# Coordination and Power in Water Governance: The Case of Prescott Active Management Area

by

Deborah Olufunmilola Ayodele

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved October 2017 by the
Graduate Supervisory Committee:

Kelli L. Larson, Chair
Robert Bolin
David Manuel-Navarrete

ARIZONA STATE UNIVERSITY

December 2017

ABSTRACT

Studies of governance have focused on the interactions among diverse actors while implicitly recognizing the role of power within those relationships. Explicit power analyses of water governance coordination are needed to better understand the conditions for and barriers to sustainability. I therefore utilized a novel conceptual framework to analyze vertical and horizontal governance, along with power, to address how governance interactions affect water sustainability in terms of (1) interactions among governance actors across local to state levels; (2) coordination among actors at the local level; and (3) the exercise of power among assorted actors. I adopted a qualitative case study methodology that involved triangulating interview transcripts, policy documents, and other data in the case study area of Prescott, Arizona.

Across governance scales, my analysis found that informational and contentious interactions occur around water management plans, groundwater withdrawal fees, and growth debates due to the stipulations of Arizona's Groundwater Management Act. Locally, municipalities in different groundwater basins coordinate by pooling resources for water development due to shared growth visions. However, municipalities within the same groundwater basin are divided in their pursuit of the state-mandated goal of safe yield due to discontent arising from differing growth visions, libertarian values of water control, and unequal responsibilities among actors in conserving water or monitoring use. Finally, local and state actors exercise power through litigation, legislation, and political processes to pursue their interests, thereby limiting coordination for water sustainability.

My explicit analysis of power reveals that coordination occurs not just because of water policies but due to interest-based water narratives (growth and libertarian). The

emphasis of growth proponents on supply augmentation and libertarian opposition to regulations pose significant barriers to water sustainability. Successful policy-based pursuits of water sustainability will, thus, require an acknowledgment of these management asymmetries and commitments to addressing them.

ACKNOWLEDGMENTS

I gratefully acknowledge the guidance of my chair and committee: Dr. Kelli Larson (chair), Dr. Bob Bolin, and Dr. David Manuel-Navarrete. Thank you, Kelli, for your timely, clear, and thoughtful feedback. Your feedback, and the many challenging questions you asked, have improved this work. Thank you, Bob, for introducing me to social science and political ecology theories. The critical comments and insights you provided in the course of this research have helped give this dissertation depth. Thank you, David, for the opportunities to discuss my research with you. Those meetings helped me clarify my ideas and have enriched this work.

I also want to thank every individual I interviewed for this research. In taking the time to answer my questions, you enriched my understanding of Arizona water issues and hence, this research.

In addition, I gratefully acknowledge support from the School of Geographical Sciences and Urban Planning, AZ Water Association, Melvin G. Marcus Memorial Fellowship, the Graduate and Professional Students Association at Arizona State University, and Campus Christian Center (C3). Thank you for providing financial and other resources instrumental in completing this project.

Finally, I am indebted to my family, friends, mentors, and colleagues whose support has been invaluable during my doctoral program. Thank you for celebrating my milestones and offering encouragement, advise, and a listening ear in challenging times. I truly and sincerely appreciate you.

TABLE OF CONTENTS

Page

APPENDIX Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

# CHAPTER 1

## INTRODUCTION

Studies of governance coordination have focused on the interplay between and integration of governance actors, while implicitly recognizing the role of power within those relationships. Yet, explicit power analysis within studies of water governance coordination is important to better understand the conditions for and barriers to water sustainability. To address this research gap, I utilize a novel conceptual framework that combines propositions of vertical governance, horizontal governance, and power, to answer the following questions: (1) What interactions exist among governance actors involved in water management across local to state levels, and how do these interactions affect sustainable water governance? (2) In what ways do actors at the local level coordinate (or not) in governing water resources, and how do these interactions affect sustainable water governance? (3) How is power exercised among a variety of water governance actors across levels, and what are the implications for sustainable water governance?

My explicit analysis of power reveals that coordination occurs not just because of water policies but due to non-sustainability focused, interest-based water narratives (growth and libertarian). The emphasis of growth proponents on supply augmentation and libertarian opposition to regulations pose significant barriers to water sustainability. Successful policy-based pursuits of water sustainability will, thus, require an acknowledgment of these management asymmetries and commitments to addressing them.

## Problem Statement

The world's water crisis is increasingly due to inadequate or failed governance, as opposed to the physical scarcity of this critical resource (UN Water, 2006). Regardless, water scarcity is an issue threatening many regions of the world, whether rural or urban, and irrespective of geographic, economic, or social contexts (Swyngedouw, 2006; Wutich et al., 2014). Interestingly, water scarcity is not only a problem for arid regions but humid ones as well (Feldman, 2009). Rapid urbanization and changing climate, including their impacts on water quality and riparian ecosystem health, only exacerbate this water resource threat. Unfortunately, current water governance practices have proved insufficient in tackling these challenges.

Despite many attempts at water sustainability, no water system in the world has achieved this but many are in transitions towards sustainable water governance (Brown et al., 2009). Feldman (2012) argues, in his book *Water*, that freshwater sustainability is threatened by the struggle for geopolitical control, which result in conflicts among contending parties. This struggle for control is often seen between countries, states, and among different water users. Examples across the United States show that in resolving conflict among users and promoting water sustainability, many states create statutory institutions to guide water governance (Blomquist, 2016; Sophocleous, 2012) similar to the case in Arizona.

Conflicts among Arizona's water users including the federal government threat of cutting funds for the Central Arizona Project (CAP) led to the enactment of Arizona's 1980 Groundwater Management Act (GMA) (Connall, 1982). The Act was a result of concessions made by the state's major water users (agriculture, municipal, and industrial)

and has been shown to contain 'loop-holes' that constrain the state's water sustainability by increasing groundwater overdraft (Maguire, 2007). Arizona's GMA currently mandates the active management of water in *only five* urbanizing and urbanized areas of the state referred to as Active Management Areas (AMAs), while another *three* are designated as Irrigation Non-Expansion Areas (INA). The GMA mandates safe yield[1] in Prescott, Phoenix, and Tucson AMAs, although only Phoenix and Tucson AMAs receive Colorado River water. Despite this imported water, it is recognized that groundwater overdraft is increasing in both areas and would continue under current water management (Maguire, 2007)—a situation that is detrimental to the state's water sustainability.

Within Arizona, many studies have researched the arid metropolitan Phoenix region. These studies have focused on the sensitivity of water demand in the area to climatic parameters (Balling and Gober, 2007), vulnerability analysis of its water supply system (Bolin et al., 2010), determinants of water demand (Harlan et al., 2009; Wentz and Gober, 2007), [in]effectiveness of water policies (Hirt et al., 2008; Larson et al., 2009), simulation modeling to explore long-term impacts of different water governance regimes (Keeler et al., 2015), and a sustainability appraisal of Phoenix's water governance regime (Larson et al., 2013), to mention a few. The rationale for focusing on Phoenix is compelling given the fact that it is the 14$^{th}$ largest metropolitan area in the United States with a population of over 4.6 million people (U.S. Census Bureau, 2017). However, the interconnected nature of water resources makes research on places outside the Phoenix metropolitan area crucial, especially those areas connected to the Salt-Verde Watershed

[1] Safe yield is a state where water withdrawn from an aquifer equals recharge to it (Sophocleous, 1997). As a concept, safe yield is one metric for assessing groundwater governance but reflects only a partial view of water sustainability (Alley and Leake, 2004).

that supplies water to the Phoenix region. One such place is the greater Prescott area, where groundwater pumping threatens stream flows to downstream Phoenix.

Meanwhile, there are a few studies on water governance in the greater Prescott area. These studies have focused on vulnerability to water scarcity (Collins and Bolin, 2007), water, growth, and politics of scale in the Central Highlands (Bolin et al., 2008), information networks in the initial Verde River Basin Partnership (VRBP) (Muñoz-Erickson et al., 2010), ego networks in the VRBP (Cutts et al., 2010), power and politics in Yavapai County's water conflicts (Whitmire, 2013) among others. Despite these studies, not enough is known about the degree of coordination among water governance actors across levels related to the AMA. Also, there is a need to better understand to what degree the region's 'Active Management Area' status promotes water sustainability.

This focus on Prescott AMA is important because, first, the AMA relies heavily on dwindling non-renewable groundwater without access to adequate alternate surface water. Second, the area is experiencing persistent water conflicts due to planned water import from another sub-basin. Third, there are conflicts of interests between actors in the study area and a major downstream surface water rights holder ─ the Salt River Project (SRP). Finally, Prescott AMA's population is growing rapidly due to amenity migration and the pleasant climate (Figure 1). With focus on Prescott AMA, the purpose of this study is to assess the conditions for and barriers to water sustainability with respect to coordination among governance actors and their exercise of power. To accomplish this purpose, I integrate propositions of vertical governance, horizontal governance, and power while drawing from human-environment geography, political ecology, and socio-ecological governance literature.

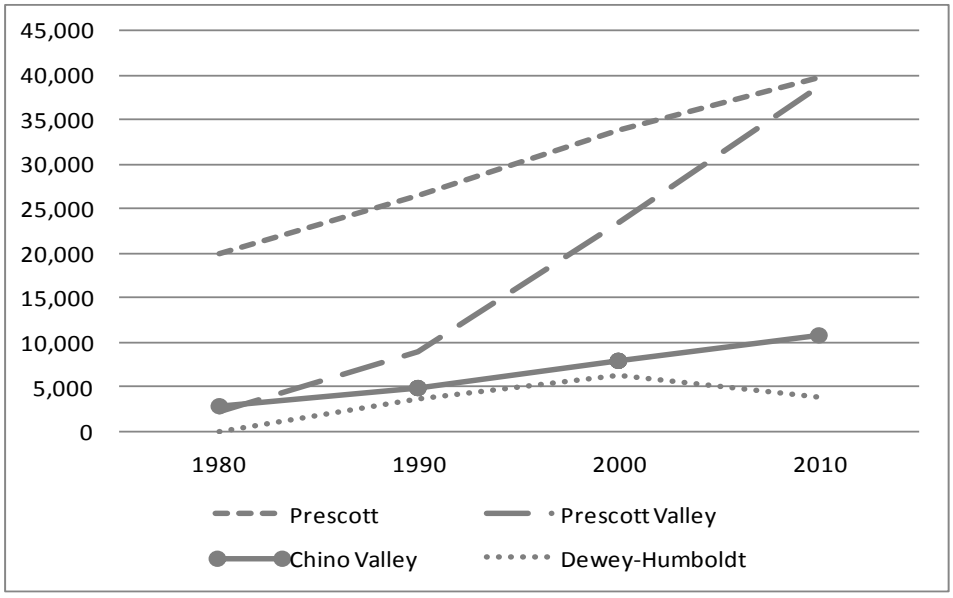


*Figure 1*. Population Growth in Prescott AMA Municipalities since 1980

**Research Questions and Methodology**

The resource governance literature calls for coordination among governance actors across jurisdictional levels (Young, 2006) and around specific issues (as occurs in collaborative governance) (Emerson et al., 2012). Similarly, research shows that water sustainability is influenced by the degree to which actors have power commensurate to their roles in water governance, and how such power is exercised within governance (Norman and Bakker, 2009, p. 112). In their study of groundwater governance, Knüppe and Pahl-Wostl (2011) evaluate vertical and horizontal integration across their case studies. Yet, a framework that combines vertical governance, horizontal governance, and power increases our understanding of the relationship between institutions and water sustainability in areas of persistent conflicts. In applying this novel framework in which the exercise of power is a key component of vertical and horizontal governance, this research examines issues of

coordination and power in water governance as it relates to water sustainability. With the focus on Prescott AMA as a case study, this study investigates the following research questions:

1. What interactions exist among governance actors involved in water management across local to state levels, and how do these interactions affect sustainable water governance?
2. In what ways do actors at the local level coordinate (or not) in governing water resources, and how do these interactions affect sustainable water governance?
3. How is power exercised among a variety of water governance actors across levels, and what are the implications for sustainable water governance?

Following a case study approach, I adopted a qualitative methodology for this research (Travers, 2001; Yin, 2013). I ensured robust analysis through the triangulation of documents, semi-structured interviews, direct observation and archival records. Data collected with these instruments were analyzed with text analysis methods. For the interviews, both government and non-government actors were interviewed to capture the spectrum of actors involved in water governance. Respondents were identified through a purposive method. The first part of the research involved assessing the interaction between governance actors across local (municipal), regional (AMA), and state levels; in the second part, I assessed interactions between governance actors at the local level. Finally, in the third part, I investigated how power is exercised at different levels of water governance in the study area.

**Research Framing and Significance**

Of the four main traditions within Geography, namely: environmental sciences; methods, models, and GIS; nature and society; and people, place and region (American Association of Geographers, 2017), I situate myself within the nature and society

tradition. Within this tradition, my research focuses on water resource governance. Water resource governance as a field of inquiry cuts across disciplinary boundaries (such as geography, political sciences, economics, anthropology, sociology) and exists within interdisciplinary clusters (such as sustainability science), due to the diverse nature of water resource issues. In this dissertation, I contribute to the field of water governance by drawing from human-environment geography, political ecology, and socio-ecological governance literature to investigate the extent to which institutions created for water governance promote water sustainability.

Using a research framework that integrates principles of sustainable water governance with theories of scale and power, this dissertation aims to refine insights on how different characteristics of vertical interactions in multilevel governance affect water sustainability. Specifically, this framework contributes to an understanding of the relationship between local level actors and those with regulatory authority and legitimacy at another level (Gupta and Pahl-Wostl, 2013; Markard et al., 2012). Also, this research provides essential information on the conditions surrounding collaborative endeavors around water—that is, which actors interact and why—that can be utilized and built upon by other studies on sustainable water governance in the study region (Larson et al., 2013).

