senior to later appropriators. Surface water rights, therefore, have particular attributes, including the date of the original appropriation, the point of diversion and the quantity appropriated. The Gila Watershed Adjudication is a legal proceeding to catalogue and prioritize all of the surface water rights to the Gila River and its tributaries, including the Verde River. The Arizona Supreme Court has ruled that wells that are withdrawing a stream's sub-surface flow, or “subflow,” are also subject to the adjudication. In the last forty years, the number of wells in the Verde Valley has quadrupled. It is likely that many of these wells will be deemed in the adjudication to be misappropriating subflow.

adjudication was initiated in 1974. (Notably, a majority of residents today moved to the Verde Valley after the adjudication started; thus in many cases a previous landowner filed the statement of claimant for a given property; see “Public understanding,” below). Many farmers and ranchers have worked with a lawyer or consultant to establish the date of their claim, drawing evidence from historical documents, such as land surveys, land patents, homestead documents, and aerial photographs.⁸ Now, they are waiting for the adjudication to come. Several described relying on their attorney, or their ditch association’s attorney, for information and updates.

“...They [farmers] can only can do so much when it's a legal battle and it's all this kind of stuff. It's much more of, they're observing and they're waiting to see what happens, but when they can be involved they are, but there's only a few ways they can do that.”
– Agricultural representative, AZ 6

“I think they're [farmers and ranchers are] just watching the scene... [to] see where the gun's aimed at and see if you can see what they can do to try to dodge the bullet, or, if they're gonna have to shoot back. Cause it's all gonna have to be done legislatively.” – Rancher, AZ 27

“[H]ow's your shared infrastructure? And, how's your relationship with your neighbor? 'Cause if your neighbor can take it all before you get it, he can take it all before you get it and you don't have a lot of legal recourse.” – Conservation group representative, AZ 1

“...you know, to be honest with you, I don't understand it enough probably... water is important. That's why everybody's working at it and trying to get the rights to it... I don't know if I'm concerned [about the adjudication], but I am certainly aware of it... Then again, we have an attorney. You know, our water, our ditch association. And they educate their clients you know?... There hasn't been anything officially that we had to deal with, with that. Just being aware of it, that it's coming.” – Ditch manager, AZ 26

Expectations and concerns. Some participants felt that finalizing the adjudication would be beneficial for farmers, ranchers, and other historic water rights claimants, because it will clearly quantify and prioritize their surface water rights, and improve public awareness around water rights and water use. Those with higher-priority claims will have a stronger legal basis for protecting their water rights once the adjudication is complete, and more options for doing so. Some participants expected outcomes that could be unfavorable for current water users, such as new regulations and/or metering that could increase costs, and/or affect agricultural operations. Some speculated that the adjudication could affect property values.

“I wish it [adjudication] would come sooner than later for us. What it will do, hopefully, is it will put on notice a lot of these junior water users that just started expanding. You know, they had two acres, now they have four, you know, because they leveled off some river ground. And hopefully they'll address and fix all that. Because that really hurts everyone when, when you have these, you know, claimants that started irrigating, you know, not so many years ago, that they take away

⁸ These documents include the Hancock Survey (1914), The Phelps Survey (1920), the Holmquist Survey and Fairchild Aerial Photography (1934), and the Hayden Report (1940), among others.

from the, the historic irrigated land rights... I think there's a lot of misinformation out there.”
– Farmer, AZ 13

“...unless we got a handle on, not only who the senior right holders are, but this question of subflow; and, when is a well pumping groundwater versus surface water under prior appropriation... We are afraid that if this goes longer—and it's [the adjudication is] predicted to go many years longer—it might be too late for the Verde... We need to do some other things to try to stem the, the impacts. Everyday you're having new threats.”
– State/federal government official, AZ 18

“They [claimants] have an unadjudicated right that they, or, claim that they treat like a right now, so that's kinda as good as you can get. Any adjudication is gonna decrease your right probably, or at least decrease the de facto amount of water that you're consuming somehow.”
– Local/county government official, AZ 12

“Our members get really concerned about that [metering wells] for a few reasons. The first is that any time you put a number on something, it makes it really easy to regulate it, or at least easier to regulate it, and so that's usually the purpose of a meter. It precedes some sort of water use regulation, which probably means they're going to have less water available to do what they're already doing. The other concern is that it's just one number, and so it doesn't accurately reflect things like ‘What's the economic value of that water that they are using, and how do you quantify that?’ It doesn't reflect, ‘What conservation methods do they have in place? What would that number have looked like ten years ago, five years ago?’ It doesn't reflect that, something that they're already doing. It really is this isolated number that they feel like can only be used against them and there's no way for it to be a positive type of situation.”
– Agricultural representative, AZ 6