Regarding the power analysis in this dissertation, first, I present a deductive process for analyzing power in water governance research by drawing on content analysis methods and building on Avelino and Rotmans' (2011) power framework. Next, I assess how different forms of power support or oppose decision making for sustainable water governance. Finally, I analyze the relationship between Prescott AMA's governance framework and water sustainability in the Central Highlands. Overall, I investigate how

power is exercised in water governance interactions. This investigation aims to provide insights on factors that promote or inhibit water sustainability and the practice of sustainable water governance.

**Study Area**

Prescott Active Management Area (AMA) is located within Yavapai County in Central Arizona. Locally known as the Quad-City Area, the Prescott AMA consists of four incorporated municipalities and other smaller communities (Figure 2). This research focused on these incorporated municipalities, which are the City of Prescott, Town of Prescott Valley, Town of Chino Valley, and Town of Dewey-Humboldt. Some of the smaller communities are mostly served by the City of Prescott municipal water system and so are implicitly included in the study through focus on the City of Prescott. Since 1980, population growth in the Quad-City Area has been significant despite the economic crisis that affected the entire state in 2008. This is in part due to amenity migration, especially the region's year-round pleasant climate. Between 1990 and 2010, total population in the area more than doubled, with the 2010 US Census reporting 93,376 residents (see Figure 1 above).

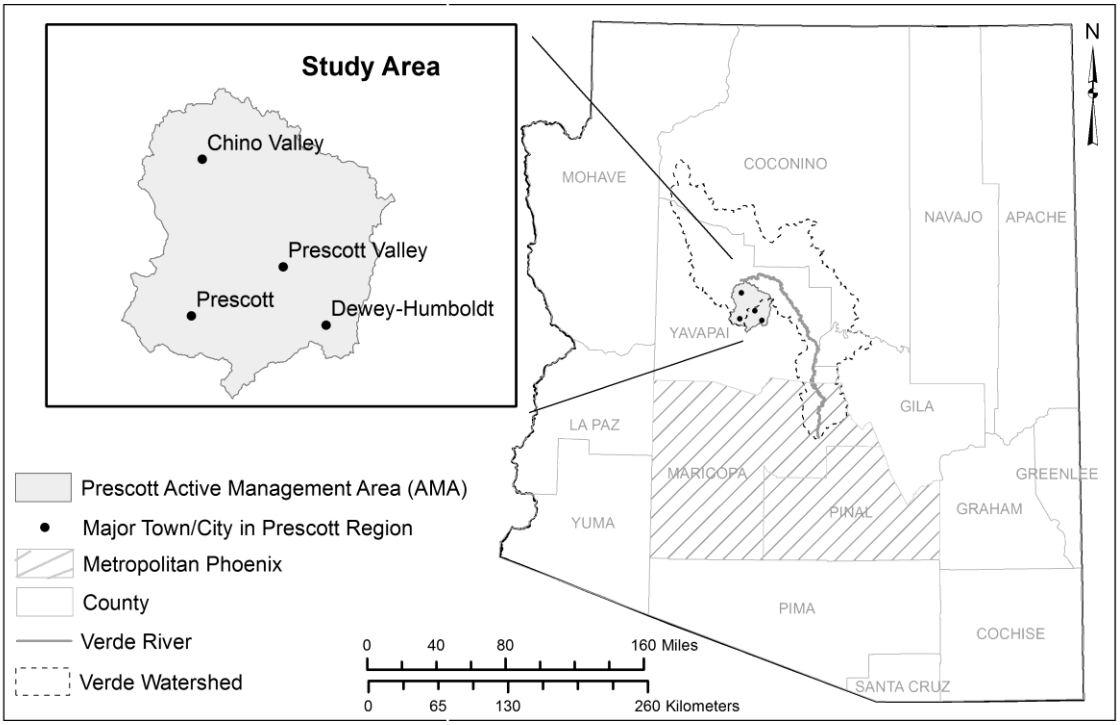


*Figure 2*. The Study Area: Prescott Active Management Area

In terms of physical characteristics, Prescott AMA is located in the central highlands physiographic province of Arizona. Geology in this province is characterized by crystalline and sedimentary rocks with different degrees of fracture networks leading to highly variable amounts of available groundwater (Anderson et al., 2007). Natural recharge is low and average annual rainfall in the area is about 18 inches (Arizona Department of Water Resources, 2009), resulting in groundwater resources that are largely non-renewable and finite (Anderson et al., 2007). Meanwhile, the area is drained by the Verde River and Agua Fria River. The Verde River is important not just to this region but to the entire state, as it is one of Arizona's last flowing perennial rivers.

Prescott AMA was created as a result of the Groundwater Management Act (GMA), which was passed by state legislature in 1980 and adopted in 1984. The GMA is

the leading policy for managing water resources in Arizona. The policy's goal is to stop groundwater overdraft in designated areas of the state by 2025, such that the amounts of water withdrawn from aquifers equal natural or artificial recharge ─ a state known as safe yield (Hirt et al., 2008; Larson et al., 2009). Pursuant to the GMA, the study area (Prescott AMA) has a water management goal of achieving safe yield by 2025 (Arizona Department of Water Resources, 2008).

The study area's ongoing attempt to secure alternate and external water resources (to supplement its groundwater) is through water import from a neighboring groundwater basin. In 1991, through amendments to the state's water management statutes, the City of Prescott received exemptions to import water from the neighboring Big Chino basin (Arizona State Legislature, 2017; Town of Prescott Valley, n.d.a). However, water import from the Big Chino has been stalled due to disputes with a major surface water rights holder downstream – Salt River Project (SRP) – which supplies water to the downstream Phoenix metropolitan area (the 14$^{th}$ largest metropolis in the United States). This dispute is constructed around the hydrologic connection between groundwater and surface water, a connection that is not recognized by Arizona water laws. The City of Prescott (and its project partner, Prescott Valley) have claimed that their pumping in the Big Chino will not affect water flows in the Verde River while SRP claims that its rightful allocation from the Verde River will be affected by planned Big Chino pumping upstream (Bolin et al., 2008). The City of Prescott has rights to Watson and Willow Lakes which receive water from Granite Creek (a tributary of the Verde River) but with the absence of adequate surface water supplies and the stalled water import from the Big Chino, the region as a whole continues to rely heavily on its dwindling, non-renewable groundwater.

## Organization of Dissertation

This dissertation is organized into five chapters. In Chapter 2, I review the literature on vertical governance, horizontal governance, and power. In Chapter 3, I provide a detailed exposition of the methods adopted in the study's qualitative approach. Chapter 4 comprises the results obtained from analyzing the project's primary and secondary data. Finally, in Chapter 5 I present first, a discussion of the project's findings in relation to previous studies. Second, I provide concluding thoughts that summarize the core findings and implications of this water governance research.

# CHAPTER 2

# LITERATURE REVIEW

In this chapter, I review literature pertinent to this water governance research. The chapter is organized into three main parts. In the first part, I review the literature influencing my conceptualization of water governance. In the second part, I summarize and review previous water resource research in the Central Highland region of Arizona, focusing on studies within the past decade. Finally, I review the literature which comprises the conceptual framework for this dissertation, namely: vertical governance, horizontal governance, and power dynamics in water governance.

## Conceptualizing Water Governance

In recent years, a number of water resource scholars have defined governance (Bakker, 2010; McKay, 2007). Bakker (2010) defines governance as "the range of political, organizational, and administrative processes through which stakeholders (including citizens and interest groups) articulate their interests, exercise their legal rights, make decisions, meet their obligations, and mediate their differences" (p. 44). In other words, governance involves decision-making by *both* government and non-government actors.

Regarding water resources, the shift from 'government' to 'governance' seeks to address the wide array of actors who are involved in water resource decision-making, such as various water users, non-profit organizations, and business interests. This shift in academic discourse from government to governance has occurred to reflect changes that are occurring in the management of water resources (Norman, 2012; Pahl-Wostl, 2009).

Specifically, the shift in discourse reflects the increasing attention given to non-government actors such as non-profit organizations and private businesses—in environmental governance and decision-making. Also, devolution of management has taken place, resulting in increased citizen participation through, for example, water advocacy groups at the local level and watershed organizations at the regional level. Basically, local community actors such as civil society and environmental groups now play more active roles in water management than they did in the past when water management mainly involved technocrats.

Distinctions are also being made in water resource literature between water management and water governance. Water management places an emphasis on activities such as analyzing, monitoring, developing, and implementing measures that keep water resources within desirable limits, while water governance includes the actors that formulate and help implement the rules under which management takes place (Lubell et al., 2009; Pahl-Wostl, 2009; Wiek and Larson, 2012). In other words, water management involves the activities of specific actor groups such as water utilities in monitoring, developing, and providing water, while water governance involves all actors that make up the socio-ecological water system (Pahl-Wostl, 2009; Van der Brugge and Rotmans, 2007; Wiek and Larson, 2012). Governance actors include both the water utilities (government actors) and water users (non-government actors). Thus, water governance provides a broader framing for water resource decision making.

**Water Sustainability.** Defined simply, water sustainability is the provisioning of water for present human and ecological uses while ensuring adequate supply for future generations, and ecology (Larsen and Gujer, 1997; Marshall et al., 2010; Wiek and

Larson, 2012). Research shows that no water system has fully achieved sustainability but many are transitioning towards sustainable water governance (Brown et al., 2009). Yet, transitions do not just happen. Instead, practical implementation, coordination between all stakeholders, and active participation of local level non-government actors are needed for sustainability visions to be accomplished (Nastar, 2014; Van der Brugge et al., 2005). In their assessment of the Dutch water sector, Van der Brugge and Van Raak (2007) conclude that in addition to implementing strategic visions, a joint learning process amenable to experimentation and aimed at developing innovations were needed to achieve water sustainability. They further argue that successful transitions require a coordinated process that involves cooperation among governance (both government and non-government) actors.

Water sustainability generally requires moving from socio-ecologically unsustainable practices to sustainable ones. In contributing to a solution-oriented water sustainability, Wiek and Larson (2012) argue that:

> The ultimate goal is to transition to water governance regimes that better comply with sustainability principles: optimizing economic and social welfare in an equitable manner without compromising the viability and integrity of the supporting ecosystems in the long term. (p. 3169)

The foregoing quote aligns with the sustainable development vision outlined in the United Nations' Brundtland Report (World Commission on Environment and Development, 1987). Whereas in previous years, water managers were solely tasked with water resource activities, the renewed involvement of non-government actors in water governing activities necessitates changes in the traditional means of decision-making within the water sector. Cooperation is needed between government and non-government actors.

Many concepts are offered in water governance practice and studies to describe and prescribe pathways to water sustainability. I review the concepts central to this study in the upcoming sub-sections. Specifically, I review safe yield, integrated water resource management, and sustainable water governance.

***Safe Yield.*** In the early twentieth century, the concept of safe yield was advanced in hydrogeology for managing groundwater. According to Sophocleous (1997), safe yield is the "attainment and maintenance of a long-term balance between the amount of water withdrawn annually and the annual amount of recharge" (p. 1). However, many scholars argue that a safe-yield goal is inadequate for achieving water sustainability (Alley and Leake, 2004; Alley et al., 1999; Bredehoeft, 2002; Bredehoeft et al., 1982; Mays, 2013; Sophocleous, 1997; Theis, 1940). One of the main criticisms against this concept is that safe yield focuses on the balance between groundwater pumping and recharge, as the requirement for achieving sustainable groundwater use while ignoring natural groundwater discharge (e.g. to streams, or through evapotranspiration) (Bredehoeft, 1997; Bredehoeft, 2002; Sophocleous, 1997). Groundwater use that supports water sustainability is one that recognizes the interconnectedness of groundwater and surface water, along with hydrologic cycle processes such as evapotranspiration. Safe yield is deficient in these considerations (Bredehoeft, 2002). According to Sophocleous (1997), "if pumping equals recharge, eventually streams, marshes, and springs dry up. Continued pumping in excess of recharge also eventually depletes the aquifer" (p. 1). Thus, safe yield though having a guise of sustainability does not promote overall water sustainability as it could lead to surface water 'unsustainability'. Yet, safe yield continues to be applied

in groundwater management policies around the world (Kalf and Woolley, 2005) but is inadequate as a metric for water sustainability.

The study area (Prescott AMA) has a statutory water management goal of safe yield, a goal that is generally understood to be the region's tool for achieving water sustainability (Upper Verde River Watershed Protection Coalition, 2010). However, previous research and stakeholder publications regarding the region suggest that safe yield is not being achieved (Arizona Department of Water Resources, 2014a; Bolin et al., 2008; Upper Verde River Watershed Protection Coalition, 2010). Given the foregoing discussion, safe yield provides only a partial view of water sustainability whereas a comprehensive view is needed for ensuring sustainable water resources. In the following sub-sections, I review integrated water resource management and sustainable water governance which are two concepts advocated by water resource scholars for comprehensive water sustainability planning.

***Integrated Water Resource Management.*** Since the turn of the twentieth century, water scholars have advocated Integrated Water Resource Management (IWRM) as the method for effectively and sustainably managing water resources (Mukhtarov, 2008). IWRM includes features that scholars advocate as necessary for instituting sustainable water governance (Orlove and Caton, 2010). According to the Global Water Partnership (Global Water Partnership, 2000),

> IWRM is a process which promotes the co-ordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. (p. 14)

Due to the emphasis on coordination among different groups of political and social actors, IWRM is inherently a governance approach.

Integrated governance is needed because the dominant water governance model in practice is at-best fragmented, with little to inadequate coordination between government actors and other stakeholders (Biermann and Pattberg, 2008). This fragmentation in governance often involves little or no communication between different agencies whose decisions impact water sustainability (Zelli and Van Asselt, 2013). This limited communication is often the result of multiple agencies and water providers managing different aspects of water (Biermann et al., 2009). Furthermore, water flows across political boundaries and hence there are scalar mismatches in the hydrological functions of watersheds and boundaries of decision making. Yet, the pursuit of water sustainability makes participation (and integration) of government and non-government actors across sectors and scale imperative (Wiek and Larson, 2012).

One of IWRM's main features is that it advocates the integration of different water use sectors such as agriculture and municipal, among others (Orlove and Caton, 2010). This feature is in direct confrontation to the fragmentation generally found in water governance. Fragmentation in water governance is typically seen in the form of multiple government entities working at various scales and on different aspects of water resources without sufficient coordination between them (Biermann and Pattberg, 2008; Zelli and Van Asselt, 2013). Although IWRM has been contested and debated in terms of its ability to be operationalized in real-world water governance, it still serves as a standard for directing and assessing what constitutes 'good' governance of water resources (Biswas, 2004, 2008; Bouwer, 2000, 2002; Grigg, 2008; Medema et al., 2008; Rahaman and Varis, 2005; Van der Zaag, 2005). Fragmentation can be decreased through coordination of activities among stakeholders.

***Sustainable Water Governance Principles.*** In an attempt to provide a comprehensive coverage of the varying aspects of water sustainability, Wiek and Larson (2012) define sustainable water governance as:

> the process that involves all relevant stakeholder groups in coordinating the water-related supply, delivery, use, and outflow activities in a way that ensures a sufficient and equitable level of social and economic welfare without compromising the viability and integrity of the supporting hydro-ecosystems in the long-term. (p. 3162)

They propose seven principles that combine narrower views (such as safe yield, water quality, adaptive capacity, social learning, inclusive governance, among others) of water sustainability. Their proposed principles are: (1) Social-ecological system integrity, (2) Resource efficiency and maintenance, (3) Livelihood sufficiency and opportunity, (4) Socio-ecological civility and democratic governance, (5) Intra-generational and inter-generational equity, (6) Interconnectivity from local to regional to global scales, and (7) Precaution (mitigation) and adaptability (Table 1).

Table 1.
*Sustainable Water Governance Principles and Key Features*

| **Sustainable Water Governance Principle** | **Key Features** |
|---|---|
| Socio-ecological system integrity | Maintaining in-stream flows<br>Maintaining water quality<br>Stabilizing aquifers<br>Coordinating resource use at appropriate scales |
| Resource efficiency and maintenance | Reduced water demand and increased water efficiency<br>Encouraging water reuse<br>Eliminating water loses<br>Achieving balance between groundwater extraction and recharge |
| Livelihood sufficiency and opportunity | Sufficient water quality and quantity for livelihood activities<br>Sufficient water quality and quantity for economic activities<br>Fair compensation for stakeholders that lose water access without harm to other users |
| Socio-ecological civility and democratic governance | Involvement of all stakeholders<br>Representation of different interests and perspectives<br>Establishing collaborative water governance |
| Intra-generational and Inter-generational equity | Access to safe, clean water for all residents<br>Ensuring fair distribution of costs and benefits among stakeholders<br>Facilitating inclusiveness among diverse stakeholders<br>Ensuring the representation of future generations (e.g. through civil society participation) |
| Interconnectivity from local to regional to global scales | Eliminating negative impacts on other areas<br>Coordinating between local and broader scale stakeholders |
| Precaution (mitigation) and adaptability | Anticipating water quality and scarcity problems<br>Mitigating water quality and scarcity problems<br>Incorporating activities that reduce vulnerability to water quality and scarcity problems |

Adapted from Wiek and Larson (2012)

These principles by Wiek and Larson (2012) guide the analysis conducted in this dissertation on the conditions for and barriers to water sustainability in Prescott AMA, with respect to coordination among governance actors and their exercise of power. In the remaining parts of this dissertation, I use the phrases 'water governance for sustainability' and 'sustainable water governance' interchangeably in referring to practices that promote comprehensive water sustainability.

## Previous Central Highlands Research

In this section, I provide *in-depth reviews* of five studies published within the past decade regarding the Central Highlands' water resources. Four of the studies are peer-reviewed journal publications (Bolin et al., 2008; Collins and Bolin, 2007; Cutts et al., 2010; Muñoz-Erickson et al., 2010) while the fifth is a dissertation (Whitmire, 2013). This review is important because previous research highlights current water resource knowledge in the Central Highlands, which help situate this research and its findings. The subsequent in-depth reviews are presented chronologically.

**Vulnerability to Water Scarcity.** Focusing on Prescott, Prescott Valley, Chino Valley, Dewey-Humboldt, and the surrounding rural area of unincorporated places, Collins and Bolin (2007) assessed vulnerability to water scarcity in the Central Highlands. Following Cutter (1996) and Cutter et al. (2000), the authors adopted the hazards-of-place conceptualization of vulnerability to identify the people and places that are both biophysically and socially vulnerable to water scarcity—referred to as place vulnerability. Using a Geographic Information System (GIS), they mapped the specific

people and places in the Central Highlands that are differentially affected by water scarcity.

To assess biophysical vulnerability, the authors used spatial data on registered wells and regional aquifer(s) alongside census data from government agencies to develop biophysical variables, namely access to groundwater (determined by the number of exempt[2] wells without access to basin-fill aquifer) and well spacing. The biophysical variables were transformed into indices, integrated, and mapped by census blocks to identify places of biophysical vulnerability to water scarcity. Collins and Bolin (2007) found that growing and unincorporated communities adjacent to Prescott and Dewey-Humboldt have the highest biophysical vulnerability to water scarcity due to limited groundwater access influenced by local geology. Meanwhile, places with relatively dense well spacing close to Chino Valley are vulnerable to water scarcity due to reduced groundwater storage and potential contamination despite overlying a basin-fill aquifer. The least biophysically vulnerable areas are unpopulated census blocks and Prescott Valley, where well-spacing density is low with few households depending on exempt wells.

A sociodemographic index (determined by population structure, socioeconomic status, and place dependency) and water-provider type index (based on whether households were within municipal water provider service area, within a private water provider service area, or had exempt wells) were used in assessing social vulnerability to water scarcity. Collins and Bolin (2007) found households on exempt wells to be more

[2] An 'exempt well' in Arizona is any well with maximum pump capacity of 35 gallons per minute. Exempt wells are not subject to the groundwater-withdrawal reporting requirement mandated by the Groundwater Management Act of 1980 – that is, they are 'exempt' from regulation.

socially vulnerable due to the high costs of mitigating and adapting to localized water scarcity. Also, social vulnerability increased due to the costs of deepening wells, as the water table drops, and treating arsenic and other contaminants in groundwater.

Based on the sociodemographic index, the authors' analysis shows that Prescott, Prescott Valley, Chino Valley, Dewey-Humboldt, and adjacent growing areas have high social vulnerability. However, the surrounding rural regions are less socially vulnerable due to lower housing density and population per census block. Areas of unregulated lot division (lot splits)[3] in Chino Valley, Dewey-Humboldt, and north of Prescott Valley showed high social vulnerability to water scarcity, while provider-type social vulnerability is mediated at the community level. For example, residents of Prescott and Prescott Valley are less socially vulnerable to water scarcity because they are mainly served by municipal water providers.

In combining sociodemographic and water provider indices, Collins and Bolin (2007) found that areas with high densities of vulnerable populations (that is, the elderly, children, female-headed households, non-white residents, and Hispanic residents) that rely on exempt wells have high levels of social vulnerability to water scarcity. Places with a high density of vulnerable populations served by either municipal or private water providers have moderate to high levels of social vulnerability to water scarcity. By contrast, places with little or no vulnerable populations (which were in mostly less or uninhabited areas outside Prescott, Prescott Valley, Chino Valley, and Dewey-Humboldt) are less socially vulnerable to water scarcity.

[3] Lot splits occur when a landowner divides a lot into smaller lots. Lot splits in Prescott AMA mostly depend on exempt wells for their water, leading to an increased proliferation and density of exempt wells.

In terms of overall vulnerability to water scarcity, Collins and Bolin (2007) combined and assigned equal weights to the indicators of biophysical and social vulnerability (namely access to groundwater, well spacing, socio-demography, and water provider type) within a GIS. The authors found that the most vulnerable areas, overall, to water scarcity are densely populated lot-split subdivisions outside Prescott and Prescott Valley that are dependent on exempt wells. Generally, the authors observed the following:

(1) Areas of biophysical vulnerability did not always intersect with areas of social vulnerability;
(2) Adopting Cutter et al.'s (2000) characterization of vulnerable population results in a positive correlation between sociodemographic vulnerability and population density; and
(3) Areas of sociodemographic vulnerability relate to those of water provision system vulnerability. However, the relationship between sociodemographic vulnerability and vulnerability by water provider type was reversed with higher population density. This reversal was due to the economies of scale and reduction of risks acquired through municipal water provision. The relationship described above explains why Prescott and Prescott Valley both have high sociodemographic vulnerability and low vulnerability based on water provision type.

Although Collins and Bolin (2007) found that exempt well households are generally more vulnerable to water scarcity, the authors did not explain the factors responsible for the continued prevalence and proliferation of exempt wells. I fill this research gap by assessing how power is exercised by different governance actors across local to state levels.

**Water, Growth, and Politics of Scale in Arizona's Central Highlands.** In a subsequent study, Bolin et al. (2008) examined the scalar politics of citizen groups, government actors, and development interests in the Verde River watershed (which contains the Prescott Active Management Area, or Prescott AMA). Within the AMA,

Prescott and Prescott Valley jointly pursue groundwater importation from the Big Chino basin, an endeavor made possible by a 1991 state legislation. Meanwhile, within the watershed, civil society groups, environmental groups, and Verde Valley municipalities argue for the effects of Big Chino water importation on the health of the Verde River and the water supply of Verde Valley communities. Salt River Project (SRP), a company that serves water to Phoenix residents, is a major political actor in the region's water resources due to that entity's priority rights to about 85% of Verde River flows.

Using data from semi-structured interviews, informal interviews, and document review, the authors interrogated the water conflict that developed around Prescott AMA's Big Chino Project[4] (BCP). The authors described Prescott's planned water import as a "spatial fix"[5] that temporarily defers water scarcity in order to promote the region's residential growth-dependent economy. Using interview quotes, Bolin et al. (2008) showed that although imported water is claimed as needed to achieve the AMA's management goal of safe yield, the imported water was being earmarked to enable and support new residents, thereby facilitating growth. They further noted that Prescott's pursuit of a spatial fix reflects the "contradictions inherent in overconsumption of finite resources" (p. 1498).

The authors used a 'politics of scale' lens to describe how different groups rescale the ongoing water conflict to suit their interests. Specifically, environmental groups draw on the effects of pumping on both the river and the endangered species in it, thereby

[4] The Big Chino Project is the water import project being pursued by Prescott AMA municipalities to move water from the Paulden area (outside AMA boundaries) into the AMA. This water importation was made possible by an exemption passed by legislation, which countered statutory GMA restrictions on groundwater importation into AMAs.

[5] A spatial fix occurs when external material is brought in to replace current material deficit without dealing with the underlying conditions causing the deficit.

rescaling the area's water conflicts from the local to federal scale. In 2004, the Center for Biological Diversity (CBD) filed a notice to sue Prescott, Prescott Valley, and a number of federal agencies for violating (or future violations of) three sections of the Endangered Species Act (ESA). Verde River Citizens Alliance (VRCA) rescaled the effects and impacts of the BCP from strictly AMA to watershed-wide, while CBD jumped scale by invoking the federal ESA. In another example, Citizens Water Advocacy Group (CWAG) jumped scale by calling for a federal Environmental Impact Statement (EIS) and invoking requirements of the National Environmental Policy Act (NEPA) for a project that proponents see as a local matter. Meanwhile, supporters of the BCP focus on scales that advance the project. A project supporter interviewed by Bolin et al. (2008), for example, focused on the project's impact on only the first 25 miles of the Verde River, where there were no endangered species. Based on the politics of scale theory that informed their analysis, the authors showed how BCP proponents reinforce their stance by only referring to scales that favor their project.

The claims of environmental groups and Verde Valley communities that the BCP would adversely impact the Verde River were based on evidence provided by USGS reports such as Corkhill and Mason (1995), Wirt (2005), and Wirt and DeWitt (2005). In addition, reports published by two retired USGS scientists, Meyers and Wolfe (2007), provided civil society groups with information which supported their opposition to the Big Chino Project (Bolin et al., 2008). However, as reported by Bolin et al. (2008), the USGS reports were sharply debated by Prescott AMA municipalities who invoked scientific uncertainty because they look to the BCP to allow growth in their cities. Proponents of the Big Chino Project debated the applicability of the USGS reports to the

water import project. Instead, BCP proponents (Prescott and Prescott Valley) pointed to consultant studies which suggested that BCP pumping will have minimal effect on Verde River flows.

In their analysis, Bolin et al. (2008) framed the key political actors involved in the region's water conflicts as upstream or downstream actors based on their support or opposition to the BCP. Political upstream actors in the watershed are Prescott and Prescott Valley, while downstream actors include CWAG, Verde Valley communities, Verde Watershed Association (VWA), VRCA, CBD: Save the Verde Campaign, and The Nature Conservancy's Verde River Program (TNC), among others. Upstream actors advocate for the BCP project while downstream actors (in Verde Valley) do not. Thus, the terms upstream and downstream do not represent actual geographic areas but are terms that indicate political support or opposition to the BCP. For example, CWAG is a civil society group with a watershed-wide focus that started in the Upper Verde River watershed but aligns "politically with downstream groups and communities of the Verde Valley" due to its opposition to the BCP project (p. 1501).