“I think ranchers, rural and close in [to urban areas] are concerned about water, you know, well managing or monitoring. And that it would be over-used. Now... I think some of these [large] wells need to be monitored. But the little people, the normal people, I should say... I'm using the term normal and probably not the proper sense but... regular ranchers, you know, aren't abusing this privilege of having wells.” – Agricultural representative, AZ 24a

“I'm just not in favor of any more control... Who's gonna determine, well, you can have X amount of gallons of water for a certain amount of days, and you can have X amount of water for a certain amount of days? That's just, you know, I can't, that's just too much control. And in our business, it's hard to manage from one day to the next anyways. I mean, some years, you know, at this time of the month or whatever, I might not need all the water I got, but then next year, I might need twice that much water. I mean, there's too much fluctuation in the environmental effects... It's not like we're running a factory where everything's all the same all of the time... I think that's one of our biggest problems, is like SRP and them. They want to be able to share, but they've got a product to sell to somebody. But in the same token, we have to protect ourselves to be able to sell a product...” – Rancher, AZ 27

“I think the major impact is in your real estate value. That's what's clear, and immediate, and present. If you look right now, if you wanted to just do a little Google and multiple-listing search and look for two-acre residential properties in Camp Verde, you're going to find that the ones that are irrigated are going to be two to three, and possibly even more, times more valuable, higher priced. It's a fundamental difference in your real estate.” – Consultant/educator, AZ 23

Uncertainty. Many participants described a high degree of uncertainty around the adjudication, including how water rights will be prioritized and quantified, who will have water rights in the end, and when changes will take effect.

“Look, and the Verde, it's, it's a hard system because, it seems like it's so simple, you know, it's like, oh, you have this water issue, you don't have adjudication. But, you have these complexities around surface water, development and groundwater, and the lack of regulation that really drive a lot of these challenges are just all starting to come together and become more of an issue... So, people don't want more rules per se... [M]ost people would not articulate it as we want adjudication. But, most people want certainty. And, most people are starting understand what uncertainty means to them.” – Conservation group representative, AZ 1

“Pretty much everybody doesn't know what [water rights] they have legally. Mostly surface water users don't know whether their claim is valid and where it falls in the priority of the Verde. Groundwater pumpers don't know if they're pumping subflow, and if they are pumping subflow, they don't know what the consequences of that are going to be, if anything and when. And groundwater users who are really far from the river, mostly don't know for sure that their neighbor isn't going to drill a well that drives theirs down, down the line. So nobody knows what they have. And I would say that actually there's a large group of people who don't even know they don't know what they have, and who've just heard lots of rumors.” – Consultant/educator, AZ 33

“...the water rights really have never been determined. So, quantification of irrigation rights or of any right, under Arizona law is the beneficial use of the water. The problem is, is beneficial use is a very broad term. And different crops use different amounts of water. And there's... there's all kinds of components to beneficial use. There's carriage water, there's consumptive use, there's field efficiencies, there's all these things that factor into how much water a farmer really needs to use. And everybody's different on the ditch.” – State/federal official, AZ 18

“...we're not sure how, you know, how good our water rights, or how they're gonna stand up because I've seen through the adjudications [in southern Arizona], I've seen some, some water rights taken away, you know? And everybody thought we had, they had good adjust, I mean, good records and good, good adjudication.” – Rancher, AZ 27

“...almost every [person] that I sit down with, they say, ‘well, am I going to lose my right? Is someone going to take away my rights?’ The thing is, is everything is so uncertain now and this adjudication has been going on for, you know, almost 40 years. So, it's, it's kind of one of those things that I, I can't say. I can say potentially that your right might be challenged because it doesn't have that historic usage. But there is a lot of uncertainty when it comes to the actual ramifications of the well usage versus the surface water versus wells that are taking subflow. There's just all this technical stuff that I don't know when or if the court will ever be able to sort through that.” – Consultant/educator, AZ 16

“It [the adjudication] leaves a lot of uncertainty there. Nobody's willing to take it on and say this is what we're going to do. The water master, I do think there's been more money allocated for to get it done and I think there's even a move to get several water masters going, and to get it adjudicated and get it over with. It's been dragging on way too long. Longer it drags on the harder it will be to resolve. So, legislators have a job to fund it properly. And maybe they will.” – State/federal official, AZ 39

Forfeiture. Under Arizona’s law on forfeiture (also referred to as “use it or lose it”) when a landowner fails to beneficially use a surface water right for five successive years, the right may be relinquished.⁹ This law will be a factor in how rights are assessed in the adjudication. Participants discussed how the fear of losing water rights claims due to forfeiture encourages landowners to irrigate more than necessary, and discourages efficiency improvements. The forfeiture law complicates efforts to improve water efficiency in the Verde Valley.