Bolin et al. (2008) also identified two major coalitions within the Verde Watershed, namely the Verde River Basin Partnership (Partnership) and Upper Verde Watershed Protection Coalition (Coalition) – upstream interests only, with both the Partnership and Coalition redrawing the map of governance and political allegiance around the region's water conflict. The Partnership was created by a 2005 federal legislation as part of a public-private land exchange program in Yavapai County and included Prescott AMA municipalities at creation. However, Prescott AMA cities left the Partnership to form the Coalition, citing the disproportionate number of Partnership

members not "accountable to public scrutiny" (Verde River Basin Partnership as cited by Bolin et al., 2008). Bolin et al., (2008) concluded that:

> The current standoff between the Coalition and the Partnership reflects the *rescaled spaces of environmental conflict*. The Coalition has 'scaled up' political alignments by creating a new municipal network that operates outside the jurisdictional scales of the PrAMA or Yavapai County, but specifically represents interests that will benefit from the BCP. The Partnership, in contrast, establishes relationships among Verde Valley municipalities, civil society groups, and federal agencies seeking to promote environmental governance at a scale comprising much of the Verde River watershed. Together the new coalitions have engendered *a reconfigured arena of conflict over the appropriate scales from which to organize environmental policy making and resource governance*… However, no effective regional environmental governance has yet to emerge from these new scalar arrangements of stakeholders, and the future of the Verde remains in question (p. 1506, 1509 emphasis mine)

At the regional level, the County and its Water Advisory Council lack the authority to regulate groundwater, which is a responsibility of the Arizona Department of Water Resources. Overall, despite the existence of the regional Active Management Area (which guides AMA level water management), there is no regional planning for managing growth in the Central Highlands. Yet, water in arid Arizona cannot be effectively managed without managing growth. Arizona's elected officials lack enthusiasm for growth management due to the state's economic dependence on construction and retail, which increase pressure on the region's water resources.

In summary, Bolin et al. (2008) identified the following major points as the features of politics of scale within the Central Highlands' water conflicts:

> (1) The Groundwater Management Act (GMA) encourages the pursuit of spatial fixes to achieve safe yield and unregulated developments outside AMAs. In fact, the GMA is limited in its ability for "rationally planning sustainable water resources in the face of continued growth" (p. 1509);
>
> (2) The BCP is just one spatial fix option among many others that are being considered in the region. The dependence on spatial fixes is so great because Arizona's political economy is dominated by residential growth with a lack of

> alternative political-economic narratives. Thus, the common strategy for countering material limits to growth (that is, depleted aquifers and reduced surface flows) is to search for a spatial fix;
>
> (3) There is a mismatch between the management scale of the AMA and the scale at which the effects of BCP impacts would be felt. Environmental groups in the region use science to legitimize claims of future harm and the impacts of the BCP beyond the AMA's management scale, rather than take the politically unpopular position of directly opposing new housing growth;
>
> (4) Environmental groups are rescaling the region's water conflict to a national scale by invoking the Endangered Species Act and the National Environmental Policy Act. This strategy helps them overcome the challenge created by the statutory mandate for groundwater import into Prescott AMA; and
>
> (5) The Yavapai Ranch Land Exchange is a spatial fix produced by Arizona legislators at the federal level to promote growth which rescaled the region's actor relations through the creation of the Verde River Basin Partnership.

Similar to Bolin et al. (2008), I adopted propositions of scale in the present research. However, in my conceptualization of scale, I focused more on the interaction of governance actors across scales and how this has affected water governance in the region than the politics of scale (Marston et al. 2009). Bolin et al. (2008) found that non-government actors employ different scales in supporting their claims of Verde River harm in the region's water conflict – a strategy that involves resource mobilization and the exercise of power. However, the authors do not elaborate sufficiently on the ways through which other governance actors mobilize resources and exercise power in promoting or undermining water sustainability. To fill this gap, I analyzed resource mobilization by state, regional, and local level actors with respect to the study area's water governance and the implications of their activities for Prescott AMA's water sustainability.

**Information Networks in a Watershed Partnership.** In their study, Muñoz-Erickson et al. (2010) used social network theory and analysis to investigate the

relationship between information networks and conflicts in the Verde River Basin Partnership (VRBP or Partnership). In 2005, federal legislation had created the partnership with a mandate to develop science-based water management strategies for the Verde River watershed.

Muñoz-Erickson et al. (2010) examined the relationship between information sharing and conflict due to the following: *vertical stratification*[6] (that is, member interests across cities, county, watershed, state, federal), *horizontal stratification*[7] (member interests focused geographically upstream or downstream of the Verde River), *expertise* of VRBP members (scientists versus nonscientists), and *ideology* (environmental values, perceived barriers to decision making, members' view of science, members' view of scientists, political ideology). Also, the authors investigated the *distribution of power* within the VRBP using measures of in-degree and betweenness centrality.

Most VRBP members who responded to the study's survey had perceived values and information as the main barriers to the VRBP's decision making. They also expressed watershed-level interests with a focus on downstream impacts of upstream activities. VRBP survey respondents were not scientists themselves but tended to hold positivist views in support of science and to think scientists should play dominant roles in policy formation.

[6] In terms of levels, the vertical governance analyzed in this dissertation is similar to Munoz-Erikson et al.'s (2010) vertical stratification. However, unlike Munoz-Erikson's focus on various spatial levels between the federal level and cities, analytically, I focused on state, regional, and local levels.

.

[7] The horizontal governance assessed in this dissertation are different from Munoz-Erikson et al.'s (2010) vertical stratification. Whereas Munoz-Erikson et al. (2010) categorized VRBP members according to upstream or downstream interests, I assessed governance interactions among the four municipalities in Prescott AMA, namely: Prescott, Prescott Valley, Chino Valley, and Dewey-Humboldt.

Through their analysis, Muñoz-Erickson et al. (2010) found that neither vertical nor horizontal stratification were responsible for the Partnership's conflicts. They also found less interaction between scientists and nonscientists than expected. Munoz-Erikson et al. (2010) had expected contests over science, and thus more interactions between scientists and nonscientists, would occur due to the high media attention the VRBP had received and due to Bolin et al.'s (2008) observation that scientific studies are used in political ways within the region. However, the authors found the following:

> (1) Ecocentrists shared information more often with members that held views of the dominant social paradigm on environmental issues;
>
> (2) Those with conservative political views shared information more often with liberal respondents than conservatives did with other conservatives and more often than liberals did with other liberals; and
>
> (3) Respondents who thought of scientists as policy advocates occupied central positions in the VRBP's social network, suggesting that they were most connected to other members, could influence information flow, and thus had more power in the Partnership's network.

The authors concluded that the lack of interaction between scientists and nonscientists as well as the central position occupied by actors who responded that science should influence policy (when the rest of the group did not share the same view) could be responsible for science not being deliberated in the Partnership, thereby limiting the Partnership's ability to achieve its goal of developing regional water governance based on science.

Munoz-Erikson et al. (2010) is another study within the Central Highlands that incorporated conceptualizations of scale. Specifically, the authors differentiated levels from local to federal government and at the watershed level. However, the authors focused on members of the initial VRBP while assessing information networks in the Verde River watershed. Although this focus was sufficient for Munoz-Erikson et al.'s

(2010) goal of understanding information networks, their focus on the initial VRBP only provides a partial understanding of stakeholder engagement for water sustainability in the Verde River watershed. Despite having slightly different study areas (Verde River watershed versus Prescott AMA), in analyzing governance interaction and implications for water sustainability, I build on Munoz-Erikson's et al. (2010) study by assessing coordination and collaboration among a broader group of stakeholders.

**Ego Networks in a Watershed Partnership.** Building on Muñoz-Erickson et al. (2010), Cutts et al. (2010) examined the ego networks of members of the VRBP to understand if member contacts and composition of networks explained why members who think science should influence decision making occupy central network positions within the Partnership. An ego network refers to the network of individual actors, compared with analyzing the whole network of a group or organization as done by Munoz-Erikson et al. (2010). Cutts et al.'s (2010) approach follows social network theory, which suggests that a higher number of personal contacts, higher proportion of external contacts, or higher proportion of unique contacts indicates access to more resources, which would allow central actors to exercise more power than others in the whole network.

Cutts et al. (2010) found that first, there is no relationship between the number of contacts, proportion of external contacts to internal (that is, VRBP) contacts, and proportion of unique contacts in determining the central network position (power) observed. Second, those who acknowledged affiliation with the VRBP occupied central network positions compared with those who did not. Third, those who acknowledged affiliation with VRBP had more unique contacts that those who did not. Finally, the size

and composition of member contacts differed with ideology concerning the subjectivity of science but did not explain the centrality of actors who thought science was objective. Specifically, those who thought science was objective have more external contacts, while those who think science is not objective have more unique contacts. Based on these results, the authors concluded that power "appears to be generated from processes within the [VRBP] network" rather than an actor's external or unique ties (p. 98). Also, Cutts et al. (2010) advanced the proposition that scientific discourse could be obscuring debates over values especially because the VRBP Act mandates science-based solutions whereas partnership members view *values* as the barrier to cooperation. According to Cutts et al. (2010): "It is plausible that the mismatch between a mandate to solve the Big Chino controversy through science and the belief of partnership members that conflict persists because of values plays a large role in halting cooperation" (p. 99).

Similar to Munoz-Erikson et al. (2010), Cutts et al. (2010) focused mainly on the initial VRBP and found that value differences were responsible for conflict among VRBP members. I build on Cutts et al.'s (2010) study by examining a variety of other stakeholders within the Central Highlands, specifically with respect to Prescott AMA's water governance. In the present study, I aim to provide understanding of not only information sharing but also other types of interaction and coordination for water sustainability among a diverse group of governance actors.

**Power and Politics in Yavapai County's Water Conflicts.** In her dissertation, Whitmire (2013) used a case study methodology involving interviews and document analysis to investigate the factors responsible for unresolved water conflicts in Yavapai County. By applying theories of deliberative democracy, network analysis, and power

relationships, Whitmire (2013) found evidence for the study's hypotheses that first, water conflicts persist in Yavapai County because the processes used to inform and engage citizens have been ineffective. Second, different aspects of power are contributing to persistent water conflicts in the county.

Regarding the study's first hypothesis, Whitmire (2013) concluded that there is no ongoing deliberative democratic process in Yavapai County. Instead, "there are those who are presenting information and others who are advocating positions" (p. 97). The political consciousness of residents is shaped by institutional and social forces such that they are not aware of water conflicts in the county or are complacent about its resolution. Thus, most residents of the county are not aware of the region's water management problems due to being uninformed or misinformed. According to Whitmire (2013), this state of affairs reveals that power is not co-shared (that is, 'power over' rather than 'power with') by citizens and decision-makers. Instead, the construction and development industry are powerful and influence the county's political agenda. Meanwhile, those who are aware of the county's water management problems are frustrated by political dynamics and the protracted nature of discussions without substantive change in current water governance practices.

Furthermore, Whitmire (2013) argued that there is no administrative mechanism for communication, trust building, and collaboration between diverse interests in the county. Collaborative efforts that span the county have been unsuccessful, such as the Verde River Basin Partnership (VRBP). Moreover, distrust among elected officials, for example, in the Yavapai County Water Advisory Committee (YCWAC) is an impediment to consensus-based decision making. This challenge is important to

acknowledge because the YCWAC structure requires consensus among members for decisions to be made. Overall, elected officials in the Prescott area and Verde Valley disagree with each other's ideas and projects, thereby impeding county-wide water governance and the resolution of the ongoing water conflicts.

Regarding the study's second hypothesis, Whitmire (2013) found that collaboration among government actors, and likewise non-government actors, was limited. Specifically, local, state, and federal agencies are limited in their ability to work collaboratively (either internally or across agencies) due to diverging institutional structures at each level. For example, the Yavapai County Water Advisory Council structure required consensus for every decision, which was often difficult to achieve and often created conflict among members rather than ameliorating it. Whitmire (2013) referred to this situation as the structural constraints of power. Meanwhile, she found few cooperative efforts between water-related NGOs in the Prescott area and Verde Valley. Thus, the power of non-government water-related organizations are dispersed because they currently do not collaborate as much as they should especially across Prescott area and Verde Valley communities.

Whitmire (2013) further observed that Arizona water laws give significant authority to the state legislature *and* do not recognize the link between surface water and groundwater, thereby impeding local and regional water governance efforts. In addition, the AMA structure gives Prescott AMA communities authority that other communities in Yavapai County lack. This statutory legitimacy contributes to the lack of cooperation between Prescott AMA and non-AMA communities in developing effective county-wide water management strategies, thereby further hindering sustainability at broader scales.

Although Whitmire (2013) established the link between Prescott municipalities' AMA designation and their legitimacy with the state legislature, it is unclear to what extent this AMA designation or 'legitimacy' promotes water sustainability in the Central Highlands. To build on Whitmire's (2013) findings, in this dissertation, I investigated this question of the relationship between legitimacy and water sustainability with respect to Prescott AMA. Specifically, I assess how interactions among diverse actors and the exercise of power in the Prescott area affects sustainable water governance in the study area.

**Positioning the Current Study**

Improving knowledge on the relationship between governance institutions and water sustainability requires studies that investigate how institutions created for water governance contribute (or not) to water sustainability. Thus, with focus on Arizona's Central Highlands, I assess the conditions for and barriers to water sustainability within the statutory Prescott Active Management Area (AMA) by assessing coordination among water governance actors and their exercise of power. I accomplish this purpose by drawing on propositions of vertical governance, horizontal governance, and power (Figure 3) in answering the following research questions:

1. What interactions exist among governance actors involved in water management across local to state levels?
2. In what ways do actors at the local level coordinate (or not) in governing water resources?
3. How is power exercised among a variety of water governance actors across levels?

In the rest of this chapter, I review the theoretical propositions and concepts that frame this dissertation, namely: vertical governance, horizontal governance, and power.

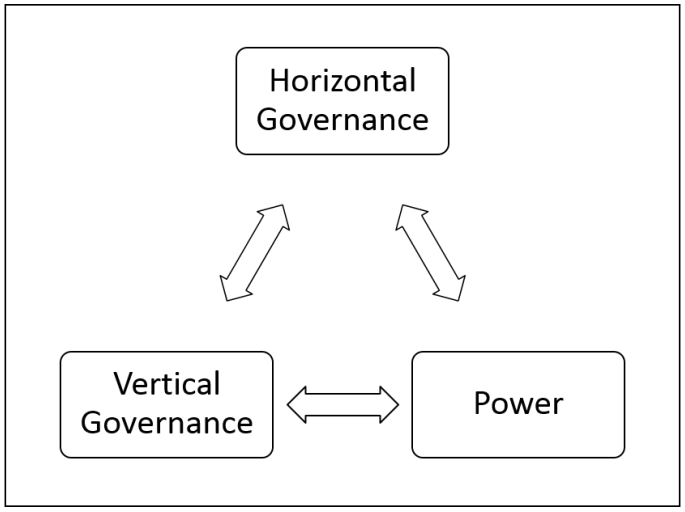


*Figure 3*. Conceptual Framework for Water Governance Coordination

**Vertical Governance**

Vertical governance involves interactions between actors, across different scalar levels (Cash et al., 2006; Van der Brugge and Van Raak, 2007, p. 35). In this study, I draw on propositions of vertical governance from theories of scale and multilevel governance (Figure 4), which I discuss in this section.

Geographical scale is a heavily debated concept in human geography (Brown and Purcell, 2005; Jones et al., 2011; Jones et al., 2007; Marston et al., 2005; Moore, 2008; Neumann, 2009). This debate has centered around the utility of scale as ontology versus epistemology since Marston et al.'s (2005) call to eliminate scale from human geography. Scholars within political ecology generally reject the conceptualization of scale as an ontological category but concede its epistemological status (Bolin et al., 2008; Brown and Purcell, 2005). Following the political ecology tradition, I draw on epistemological

conceptualizations of scale. In other words, I view scale not as an object of inquiry but as a tool for 'making sense' of the physical and human landscape (Smith, 2000, p. 725). In the context of this research's vertical governance, the three levels (or scales) in focus are the state, regional, and local levels (Figure 4). Also, I draw on the propositions of scale as a socially constructed trope, that is complicated in governance due to scale mismatches, and that is relational. I discuss these framings below.

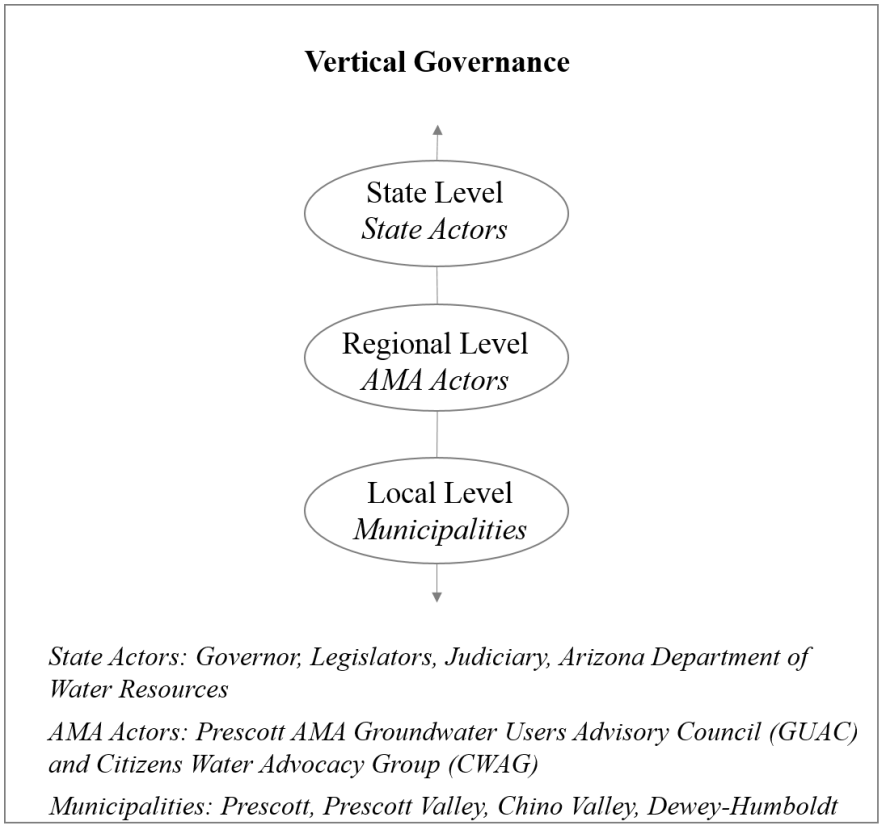


*Figure 4*. Key Actors involved in Vertical Governance

Within human geography, scale is recognized as a trope, a representation tool that encourages certain meaning while constraining others because "'true' meaning can never simply pass through a trope, it is always shaped" (Jones, 1998, p. 27). Though this understanding holds whether scale is viewed ontologically or epistemologically, I apply

scale epistemologically within this research. Jones (1998) argues that scale influences how reality is understood, for example,

> The creation of scale as a trope for understanding the city did not merely shift politics from one level to another. Rather, it recast what was true or knowable about the city within the frame of scale. Certain questions about the city simply became un-askable. The truth of an 'ordinary gaze' became less 'true', while other questions about zones, for example, became more readily askable. This is not simply a jump in scales, it is a fundamental change in the way the city was known and apprehended" (Jones, 1998, p. 28).

Since resource governance scales are created for specific management purposes, the choice of scale or the extent of scale created determines what is known about the resource and could hide or reveal the state of resource sustainability. Thus, the choice of scale could promote either the exploitation of natural resources or sustainable governance.

Geographic (and governance) scales are socially produced, that is, they are socially constructed (Marston, 2000). The social construction of scale refutes the notion that it is ontologically given. Although watersheds and groundwater basins are recognized as physical units based on their hydrological functions, research shows that even physical scales can be socially constructed. For example, Cohen and Bakker (2014) in their study of Alberta's water governance found that the creation of watershed governance 'subordinated' environmental governance to the government's political and economic goals rather than promoting sustainable resource governance. The authors argue that the choice of watershed boundary was more politically driven, than by a desire to govern water within 'natural scales'. Their finding in many ways reinforce Brown and Purcell's (2005) assertion that "there is nothing inherent about any scale… rather the social and ecological outcomes of any particular scalar arrangement are the result of the political strategies of particular actors, not the inherent qualities of particular scales" (p.

607, 609). This social construction of scale means that governance scales can be created or they could cease to exist at the will of governance actors.

In practice, water management and governance scales rarely match ecological ones, which results in scale mismatches (Zimmerer and Bassett, 2003). Sayre (2005, p. 277, emphasis mine), quotes Lee (1993) as proposing that "when human responsibility does not match the spatial, temporal, or functional scale of natural phenomena, *unsustainable use of resources* is likely, and it *will persist until the mismatch of scales is cured*." The finding of Cohen and Bakker (2014) previously presented suggest that politically driven attempts to cure scale mismatches could mask political agendas that do not promote sustainable resource governance. Thus, it is possible for unsustainable use of resources to continue even though scale mismatches are 'cured'.

Within Arizona, Active Management Areas (AMAs) are areas delineated for their historic groundwater overdraft. In the current study, Prescott AMA boundaries do not match either watershed boundaries or groundwater basins. Instead, Prescott AMA is an administrative region that merges two sub-basins from two different watersheds. With respect to the study area, AMA boundaries were instituted by Arizona's 1980 Groundwater Management Act. The AMA *did not exist* prior to this legislation. Integrating the findings of Collins and Bolin (2007) and Bolin et al. (2008) show that Prescott AMA's proposed water import from a neighboring groundwater basin to achieve safe yield would transfer vulnerability to other people, places and times. However, groundwater transfers, irrespective of its effects on surface water flows is possible due to Arizona's (incorrect) legal separation of surface water and groundwater (Bolin et al., 2008; Whitmire, 2013).

Another idea about scale important to this study is *relation across scales.* Brenner (2001) in proposing the 'plural connotation of scale' argues for analyzing the relations among scales rather than focusing on only one scale. Due to the focus on barriers to water sustainability in Prescott AMA, rather than assessing the broader social interactions among scales, I focus on water governance strategies across local, regional, and state levels. Thus, drawing from Brenner's (2001) "plural connotation of scale" (Brown and Purcell, p. 610), in research question one, I focus not only on the study area i.e. Prescott AMA but on the interactions among actors at different scales (referred to as levels in SES literature), plus the water governance outcome(s) produced by these interactions. In other words, I analyze how relations across levels (specifically, water management strategies) result in the water governance outcomes at one level (in this case, Prescott AMA).

With regards to sustainability, coordinated interaction between actors at different levels of governance is needed to sustain efforts at the local level, especially when such efforts need to be scaled-up to a higher (e.g. regional) level. Berkes' (2006) review of marine governance in Koh Sralao coastal village in Cambodia presents an example of how a lack of vertical governance interaction between the local and regional levels could limit sustainable governance efforts. In the Koh Sralao case, the village's management committee had been successful in making local fishermen switch to large mesh sized nets, which allowed crabs to grow before being harvested, thereby reducing the risk of overharvesting. However, the lack of enforcement of a similar policy due to lack of support from the regional level on neighboring fishing communities led Koh Sralao fishers to switch back to small mesh sized nets, which relegated attempts at sustainable fishing.

Vertical interactions when coordinated can also mitigate conflicts in resource governance. Marshall (2008, p. 77) has argued that the higher level of a multilevel governance could potentially foster the trust needed among local level actors (as long as the local level actors currently trust the higher levels of leadership). In addition to trust among actors, which can help conflict resolution, Knüppe and Pahl-Wostl (2011) show that a lack of integration in vertical governance can lead to conflict. In their case study of groundwater governance in the Upper Guadiana Basin (Spain), the authors found that poor integration of local and regional level actors in formulating the Special Plan for the Upper Guadiana Basin led to conflict among stakeholders.

With focus on Prescott AMA as a case study, I assess spatial and temporal scales similar to Bolin et al. (2008). However, my analytic emphasis is on water management strategies and governance actor relations across state, regional, and local levels. Overall, I posit that AMA level governance outcomes are not only influenced by local or regional level activities but those at the state level as well. In analyzing the barriers to water sustainability in Prescott AMA, I assess the conditions for and barriers to water sustainability with a focus on the coordination of governance actors across levels (Figure 4).

**Horizontal Governance**

Defined simply, horizontal governance involves governance actor interactions at a particular level aimed at resolving issues at that governance level (Termeer, 2009). In broader terms, Emerson et al. (2012) define this type of governance, which they refer to as collaborative governance, as:

> the processes and structures of public policy decision making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres in order to carry out a public purpose that could not otherwise be accomplished (p. 2)

Horizontal (or collaborative) governance in this dissertation include actors outside the local level (such as the public-private Salt River Project with senior rights to Verde River water). However, key actors involved in this study's horizontal governance are the municipalities and other communities that comprise Prescott AMA (Figure 5).

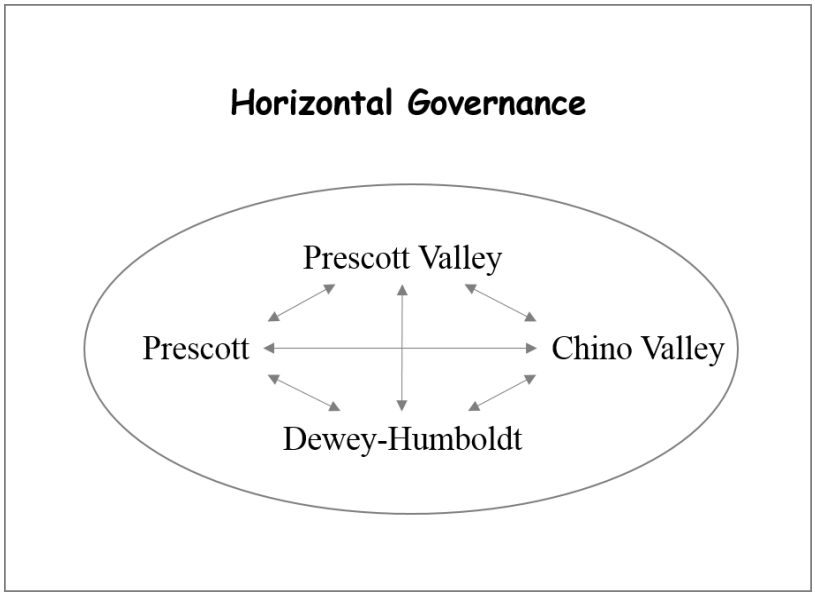


*Figure 5*. Key Actors involved in Local Level Horizontal Governance

Scholars generally agree that coordination and collaboration among actors are essential for governance that achieves its goals (Trein, 2016). Phillips (2004) presents the case of horizontal governance in Canada at the national level, which involved the national government and non-government actors. The case study was focused on Canada's Voluntary Sector Initiative (VSI), which involved a twenty-month process of joint work between the national government and non-government actors. The Trein (2016) study shows that collaboration among governance actors was an important criterion in the initiative's overall success. In particular, some elements of this collaborative relationship

involved face-to-face meetings, which allowed time to build trust and mutual understanding among actors.