“They [property owners] are hesitant on improving their irrigation systems because that's showing that they can offer it off of a lower flow. And so when the water does get adjudicated, they would get - in their view, they would get a lesser amount allocated to them because of what they're currently using... So, there's been, you know, situations where they're not looking at the most efficient system. They still wanna make improvements. But, there's, you know, they'd be more hesitant to go to drip versus some type of other system that has more surface flows... I think it's all, you know, just a lot of confusion in the [adjudication] process and it's been going on forever. But they don't wanna get caught in that situation where they're pretty much probably in their views, condemned forever with, you know, having a lower allocation.”
– State/federal official, AZ 29

“One of the big problems is that people have bought their ranchette. It's irrigated, it's got a water right. They paid for that water right. Gosh darn it, they're gonna use it. Because they paid for it. And if they don't use it, [they think] the government's gonna take it away...”
– Consultant/educator, AZ 9

“There are people that probably have historic water use right now that aren't irrigating, who are pretty consistently bombarded with that message, to use it or lose it.”
– Consultant/educator, AZ 23

“I think the use it or lose it kind of concept or framework to our law is flawed from a conservation perspective, you know? Because it forces people to waste water to hold onto their legal rights, you know?... I can't tell you how often I find people are just, ‘oh yeah, we were turning this well on and irrigating this land,’ or, ‘I need to find somebody to come and graze this or whatever because I don't want to lose my rights.’” – Farmer, AZ 36

“...use it or lose it is a really overarching issue. You can't convince people to save water if they're afraid that they're going to lose their right to it. So that I don't know how to get around. I have not been able to figure that out. We've been talking about it for years... you run up against that wall and I personally don't want to see surface water rights lost from the Verde Valley.”
– Conservation group representative, AZ 40

“...if you're on a small farm and you have an allocation of a 100, let's say a 100 acre-feet and you need 70 to grow your crops, well, guess what: the understanding that that water user has [is], ‘if I don't use my full 100 I'm going to lose it.’ And so, it doesn't matter what they do with that other 30 acre-feet, they're going to use it whether they need it or not. So, to me, our legislature needs to give us the maximum flexibility in talking about credits or being able to recharge the aquifer and not lose that opportunity and the flexibility.” – Local/county government official, AZ 38

⁹ Ariz. Rev. Stat. § 45-188. There is a question whether the forfeiture rule applies to water rights established before 1919, when Arizona enacted its first water code.

Adjudication as a fight. There is a lot at stake in the adjudication. Many participants characterized the adjudication as a conflict or fight. Several mentioned that water claimants commonly feel the need to defend their water from other users. Several described the expectation that there will be winners and losers in the adjudication.

“...[W]ater rights is the first thing. You know. There's, there's big fights over that, and adjudication of who has the water rights and who doesn't have the water rights.”
– Rancher, AZ 27

“The adjudication reinforced the concept that this is a fight... some are gonna win and lots are gonna lose. And, it, in that kind of dog-fight mentality, it was a, ‘Get what you can now. Claim more than you need, use more than you need. Do everything you can, Because the more you're using, and the more you're claiming, and the more you're... the more, more, more, is going to put you on the winner's side in the adjudication.’ That shouldn't be the message...”
– Consultant/educator, AZ 23

“...people have this water rights thing that, don't mess with it no matter what. I mean, the river could dry up and they would still never give up their water rights. So, there's... water issues are pretty major around here. People who have it are gonna keep it, and they're gonna keep their green grass no matter what.” – Local/county government official, AZ 7

Phoenix area and SRP. These tensions extend beyond the Verde Valley to the greater Phoenix area. Phoenix water users are also claimants in the adjudication, primarily through SRP. Some participants described the Phoenix area's population growth and water demand as a threat to Verde Valley water users. For example, some felt there was an expectation that Verde Valley water users should decrease their water use so that the Phoenix population can grow, and/or put water to non-essential uses (such as lush landscaping, swimming pools, golf courses). Participants did not generally distinguish between growth in the SRP service territory (where water demand has declined since 1957; see Lane, 2018) and the rest of greater Phoenix (where water demand is met with Colorado River water and groundwater supplies). Several participants cited past legal actions that SRP took against a limited number of Verde Valley water users whom SRP alleged were misappropriating water to which SRP shareholders were entitled. In contrast with those who characterized Phoenix and SRP as a threat, some participants described SRP as a partner in maintaining Verde River flows. Others recognized SRP's right to protect its claims, like any other claimant in the adjudication.

“These water rights have value and we're not going to just let SRP come and take things from us without some kind of idea about what we're giving up and whether we have the right to hold on to things.” – Farmer, AZ 36

“Phoenix is growing and growing and growing and they don't care who they rape to get water...And that's what the biggest fear is for people like us... You know, I mean, we're getting along. Over where I'm at we're just fine. Leave us alone.” – Agricultural representative, AZ 25

“That's another problem I got. You go to Phoenix, you fly over Phoenix, Tempe, Mesa, Scottsdale, all of 'em. Look at all them private swimming pools. And look at all them golf

courses... But it's not a beneficial use. Why do they need 'em? For their relaxation... If they can say, 'Well, you ain't using the water up here, we're gonna take it, 'cause we wanna fill a swimming pool or put water on a golf course.' Bull. You know? That's not right. If they were using it for a farm, I could agree with 'em, because, farmers feed the people. That swimming pool and them golf courses don't feed the people.” – Ditch manager, AZ 30a

“I think, generally speaking, the rural [Arizonans] do feel that way about, you know, when people show up and they're not coming up to visit... We know we're on the back end of the water conversation. We know we're at the bottom of the list when it comes to who's water it is. Mostly because SRP has told us that for decades. So, I think that that's a problem because this is a trust issue. So, whenever they hear somebody say, 'let's have a water conversation,' that usually means that you want to take ours. Nobody's putting it back, you know.” – State/federal official, AZ 37

“It [the adjudication] will have zero impact... Because as soon as they [rights] are adjudicated, they will belong to SRP. Zero impact. You all can stand around and fight. That's why I'm not really religious about getting involved, because in the long run... SRP is just gonna go [snatching hand motion]. You're wasting your time.” – Rancher, AZ 32

“One of the big challenges is that people have this thought... ‘the adjudication is just how SRP takes my water right, so that's bad.’ And, that's not the case because... [Verde Valley claimants are] all [mostly] senior to SRP... It does appear and feel like SRP's taking your water, even though they're not really. They're just trying to protect their downstream interests...”
– Conservation group representative, AZ 1

“...it isn't that SRP, I don't believe that they're being malicious. I think they're just following their legal right; they're just exercising their legal right to protect their shareholders. Basically, under Arizona water law, you have the right to contest the use of an upstream user, you know... And they're downstream, so, that's it.” – Ditch manager, AZ 30b

“...their [SRP's] meaning in life is to bring water to Maricopa County, right? That's what they are. They're a water provider... And as long as the water keeps flowing here, they'll do whatever they can to make sure it continues to flow. So, in reality that eight-hundred-pound gorilla down there has become my friend because I can use their, if you will, deep pockets to try to eliminate water shortages on the surface... especially on the Verde.”
– Local/county government official, AZ 35

Public understanding. Some participants described the general public's understanding of the adjudication and water rights as limited. This limited understanding may exacerbate the sense of conflict around the adjudication. Participants cited common misperceptions, including that landowners and water claimants already have clearly defined water rights (despite that the adjudication is ongoing), or that surface irrigators have water rights through their ditch, or “ditch rights” (despite that water rights claims are based on the date that an individual property was first irrigated, not the date the ditch conveyance system was constructed). Some residents believe that all water rights function like private property rights (under Arizona law, surface water rights are property rights, meaning they are protected from being taken away by the government. In contrast, there is no right of ownership to groundwater prior to its capture and

withdrawal; the right of the landowner is simply to the use of the water).¹⁰ There is poor understanding of how a surface water right is established and how it is documented for the purposes of the adjudication. Most properties have different owners now than when the adjudication began in 1974; thus, current landowners may be unaware of actions that previous owners took in the adjudication, such as filing a statement of claimant, or compiling evidence for the date of the water claim on their property. Current owners may be unaware of the adjudication process, and/or the importance of related documents. The ambiguity around whether/how forfeiture will factor in contributes to the confusion around historic use. Furthermore, there is little official information geared toward helping the general public understand water rights and the adjudication. People in the Verde Valley may get snippets of official and unofficial information from multiple sources, including neighbors, community groups, lawyers, ditch managers, SRP, the Arizona Department of Water Resources (ADWR) and the Maricopa County Superior Court. Newer landowners, including those with historic water claims, described finding it difficult to understand the adjudication, to find helpful information about the adjudication, and to identify which actions (if any) they need to take as claimants.