Thus, coordination and collaboration are important components of sustainable water governance. For example, even though Keeler et al. (2015) developed scenarios to guide sustainability transitions in the Phoenix metropolitan area, the researchers concluded that any choice on those scenarios would require the coordinated efforts of actors within the water system. The eight characteristics identified across international literature as necessary for good governance also include elements of coordination. These characteristics are participation of different actors, consensus-driven governance, adherence to set standards, governance that is transparent, responsive to change, effective and efficient, equitable and fair, and follows the rule of law (McKay, 2007, p. 150). In support of the need for coordination and collaboration in governance, one of the recommendations presented by Larson et al. (2013) in their sustainability appraisal of water governance in Phoenix pertained to building capacity through collaborations among diverse interest groups such as scientists, policymakers, and the public.

Research reveal that weak coordination (through, for example, proper role definition) in water governance result in ineffective water governance regimes. Lebel et al.'s (2013) comparative analysis of 28 river basins shows that poorly defined roles and relationships can lead to a poor institutional fit in water resource management. Institutional fit refers to the correct matching of the scale at which natural resources occur and interact within biophysical systems and the scale at which they are governed by people. Thus integrated, coordinated and collaborative governance does not just happen; instead, it requires intentional planning, allocation of resources, and implementation

across multiple actors (Mitchell, 2006).

**Power in Water Governance**

Power is a foundational concept within social theory and is theorized beyond the boundaries of sustainability or political ecology research. For the purposes of this dissertation, I define power as the mobilization of resources by actors to achieve a goal (Avelino, 2011; Paulson et al., 2003). Avelino and Rotmans (2011) define resources as follows:

> "*Human resources* refer to 'man power' or human leverage, i.e. personnel, members, voters, clients, supporters, fans, etc. *Mental resources* include information, concepts, ideas and beliefs. *Monetary resources* are funds, cash and financial stock. *Artefactual resources* comprise apparatuses, products, construction and infrastructure, but artefactual resources can also include a song, a dance, a painting, a photography or a movie. *Natural resources* refer to raw materials, the four elements, physical space, time and organic life." (p. 798, emphasis mine)

This conceptualization of power shows that governance is power-laden mainly because governance involves the mobilization of one or more resources by various actors. Thus, given that governance actors are always interacting, one goal of power research is to better understand how resources are mobilized, who mobilizes resources and thus exercises power (Corbridge, 2009; Markard et al., 2012).

Within this research, power is *not* conceptualized as external to an individual or fundamentally negative. Instead, I view power as what constitutes both individuals and their interactions with others (Paulson et al. 2003). In this sense, power is not an object to be had or found somewhere but is wielded by actors in mobilizing resources. Corbridge (2009) provides the following example of the ubiquity of power:

> it is trite to think of power only in negative terms. The possibility of having a conversation with someone, of running a class or seminar in which people can learn, of playing a football match, depends upon the deployment of power: of people taking turns to speak and listen, of students and teachers doing work as agreed, of players deferring to a referee. People both exercise power and are on the receiving end of power at different times every day, in all realms of life. (p. 575)

Thus, power embodies the social relations that exist between actors in relationships and as resources are mobilized. Yet, though power is not a negative characteristic that should be eliminated, asymmetric power leads to conflicts in environmental governance (Paulson et al., 2003). Power asymmetry is an area of concern that leads to not only conflicts but unsustainable resource governance as well.

Power is spatialized (Corbridge, 2009) and the choice of scale empowers or disempowers different actors (Jones, 1998). In their study of water conflicts in Arizona's Central Highlands, Bolin et al. (2008) show that groups marginalized at one scale 'jump scales' to turn the balance of power in their favor through their analysis of water governance in the Central Highlands. For example, civil society in the region invoked federal laws to contest the statutory water importation plans of municipalities. In another study of water governance in Alberta, Cohen and Bakker (2014) show that the choice of watershed boundary (ecological scale) by decision makers actually "reconfigures power structures and prioritizes some resources over others in ways that can entrench, rather than resolve, the crises it was designed to address" (p. 128). The two studies cited provide examples of how the spatiality and asymmetry of power perpetuate conflicts and promote unsustainable resource governance.

The exercise of power is often linked to decision-making and in that sense, could pose a methodological challenge. In providing conceptual clarity, Avelino and Rotmans

(2011) suggest that in terms of how power is exercised, power could either be innovative, reinforcive, transformative, or destructive. *Innovative* power refers to the capacity of actors to create new resources, *reinforcive* power is exercised when actors make and enforce the operating rules, *transformative* power is their capacity to transform the distribution of resources, and *destructive* power is the capacity of actors to annihilate or destroy existing resources. For instance, in mobilizing monetary resources, innovative power is exercised when governance actors provide new funding that influence decisions or actions. Reinforcive power is exercised when actors perpetuate the current allocation of funds. Transformative power is exercised when actors change how funds are allocated among actors or initiatives, while destructive power is exercised when actors stop funding for the current project. Moreover, Avelino (2011) suggests that these forms of power (innovative, reinforcive, transformative, and destructive) can also be applied to situations that do not involve (goal-oriented) decision-making. In this regard, the author argues that:

> … in order to keep an issue of the agenda, one must either get completely rid of this issue (destructive power), or claim that other issues are more urgent, either by emphasizing existing issues on the agenda (reinforcive power), by inventing a completely new issue (innovative power), or by developing a new paradigm (transformative power). (p. 81)

Using the case of Prescott AMA, I assess how these different forms of power support or oppose decision-making in sustainable water governance.

Although power is not an object that can be isolated and studied, some methods in political ecology that have been used to study power include participant observation, qualitative interviewing, discourse analysis, and sociological analysis of complex institutions (Mackenzie, 1995; Paulson et al., 2003). For example, in a study of the

relationship between farmers and the environment in Kenya, Mackenzie (1995) used a combination of oral histories through ethnographic interviewing and archival records to understand gendered struggles to control land. In this study, Mackenzie (1995) found that the sustainable management of soils in the region is dependent on the level of wealth of households, and the extent to which women have rights to land ownership. Interviewing generally provides a means to interact with respondents and gives access not only to their words but non-verbal expressions as well. However, despite the strides that have been made in the empirical analysis of social relations (and power), continual methodological refinement is necessary due to the role of power in promoting or inhibiting sustainable resource governance.

I develop and present a deductive process for analyzing power in water governance research by drawing on content analysis methods and building on Avelino and Rotmans' (2011) power framework (presented in Chapter 3). For the analysis that proceeds from this deductive process, I rely mainly on data from the interviews conducted. However, in addition to interview data, I narratively integrate interview findings with direct observation (field) notes, archival records, and document review in the results presented (Chapter 4).

Overall, previous research on water resources in the Central Highland region show that power is exercised not only by government but also non-government actors[8]. Bolin et al. (2008) shows that in resisting groundwater importation into Prescott AMA, civil society groups invoked the federal Endangered Species Act to give legitimacy to their claims. Yet, the need to legitimize their stance raise questions about how much

[8] These government and non-government actors include political economic interests working through the government as well as outside government.

'governance' actually exist in the study area. In addition, Whitmire (2013) argues that the Prescott AMA structure gives Prescott AMA communities political power within the state legislature that civil society and neighboring communities lack, and "which substantially thwarts the ability of communities to collaboratively develop and implement timely and appropriate regional water management policies" (p. 126). These findings on power in the study area raises questions about the extent to which an AMA designation or 'legitimacy' promotes water sustainability in the Central Highlands. These questions though seemingly local, reflect the constraints of water governance in many urban areas where water resources are impacted by climate variability and change and rapid population growth (Vorosmarty et al., 2000). In research question three, I address these knowledge gaps by assessing how power is exercised by different actors related to the AMA's water governance. I contribute to the field of water governance by improving understanding of the relationship between governance structures and water sustainability.

**Conclusion**

Governance − which involves the increased participation of non-government actors in decision-making − is a fairly nascent theme in water resource research. This development, alongside stressors of climate variability/change and population growth, has created higher standards for water resource planning and sustainability. Within Prescott AMA, different values of government and non-government actors on water issues and the absence of deliberative democratic processes fuels the region's persistent conflict. Meanwhile, research and stakeholder publications from the Central Highlands suggest that Prescott AMA is not achieving its management goal of safe yield – a partial

metric for water sustainability that does not consider natural discharge through baseflow and evapotranspiration. In the rest of this dissertation, I utilize a novel framework that integrates propositions of vertical governance, horizontal governance, and power to investigate (1) water governance across state, regional, and local levels; (2) collaborative governance at the local level; (3) the effects of AMA 'legitimacy' and other exercises of power on the region's water sustainability. In the next chapter (Chapter 3), I discuss the qualitative methodology used in this research.

# CHAPTER 3

# METHODOLOGY

A qualitative methodology was adopted for this research. Such a methodology is appropriate because of the descriptive and investigative nature of the research questions posed. According to Gay and Airasian (2000), research that uses the qualitative methodology "seeks to probe deeply into the research setting in order to obtain understandings about the way things are, *why* they are that way, and *how* the participants in the context perceive them" (p. 16, emphasis in original). Among the different approaches to qualitative research available, this study was completed using the case study approach (Creswell, 2013). A qualitative case study methodology was adopted because of this research's in-depth focus on a delineable geographic and social arena − Prescott Active Management Area (AMA) (Yin, 2013).

In line with features of the qualitative methodology, I used narrative data of primary and secondary origin (Gay and Airasian, 2000; Gay, 1996). Primary data were gathered through interviews and fieldwork, while secondary data were obtained from archival sources and documents. Furthermore (as characteristic of the qualitative methodology), I use quotes of people's experiences gathered through in-depth interviews and from other textual sources (Taylor and Bogdan, 1998). Inductive and deductive analyses were conducted using text-analysis methods from grounded theory and content analysis, thus, covering the spectrum from systematic coding to qualitative interpretation. In the remaining sections within this chapter, first, I present the methods of data collection, preparation and analysis employed. Second, I present the specific analysis conducted for the three research questions analyzed in this dissertation.

## Data Collection

The four data collection instruments used in this research are in-depth interviews, fieldwork (direct observation), archival sources, and document reviews. I discuss each data collection instrument below.

**Semi-structured Interviews.** I adopted a semi-structured interview style in this research to allow the comparability of responses across different groups. A semi-structured interview involves the use of an interview protocol to guide questions asked, where the interviewer can ask further questions if needed (Bryman, 2012). Unlike a structured interview, this interview style allows respondents to answer questions with as much detail as they can provide. The use of semi-structured interviews also allowed for subjective responses, especially in regard to questions that interrogated relations and interactions among governance actors in the study area. Interviews for this dissertation were conducted through summer 2015 to spring 2016.

Two sets of interview guides were initially developed for this research. The first guide was tailored to interview government actors at different levels of governance (i.e., local municipalities and regional-state agencies) while the second was designed to interview non-government actors. The questions within these two interview guides were divided into four topics: water management, vertical governance, horizontal governance and water sustainability. Each section had main questions that were generally asked of all governance actors interviewed, and probe questions that were only asked as needed. For example, a main question could be: what programs do you implement in order to achieve safe yield? Meanwhile, a probe question would be: who provides oversight for these programs?

The interview guide topic of water management was aimed at getting background information about the respondents' entry into, and role in water governance within the region. Also, water management questions interrogated the area's water management goal(s). Questions asked included: How did you get involved in water issues? What are the main water management goals in this area? These questions and others generally provided data on interviewee's perspective of the area's water governance. The second interview guide topic (vertical governance) focused on interaction between state level governance actors, regional level, and local level actors. An example of the questions asked includes, how do you interact with the ADWR office? This second topic specifically examined the first research question of this study, which is *what interactions exist between government actors involved in water management across regional to state levels, and how do these interactions contribute (or not) towards sustainable water governance?* Meanwhile, the third interview guide topic (horizontal governance) focused on interaction between governance actors at the same level and included questions such as: what relationship exists between your department and local water groups? This interview topic was aimed at interrogating this study's second research question, which is *in what ways do diverse actors in the study area coordinate in governing water resources, and how do these interactions contribute (or not) towards sustainable water governance?* Finally, the fourth topic of the interview guide had questions interrogating water sustainability in the study area with questions such as: what are the impacts of the Groundwater Management Act and the goal of safe yield in this area?

There were no direct questions about power in the interview guide. Instead, the aim of this research's methodology was to investigate power through deductive analysis

of governance actor responses to questions on water management, actor interactions and the area's water sustainability and safe yield management goal. This approach was taken to reduce the bias that could be introduced when governance actors are asked directly about power. Notwithstanding, many governance actors referred to power specifically, or issues of power without being prompted. All responses were triangulated with other data sources to arrive at the results presented in Chapter 4. The deductive process applied in analyzing power is explained later in this chapter.

After the first couple of interviews in the summer of 2015, a third interview guide was designed with additional questions specifically for state level actors. These questions were a result of insights gained during the initial interviews. The additional questions were targeted at assessing the role of state level actors in Prescott AMA's water governance. A sample question from this interview guide is: what are the responsibilities of your office in ensuring that Prescott AMA achieves safe yield? The questions in this guide provided data specifically for research question one. All the interview guides are included as Appendix A.