“...one other way that the lack of education makes it hard to change the status quo is that... there's actually a chance that some people will find out that they don't have what they think they have [in terms of water rights or the ability to use water long-term]. And thus, you have a certain set of people who would rather not look. Would rather not find out. And would rather not make any changes, because changes would imply that you'd have to look.”
– Consultant/educator, AZ 33

“A lot of people have no idea [how their water right is defined], they just think they have a ditch right and that's not actually a thing. But their lawyer told them it was and so, that's another huge issue is people are doing this like family law practice guy who talks about ditch rights, which aren't actually a thing. And so, there's a lot of misinformation... I can't imagine, like a landowner or a homeowner or, you know, the average person trying to go onto DWR's webpage and solve a problem. So, that becomes, you know, the huge issue.”
– Conservation group representative, AZ 1

“...a lot of these folks are on wells or have struggled because they've got to dig their wells deeper, you know, and so the power costs more, so the water cost more... and they think it's theirs. There is this natural affinity to 'I've put this hole in the ground, I just spent twenty thousand dollars, don't tell me I can't pump this water.' Now they are starting to get this sense like, 'What do you mean everybody, this water is not mine?' I think... there's a fear about you know, the drought...and there is a lot of attention to our rivers and not just the Verde... Everybody wants them [landowners] to be, you know, to be well taken care of. But they're worried about a, you know, an urban grab... But first it's... 'Hey, am I going to be able to have water here?' You know, to them it will be about, 'If I'm not getting it, who is?'” – State/federal official, AZ 37

“You'll hear the term 'grandfathered' a lot, and I think it gets used really loosely, I mean, I know that it has a legal connotation as well, but you will hear someone... say that their right is grandfathered, because the person before them was doing that, even if it was just five or ten or 50

¹⁰ *Town of Chino Valley v. City of Prescott*, 638 P.2d 1324, 1328 (Ariz. 1981).

years ago. And, so, there's a lot of perpetuation of misunderstanding around the water rights and the historic use.” – Consultant/educator, AZ 23

“Anybody that has a water certificate or a claim... they are caught in the middle from all of this. These are the people that are affected by the decisions of all these people that they have no say in, and they're not invited. Department of Water Resources ought to have to send a letter every time something happens that affects their rights, and they don't.” – Rancher, AZ 32

“...to understand that there is actually something still happening, and the next zone if adjudicated would be the Verde Valley and the surrounding area, was fairly shocking. Very surprising. Because no one I talked to in the neighborhood has mentioned that at all... but those are also second generation third generation owners. I don't know if they really realize it. Everyone knows about 1980 [Groundwater Management Act] and people have their paperwork, but I don't think anyone locally that I know has ever talked about, ‘Wow, you know, this is still going on.’ It's not exactly coffee and cinnamon roll conversation... However, you know, if there are preventative or measures that we should be doing to exercise our rights more completely, that would be good to know... So, I'm still, I think, in the information gathering phase so to speak to be like, okay, what's out there?... And the call to action is vague. You know, I mean, it's, okay the adjudication isn't over, I get that. What does that mean? What do I need, what should I be doing as a residential water owner? Those type of next steps are unclear to me right now. I know that I need to do something. I have not yet defined what that is.” – Farmer, AZ 43

Interview Participants' Project Suggestions: A summary

Education and outreach suggestions

- For real estate brokers and agents:
 - o How to accurately document a property's water claims or rights, based in Arizona statutes, and legal disclosures of ongoing lawsuits and adjudication
 - o The questions they need to ask property sellers
- For legislators and local elected officials:
 - o The value of the Verde River and maintaining flows
 - o Thorough background on water issues
- For residential irrigators:
 - o Importance of water conservation
 - o Best practices for irrigation and landscape management: how much and how often to irrigate; cost effective strategies
 - o Crop and landscaping choices: native species and crops/plants that grow well in the Verde Valley
 - o Bermuda grass removal or replacement

- For students and educators:
 - Develop more curriculum around water.
 - Build on Project Wet (fourth grade water education in the Verde Valley)

- For newer Verde Valley residents:
 - Best practices for rural living

- For the public:
 - The value of the Verde River and maintaining flows
 - Factual information about ecology, hydrology, agriculture, the ditch system, etc. of the Verde Valley
 - Factual information about the adjudication, other ongoing lawsuits related to land/water conflicts
 - The value of agriculture for the community, in terms of property values, sense of place, economy, etc.
 - How to be a good steward of public land (such as cleaning up after your dog, packing out trash, etc.)

- For ranchers:
 - Trainings on regulations and scientific information related to regulations

Applied project suggestions

- Explore opportunities for partnering among neighbors on land easements
- Establish markets for low-water-use crops
- Find funding for irrigation infrastructure and increased water efficiency
- Work together with key stakeholders toward settling the adjudication
 - Explore opportunities for sever and transfer
- Manage vegetative growth along the river to reduce potential flood damage
 - Work with federal and state agencies involved with river and watershed management
- Manage salt cedars and other invasive species in the Verde River Watershed
- Provide parcel-level assessments of historic water use

Research and data suggestions

- Study the factors affecting water infiltration on ditches
- Compare annual water use of different land uses and agricultural products
- Conduct field-tests of low-water-use crops such as quinoa, millet, teff, okra, etc.
Measure yield per acre, water use per acre
- Identify best practices for crop switching (for example, from Bermuda grass to other crops)
- Compare health of river/riparian area where there is no livestock with areas where there is livestock
- Document how Arizona's water laws (such as forfeiture) affect parcel-level water use and property values; explore how alternative ways of managing water (such as the Verde River Exchange, or establishing an Active Management Area) could affect parcel-level water use and property values
- Monitor flows at the headwaters of the Verde River
- Monitor river turbidity and causes of turbidity
- Monitor parcel-level irrigation/outdoor water use
- Data sharing and compilation:
 - o Compile scientifically valid data, information, and reports, and make it available to the public.
 - o Compile data points as a starting point for discussion/engagement, such as number of wells, wells on historically irrigated land, number of wells in subflow zone, water flow in ditches
 - o Develop a model with existing data so the public can play with it, understand and discuss it; assess validity. Weed out "noise" of invalid data. Refine the model with the valid data for better understanding of the current situation.
 - o Make information about historically irrigated lands publically available; compare with currently irrigated lands
- Conduct poll or survey to identify what people know and don't know about water and the adjudication. Use this information for more targeted education efforts.
- Explore how reclaimed water augments existing groundwater and/or surface water supplies; potential advantages, disadvantages, and risks of expanding use of reclaimed water

Survey Results: Information interests and data gaps

The results of the survey revealed that there are diverse information interests and data/knowledge gaps around water and agriculture in the Verde Valley. No issue or topic emerged with support from a majority of participants. As shown in Figure 2, the top information interest was water rights and settlements, with 17 participants (46%) identifying it as one of their top three interests. In second is the issue of competing demands and values for water and land (such as urban growth, tourism), with 15 votes (40%).

On knowledge and data gaps (Figure 3), the top two issues were best management practices (14 votes, or 37% of participants naming it as a critical gap in knowledge or data) and local hydrology (12 votes, or 32%). Five different issues received votes from 8-9 participants, suggesting that there are multiple gaps, and/or multiple perspectives on what the gaps are.