Interview respondents were identified purposefully. This purposive sampling strategy is different from the notion of sampling in quantitative research. Purposive sampling in qualitative research involves approaching respondents based on the goal of research (Bernard and Ryan, 2010). This approach is useful in the study of special populations – in this case, key actors and stakeholders in the study area's water governance. Hence, the respondents interviewed are considered key actors and informants regarding Prescott AMA's water governance.

Another distinctive feature of this research's purposive method for selecting respondents is that, eventually, the research involved interviewing (most of) a population as opposed to a sample (Trochim and Donnelly, 2009). Specifically, the key persons that could speak about water resources in each of the municipalities within the AMA were interviewed. Out of the fifteen people contacted, a total of thirteen people were interviewed. One person declined to participate while the other person was not available throughout the course of the research. These interviews involved both government and non-government actors at different jurisdictional levels (Table 2). In all, representatives from two local civil society groups within the broader region of the study area were interviewed. Also, out of a five-member Groundwater Users Advisory Council (GUAC), four people were interviewed, three of whom are current members. Finally, two ADWR staff members were interviewed. Some interviews had more than one person at a session and one person was interviewed twice. Overall, I conducted twelve in-depth interviews with thirteen respondents.

Table 2.
*Government and Non-Government Actors Interviewed for this Study*

| | **Government actors** | **Non-government actors** |
|---|---|---|
| **State (ADWR) level** | 2 | - |
| **Regional (AMA) level** | - | 6 |
| **Local (municipal) level** | 4 | 1 |

All the interviews conducted in Prescott AMA and Phoenix were in-person with ADWR staff. Each interview lasted an average of sixty minutes and each was recorded. Consent was obtained for all interviews and a consent letter served as the instrument of recruitment (see Appendix B and C for this research's Institutional Review Board (IRB)

exemption, and consent letter). Respondents' contact information was obtained from public sources such as organization websites and phone books.

Water stakeholders in the study area belong to multiple groups, each with a different mission and these distinctions in each group's focus are reflected in the interviews conducted (see Table 3 for the different groups the interviewees represent). One possible advantage of this method was that during the interviews, I was able to get a more comprehensive view of water governance in the study area. However, one problem with this multiplicity of roles was the challenge in defining who was a government actor and who was not, based on their roles in different contexts. For example, one respondent was a municipal staff and a member of the Groundwater Users Advisory Council (GUAC), should they be considered a government actor on the GUAC or a non-government actor? I tackled this challenge by grouping respondents by whether their participation in a category was linked to their elected, appointed, or civil service position[9]. In the foregoing example, the municipal staff is a government actor based on their civil service position. However, I identify them as a non-government actor on the GUAC because they are putatively representing a particular water use sector.

As a result of the overlapping roles performed by water stakeholders in the study area, during fieldwork I sought out individuals who could respond to the same questions I already had responses to. This helped me validate the information received from different actors within the same actor group. Table 3, below, is not a comprehensive deduction of all the categories of my thirteen respondents. However, Table 3 presents a summary of the groups represented by the interviewees based on the specific responses I received

[9] For example, the mayor is an elected government actor, director of the Arizona Department of Water Resources is appointed, while municipal staff are civil service government actors.

from them regarding their affiliate roles. Thus, a government actor could be an exempt well owner but if they did not offer responses related to being an exempt well owner, then (in Table 3) I did not include them in the category of being an exempt well owner. Essentially, the goal of the interviews, to gain perspectives from government and non-government actors in different categories on the interactions that occur between actors in achieving water governance goals, was achieved.

An important governance change that occurred in Prescott AMA since Bolin et al.'s (2008) study is the closure of the local Arizona Department of Water Resources (ADWR) office. While designing this research, using information from published research (Bolin et al., 2008), I intended to interview the local ADWR AMA director. However, during my fieldwork, I found that the local ADWR office had closed in 2010. In its place, Arizona has one AMA director for all five AMAs in the state where there had been one for each AMA. As discussed in the next chapter, the closure of this office (due to budget cuts as a result of the state's economic downturn in 2008) significantly reduced water governance capacity in Prescott AMA. Nevertheless, I interviewed the AMA director who provides oversight to all the AMAs, including Prescott AMA.

Table 3.
*Affiliations of the Governance Actors that Participated in Study*

| | |
|---|---|
| Arizona Department of Water Resources (ADWR) | Government Actors |
| Northern Arizona Municipal Water Users Association (NAMWUA) | |
| Upper Verde River Watershed Protection Coalition (UVRWPC) | |
| Municipal Staff and Official | |
| Verde River Basin Partnership (VRBP) | Non-Government Actors |
| Prescott AMA Groundwater Users Advisory Council, GUAC (current and former) | |
| Citizens Water Advocacy Group (CWAG) | |
| Exempt well owners | |

Unlike quantitative research, qualitative research does not require a large pool of respondents due to the in-depth nature of interviews and the emphasis on other data collection instruments (Gay and Airasian, 2000). In fact, there are no precise upper or lower limits to the number of respondents to be interviewed in a qualitative study as these limits depend on the purpose of the research (Baker et al., 2012, p. 42). The purpose of this research was to assess water governance in the study area. Therefore, the respondents interviewed are key actors that cover the spectrum of government and non-government perspectives for governing water in the area. In addition to the foregoing reason, the interviews with thirteen respondents are adequate for this research because of the central role also played by other data sources (fieldwork, archives, and documents). The process for selecting respondents is further explained in the section, theoretical sampling for interviews.

**Fieldwork (Direct Observation).** Observation as a qualitative data collection instrument allows a "real-world" setting for case study research (Yin, 2013). Specifically,

direct observation is a non-participant form of observation. This means that I did not participate in any public activities. Instead, through everyday conversations, I learned what life in the communities was like and how the local culture and character of the four study area municipalities affect how water was viewed and used. Some of the observations I made confirmed what has been documented in literature, such as the role of Homeowner Associations (HOAs) in influencing water use (Turner and Ibes, 2011). However, making this observation myself was important because I saw − specific to the study area – how the requirements of HOAs such as landscaping preferences, could promote or discourage, for example, water conservation or conversations of water sustainability.

Fieldwork helped in triangulating my interview findings. For example, in discussing how connecting municipal residents to a central sewer system could contribute to water sustainability, respondents identified the sprawling layout and low density of certain parts of the AMA as a possible constraint. By personally observing the municipalities in Prescott AMA, I was able to better understand the context for these interviewee comments. Specifically, the City of Prescott's development is considerably compact, but the city delivers water to areas within the county that are dispersed and far from the city center. However, without sewer lines already extended to those areas, it is expensive for the municipality or those residents to have their wastewater transported to the city's wastewater treatment facilities for possible underground storage. Meanwhile, this dispersion is the norm in Dewey-Humboldt, where the town does not have a central water or sewer system and does not have plans to develop these services for reasons I will discuss extensively in the Chapter 4. Overall, field notes were useful in triangulating and

understanding the themes on power derived from other data collection instruments. The ability to triangulate findings is important because power cannot necessarily be isolated and studied.

**Archival records.** Archival records used include historical water demand and supply data for Prescott AMA, legal records (of water litigation), and hydrology maps. Sources of these archival records were Arizona Department of Water Resources, Lexis Nexis, and Arizona State University GIS repository. This instrument was essential in triangulating my findings from interviews and fieldwork. For example, interviews revealed that the Chino Valley-Prescott case is one of the longest-running Arizona Supreme Court cases over water. By reviewing archived legal records, I found that Chino Valley legally challenged Prescott in 1972 and the case continued till 1981 before it was dismissed by the Supreme Court of Arizona. The availability of supplemental information such as this was essential in completing this dissertation.

In addition, hydrology and municipal Geographic Information System data and maps were important for situating the municipalities, and the different water resources that were identified during interviews and fieldwork. These maps also gave context for references to features such as the 'Mingus Mountain', which is the dividing or boundary line between the Prescott area and Verde Valley. Also, maps helped in triangulating interview findings on the interaction of governance actors that share the same groundwater basin and those who do not.

**Document Review.** Published literature and other documents provided important historical perspective on the process that created Prescott AMA. Even though documents are secondary data with varying levels of reliability, three potential strengths are that (1)

they are ‘unobtrusive’; (2) they are not created from the ongoing study making them a useful source for validating research (3) they are able to cover a wider span of time regarding the research (Yin, 2013). The documents collected and reviewed for this study include peer-reviewed articles, publications by the Arizona Department of Water Resources and other groups, for example, municipal government and non-government actors. The Verde River Basin Partnership, Upper Verde River Watershed Protection Coalition, and Citizen Water Advocacy Group, for instance, have publications that are either scientific studies, informational about the entire region, or specific to the group’s activities.

Documents were used before fieldwork to gain an understanding of water issues in the study area, and the main actors involved in governance. The documents used at early stages of this research were peer-review articles that focused on Central and Northern Arizona water governance (Abraham, 2007; Bolin et al., 2008; Collins and Bolin, 2007). Documents such as news articles were used during the process of semi-structured interviewing for up-to-date developments on recent activities, and to focus interview questions. Documents were further used during the analysis of semi-structured interviews to triangulate findings. For example, respondents made reference to a Central Yavapai Highlands Water Resource Management Study (CYHWRMS). I obtained this report to ascertain contents of the publication and understand its role in the area’s governance.

**Theoretical Sampling for Interviews**

The method for interviewing that I employed was not only purposive but also involved theoretical sampling, that is, subsequent data collection was influenced by the results of ongoing data analysis (Bernard and Ryan, 2009; Corbin and Strauss, 2014). The research plan at the beginning of this study was to interview governance actors from seven different groups: Prescott AMA ADWR office, municipal water departments, Upper Verde River Watershed Protection Coalition, non-government actors, water use sectors (agricultural, industrial and municipal), private water companies, and exempt well owners. These groups were identified through literature reviews.

However, fieldwork revealed that a local Prescott AMA ADWR office no longer existed. Second, only three of the municipalities had a municipal water system, though it was possible to get actors knowledgeable on the water resources of each respective municipality. Third, fieldwork revealed the Citizens Water Advocacy Group (CWAG) to be an important non-government actor in the Quad-City Area. Fourth, fieldwork and interviews showed that irrigated agriculture and industrial water use was minimal in the AMA. In validating this finding, archival data of reported water demand in the AMA that was published by ADWR showed that in 2010, irrigated agricultural water usage was 11.4% while industrial was 5.6% of total demand. Finally, initial interviews revealed Prescott AMA Groundwater Users Advisory Council (GUAC) to be an important AMA governance actor in the area. These combinations of factors resulted in an evolving plan where industrial and agricultural water sector users were not interviewed while GUAC members were interviewed as regional level governance actors. To get further

perspectives from non-government actors, I interviewed a representative of the Verde River Basin Partnership.

Overall, water governance in the study area involves actors belonging to more than one governance category. Actors from the following groups were eventually interviewed: Arizona Department of Water Resources (Phoenix), Northern Arizona Municipal Water Users Association, Prescott AMA Groundwater Users Advisory Council, Citizens Water Advocacy Group, Verde River Basin Partnership, Upper Verde River Watershed Protection Coalition, municipal water departments and exempt well owners (Table 3).

**Data Preparation**

Data analysis is a multi-stepped process that involves many activities that often have to happen in tandem. Interview transcription occurred at different periods depending on which interviews had been completed per time. Interviews with all thirteen governance actors that participated in this study were transcribed, formatted and saved as rtf for upload into MAXQDA, a qualitative analysis management program. In order to ensure the anonymity of respondents, pseudonyms were used in the transcripts wherever individual names were mentioned. The rapport building part of the interviews where the respondents described their background was also excluded to preserve respondent anonymity. This is in line with research ethic procedures at Arizona State University.

As part of the data preparation stage, long passages of text in the transcript were divided into smaller segments. This is because I used text segment as my unit of analysis (that is, paragraph). Segments were determined mainly by turns in conversation.

Segmenting the text passages was an iterative process that also involved making judgment calls on punctuations.

## Methods and Analysis

While methodology is "a way of thinking about and studying social phenomena", methods generally are the "techniques and procedures for gathering and analyzing data" (Corbin et al., 2014, p. 3). I adopted grounded theory and content analysis methodologies in this research. Specifically, I used the inductive process developed in grounded theory for analyzing research questions one and two. This is because of this study's aim to understand the specific water governance interactions within the study area. Meanwhile, content analysis methods were used in the deductive analysis conducted for research question three. This is because content analysis methods are particularly appropriate for deductive analysis (Bernard and Ryan, 2009). In the rest of this chapter, I explain the coding and pile sort techniques employed in this research, and the specific analysis conducted for each research question.

**Coding.** Coding is the process of tagging segments of data with a word or words while a code is the tag (word/s) given to the data segment (Charmaz, 2014). In this research, the analysis for each research question included both first cycle and second cycle coding (Saldaña, 2012). The first coding cycle involved all initial code generation attempts. During the second coding cycle, codes generated in the first cycle were iteratively reorganized and combined to form more specialized categories (Saldaña, 2012, p. 58).

Coding can either follow an inductive or deductive approach. Inductive analyses were carried out in answering research questions one and two (using grounded theory methods), while a deductive approach was used for the analysis of research question three (using content analysis methods). The adopted grounded theory methods are initial coding, focused coding, and the grounded theory codebook development process (Charmaz, 2014; Corbin et al., 2014). Grounded theory methods were appropriate for research questions one and two because these methods support induction (Bernard and Ryan, 2009). In terms of content analysis methods, thematic coding was adopted for research question three. Also, the content analysis method for developing codebooks was employed. These content analysis methods are appropriate for research question three because they support deductive analysis (Bernard and Ryan, 2009).