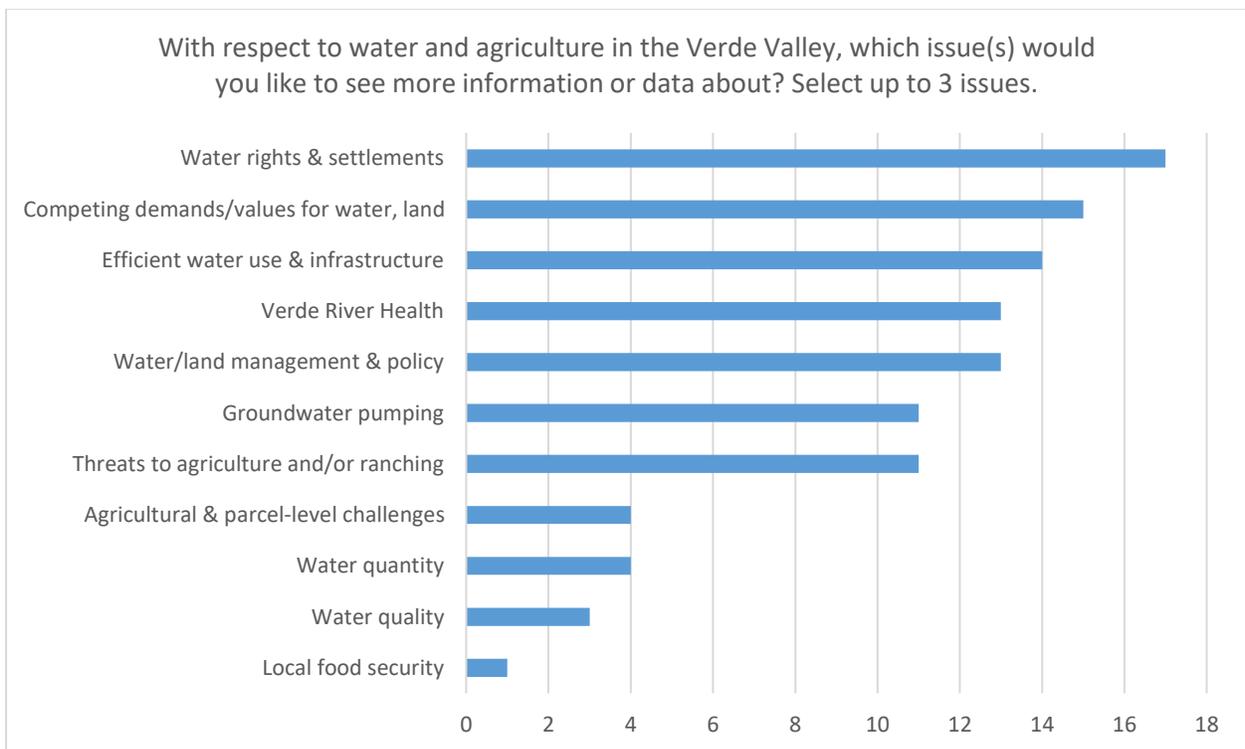


Figure 2. Top information interests related to agriculture and water in the Verde Valley.

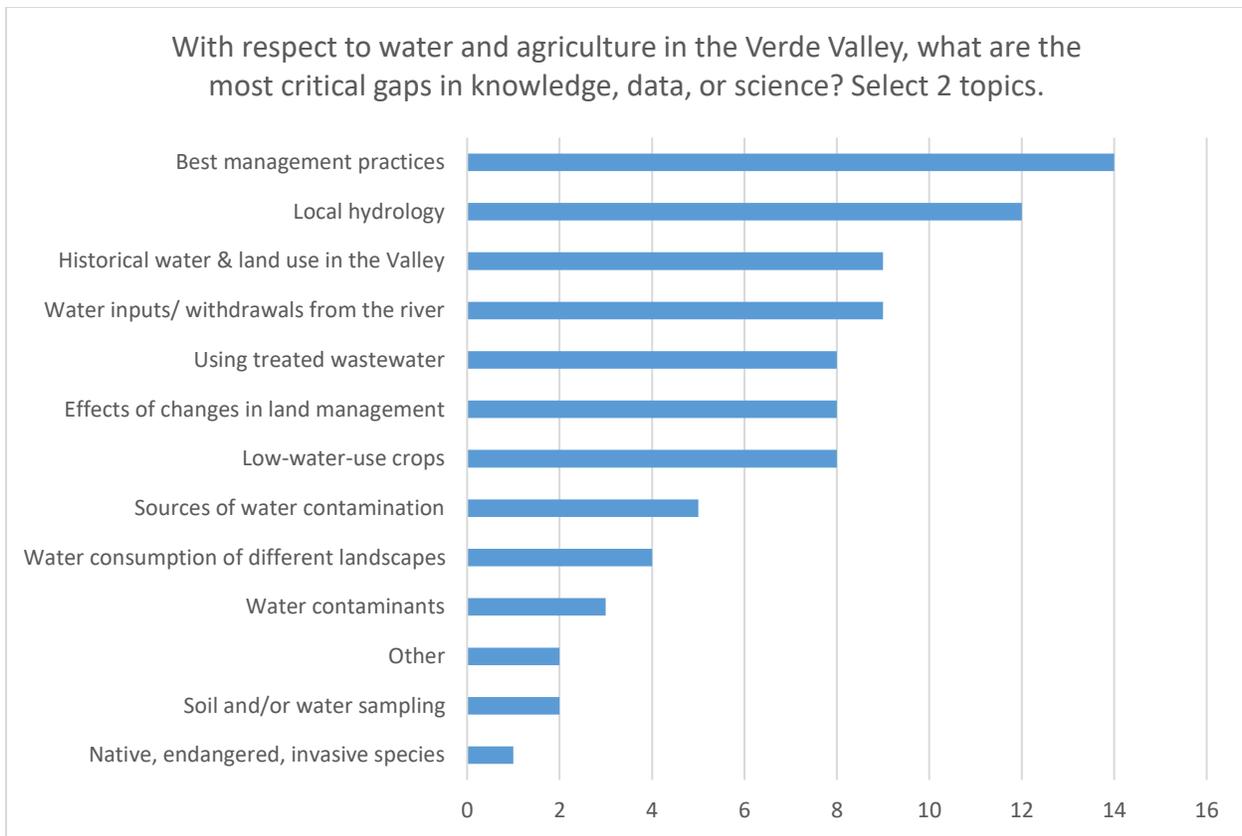


Figure 3. Top knowledge and information gaps related to agriculture and water in the Verde Valley.

Other:

- *Transitioning of water and land knowledge from historical to new land owners*
- *Scientifically backed land management, lack of science in all evaluations, too much emotional response without proof.*

Survey comments

It was difficult to choose priorities because most listed issues are interactive with each other.

Anything to secure our water rights will help

Farmers and ranchers are stewards of water conservation. This is our livelihood, without water food goes away.

Public needs to be educated regarding water rights which are a property right. All stakeholders must be at the table regarding any water discussions. Increased plant density (trees, shrubs and other plants) in the river/creek bottoms are not only reducing surface water flows, but are also causing a severe flooding issues for property owners along the rivers and creeks in the Verde Valley. When the trees leaf out, surface flows are reduced in all rivers and creeks in the Verde Valley.

There has been no long-term data compilation on: Actual use of groundwater both in the big chino or in the verde valley (available from ADWR). Actual tree counts both for the entire watershed and in the river bottoms water use (non-historic and a direct illegal diversion of water in the river bottoms) Actual historic rainfall and snow pack since data collection began, and then a correlation between these factors and actual flows plotted on a yearly graph. This documentation will clearly demonstrate what happened to the surface water, where it went and how to remedy environmental policy enacted contrary to scientific knowledge, probability and actual occurrence.

Understanding our groundwater supplies is critical to helping the Verde River survive. Future groundwater management will be necessary to success.

Concern re: new development- erroneous info re: farming.

It would be great to have more info on water management, water rights, and be directed at water users.

One of my concerns is our future water supply. Overdevelopment near the headwaters of the Verde River will affect all users downstream.

I have an idea about public education material I'd like to put together. "Living responsibly" (~20-30 pages)

Considering the balance between needed growth and the impact on the water source is important. Growth in housing and the various industries in the VV provide economic growth. What are the impacts on water availability and what are the best practices to maximize growth while minimizing the impacts?

Regarding data gaps I think the lack of data regarding groundwater withdrawals and aquifer characteristics in the Verde River Watershed is often a roadblock in many conversations. Many different people have different ideas about how much water is being extracted, how much water is in the aquifer, and how it impacts the Verde River. Also lacking is an understanding of what groundwater management programs exist in other states or even other countries. Arizona's groundwater laws are unique, but the groundwater problem is not.

There are many diverse interests that benefit from the water resources within the Verde Valley, including interests downstream (FS, FMIC, SRP, Phoenix area cities, etc.). We need to find better ways to share these resources through collaboration, open communication, and move away from the contentious rural v urban arguments we hear so often.

Conclusions

It is our hope that this summary of stakeholder perspectives on agriculture and water can be a starting point for discussions about shared interests, diverging perspectives, potential collaborations, and community-driven research and outreach in the Verde Valley. We hope to receive feedback from project participants and other stakeholders to further refine the accuracy, relevancy, and utility of this report.

In the next phase of the *Water for Agriculture* Project, we will use the perspectives outlined here, as well as the feedback we get on this report, as a foundation for developing a community-driven research project and/or outreach project. We will work with a small team of community members to identify goals for agriculture and water in the Verde Valley, and design and implement a project that aims to address those goals.

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