Codebooks are developed at different stages of a qualitative research, depending on if the approach is inductive or deductive. Consistent with inductive analysis, I developed the codebooks for research questions one and two during the coding process. However, because of the deductive approach to research question three, I developed the codebook before my analysis. Further details are provided in the analysis description for each research question.

For inductive analysis, invivo, descriptive, and versus codes were generated from the interview transcripts while theme codes from literature were used in this research's deductive analysis. An invivo code is a verbatim quote from text that also serves as a code (Saldaña, 2012). Invivo codes were used to capture phrases used by respondents that are significant to this research. For example, one of the invivo codes generated in analyzing research question one is *good faith effort.* This phrase was used by one

respondent in describing the Groundwater Management Act, management plans, and AMA management goal. Interestingly, the same theme (although not exact words) was found in other documents reviewed for this study.

A descriptive code tags a passage of text by a code to summarize the current event or experience (Saldaña, 2012). This code typically describes the event in a way that the code makes sense to a research team member who does not see the tagged text segment. An example from this research is *litigation is normal in the water world*, which describes those exact sentiments. A versus (vs.) code reveals the conflict between two ideas that occur in a data segment (Saldaña, 2012). An example from this research is *unhindered private property rights vs. regulated property rights.* This sample code was applied to text segments where respondents discussed conflicts between the need to protect property rights and the need for certain regulations if water sustainability is to be achieved.

Finally, a theme code is the word or phrase derived deductively (for example, from literature) that serves as a code for textual data (Bernard and Ryan, 2009). In this research, theme codes were applied in analyzing research question three. To understand how power is exercised by actors, *human resource, artefactual resource, mental resource, monetary resource and natural resource* as defined in the literature section, were applied as theme codes to the interview transcripts. The theme codes were derived from Avelino and Rotmans (2011) power framework. In summary, inductive codes were derived from analyzing interview transcripts while deductive codes were derived from literature.

Three coding techniques were used for analysis: initial coding, focused coding, and theme coding. *Initial coding* is a micro-level coding technique that analyzes words,

phrases, and sentences (Saldaña, 2012). In this research, initial coding was used to generate invivo, descriptive, and versus codes. *Focused coding* involves the abstraction of categories from initial codes (Saldaña, 2012). I used focused coding during the second coding cycle to group codes derived in the first cycle. *Theme coding* is a technique for marking instances of a particular code in the text (Bernard and Ryan, 2009). Theme coding is a deductive coding technique.

**Pile Sorts.** Pile sort is a technique for manipulating textual data. This technique involves sorting (typed and printed) data based on some defined criteria (Bernard and Ryan, 2009). It is a method generally applied across most qualitative methodologies including grounded theory and content analysis. In this research, I mostly used the pile sort technique to sort codes derived from first cycle coding as I progressed into second cycle coding. I describe my use of pile sorts in the upcoming sections.

**Research Question 1**

*What interactions exist among governance actors involved in water management across local to state levels, and how do these interactions affect sustainable water governance?*

This research question was analyzed inductively. The governance levels in focus were the state (ADWR), the regional (AMA), and the local (municipal). The analytic goal for this research question was to discover interactions across these three levels that contribute (or not) to the region's safe yield goal and overall water sustainability. Transcripts of in-depth interviews conducted both in Phoenix and the study area municipalities (Prescott, Prescott Valley, Chino-Valley, and Dewey-Humboldt) were used.

In the first coding cycle for this research question, I used initial coding to generate 293 invivo, versus and descriptive codes. Coding at this point was aimed at investigating the interactions among actors across state, regional, and local levels as found in the transcripts. Next, I grouped these codes by the three forms of interaction that could be present in the AMA's three levels of governance. These forms are interactions between the state level (ADWR) and the regional level (AMA), interactions between the regional level (AMA) and the local level (municipalities), and interactions between the state level (ADWR) and local level (municipalities). In a second coding cycle, I used focused coding to recode the initial codes I had generated. The purpose of this was to derive higher-level categories of governance actor interactions that affect the region's safe yield goal and overall water sustainability. These higher-level categories are the basis for the inductive codebook developed (Appendix D.1).

**Research Question 2**

*In what ways do actors at the local level coordinate (or not) in governing water resources, and how do these interactions affect sustainable water governance?*

Similar to research question one, this question was analyzed using inductive methods with the goal of identifying avenues of interactions (among local level governance actors) that affect the region's safe yield management goal and water sustainability. I used the initial codes generated in research question one but with a focus on only those pertaining to municipal actors within the AMA. A total of sixty-two invivo, versus and descriptive codes were transferred from the initial coding conducted for research question one.

I started this research question's second cycle with focused coding, using pile sorts to group the sixty-two codes into categories. After an iterative process of sorting and resorting the codes, the two themes that emerged are interactions around shared interest goals and interactions around shared groundwater (see Appendix D.2 for codebook). The codebook developed includes codes of a specific shared interest goal (Big Chino Water Ranch project), and shared groundwater issues (such as intra-basin water transfer, groundwater recharge etc.) at the local level. The discussions of these interactions are presented in Chapter 4.

**Research Question 3**

*How is power exercised among a variety of water governance actors across levels, and what are the implications for sustainable water governance?*

Power cannot be seen and could pose a methodological challenge. Thus, using content analysis methods, I developed a deductive process for interrogating power in water governance research. Building on Avelino and Rotmans (2011) power framework, I developed code definitions to guide power analysis that can be adopted for other water governance research (Appendices E – G).

All primary interview transcripts were used in analyzing this research question. The analytic goal was to reveal the various forms of power exercised by different governance actors, and how the actions of governance actors influence safe yield and overall water sustainability. Analysis for research question three involved three phases discussed below.

**Phase 1: Analyzing Resources.** The first coding cycle for this research question was primarily focused on tagging interview transcripts with the five theme codes derived from literature (that is, human, mental, monetary, artefactual, and natural resources). These theme codes are important to the analysis of power because they reveal what resources have been and are being mobilized in the study area to address its safe yield management goal and overall water sustainability. The deductive codebooks (Appendix E) were developed using definitions from published literature, specifically Avelino and Rotmans' (2011) power framework. This framework distinguishes between actor mobilization of different resources and how resource mobilization leads to the exercise of different forms of power. I adopted Bernard and Ryan's (2009) deductive codebook format. I updated and refined my initial deductive codebooks as coding progressed. The Tables in Appendix E are the final deductive codebooks developed.

The first cycle coding process for this third research question involved going through all the transcripts with one code, then another until all the codes had been applied. In the second coding cycle, the coded segments for each of the five theme codes were retrieved for further analysis in a spreadsheet. My goal in using the spreadsheet was to analyze coded segments further with the following guiding questions: (1) What are specific examples of the current resource identified in this text segment? (2) Who is mobilizing this example of the current resource? Thus, in the second coding cycle, I analyzed coded segments from the first cycle for specific examples of each resource.

During the first coding cycle of interview transcripts, 223 text segment references to the AMA's water governance were coded. In the second coding cycle, 110 actors/actor

groups were identified (Table 4). A comprehensive list of the actors/actor groups derived from the second cycle coding is presented in Appendix F.

Table 4.
*Frequency of Resource Coding from Data Analysis*

| Codes (resources) | First cycle coding (resource types) | Second cycle coding (specific resource examples) |
|---|---|---|
| Human | 223 | 110 |
| Artefactual | 86 | 34 |
| Mental | 177 | 78 |
| Monetary | 80 | 22 |
| Natural | 165 | 66 |

**Phase 2: Analyzing Power.** Using the pile sort method, I grouped the specific examples of each resource derived from the second coding cycle into the different actor classes (Appendix G). I adapted the definitions of power and resources provided in Avelino and Rotmans (2011) and Avelino (2011) to create *tables of definition* for different forms of power based on how actors mobilize different resources. The guiding question for creating this table of definitions was: how can each form of power (innovative, transformative, destructive and reinforcive) be demonstrated with each resource (artefactual, mental, monetary and natural) within a water governance framework? The result of this process is presented in Appendix H, which contains the definitions of power that were used in interpreting what form of power was wielded by actors in mobilizing resources. Specifically, it presents how each type of power is defined based on the mobilization of each resource. Human resources are not included in Appendix H because the seven actors/actor groups presented in Appendix G are the *human resources* that wield power and mobilize resources.

Finally, I queried each class of governance actors using these tables of power definition, and the analytic questions I developed. The analytic questions were essentially

culled from the tables of power definition. For example, *"Innovative Power* is the capacity of actors to create or discover new resources" (Avelino and Rotmans, 2011, p. 799). Thus, the analytic question I developed for assessing innovative power among the governance actors was: how has a particular actor created, for example, mental resources in the study area's water governance? Below, I present a summary of the analytic questions developed. These power-specific questions were applied to Prescott AMA's past and present water governance activities:

- How has *group x* invented, created or introduced *y-resource* into study area governance? (Innovative Power)
- How does *group x* sustain current institutions such that the distribution of *y-resource* remains the way it is? (Reinforcive Power)
- How has *group x* changed/is changing the way in which *y-resource* is distributed? (Transformative Power)
- How has *group x* excluded, prevented, discredited or delayed use of *y-resource* within the study area's water governance? (Destructive Power)

The results presented in Chapter 4 are a product of all four data sources employed in this research, not only interview data.

**Phase 3: Investigating power in water governance.** In this dissertation, I define power as being wielded when actors mobilize resources (Avelino and Rotmans, 2011). Through this mobilization of resources, the type of power wielded could be innovative, reinforcive, transformative or destructive. To recap Chapter 2, innovative power is the power to create resources. Reinforcive power is the power to maintain the current distribution of resources. Transformative power is power to move resources from one place to another, and destructive power is power to annihilate existing resources or resource mobilization that keeps issues off the agenda (Avelino, 2011; Avelino and

Rotmans, 2011). I conceptualize power to be wielded by actors, not something that exists independently.

The guiding sub-question for research question three was: *based on resource mobilization, who is exercising power?* I discuss research question three in terms of who (the human resource) is wielding what type of power based on how they (the human resource) mobilize each of the remaining four resources: artefactual, mental, monetary and natural (Table 5). Thus, in the results presented in Chapter 4, I discuss how the different forms of power exercised by governance actors across the state, AMA, and local levels influence Prescott AMA's safe yield management goal and overall water sustainability.

Table 5.
*Summary Description of Resources*

| |
|---|
| Human resources are the people involved in water governance. |
| Mental resources include tangible and intangible mental products that have to do with water governance in the study area specifically. |
| Monetary resources include funds and other cash or financial products. |
| Artefactual resources include man-made objects that are needed in extracting, transporting, or using water. |
| Natural resources refer to the different liquid forms of water. |

Adapted from Avelino and Rotmans (2011, 798)

## Conclusion

In this research, I adopted a qualitative case study methodology which involved the triangulation of in-depth semi-structured interviews, direct observation, archival records, and document review. Textual data obtained from these data sources were analyzed using initial and focused coding from grounded theory (inductive analysis) for *research questions one and two*, and theme coding from content analysis (deductive analysis) for *research question three*. Codebooks were developed for all three research

questions depending on if an inductive or deductive approach was being applied. The analytic codes derived for *research questions one and two* comprise avenues for water governance interactions across jurisdictional levels (such as management plans, technical resource, funding, among others), and at the local level (such as Big Chino Water Ranch project, intra-basin water transfer, groundwater recharge, among others). Deductive codes for *research question three* were derived from literature and include human, mental, monetary, artefactual, and natural resources. In the following chapter (Chapter 4), I present the results obtained from analyzing the three research questions framing this dissertation.

# CHAPTER 4

# RESULTS

This chapter presents the results of addressing the research questions posed in Chapter 1. With focus on how interactions among governance actors and their mobilization of resources affect water sustainability, these questions are:

- What interactions exist among governance actors involved in water management across local to state levels?
- In what ways do actors at the local level coordinate (or not) in governing water resources?
- How is power exercised among a variety of water governance actors across levels?

The focus of this dissertation (and this chapter, especially) is not to present an exhaustive list of governance achievements in the study area. Instead, this chapter focuses on different avenues through which governance actors in the study area interact, how those interactions influence the management goal of safe yield, and how different forms of power exercised affect the region's safe yield goal and overall sustainable water governance.

In the following sections, I present the results to the research questions detailed above. The research questions are essentially sequential in nature. The first question assesses vertical interaction between governance actors, the second assesses horizontal interaction between governance actors, and the third assesses the wielding of power across vertical and horizontal levels of governance. However, I start by discussing the mandated water sustainability goal for Prescott AMA – that is, safe yield.

**Prescott AMA's Water Sustainability Goal: Safe Yield**

Safe yield was identified as the management goal of the Prescott Active Management Area (AMA) in 1980 when the Groundwater Management Act was enacted. According to the Act, "The management goal… is safe-yield by January 1, 2025, or such earlier date as may be determined by the director" (ARS 45-562). The Groundwater Management Act defines safe yield as a "groundwater management goal which attempts to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn in an active management area and the annual amount of natural and artificial groundwater recharge in the active management area" (Groundwater Management Act, 1980, p. 1437).

Historically, overdraft data for Prescott AMA shows high year-to-year variability with a steady increase in groundwater overdraft between 1985 and 2010 (the most recent year for which data is available). Water governance actors, such as the Groundwater Users Advisory Council, municipalities, and interested residents, use annual groundwater overdraft data to evaluate the status of safe yield within the AMA. This data is computed and made available by the Arizona Department of Water Resources. The groundwater overdraft data presented below (Figure 6) shows that the region is not currently at safe yield.

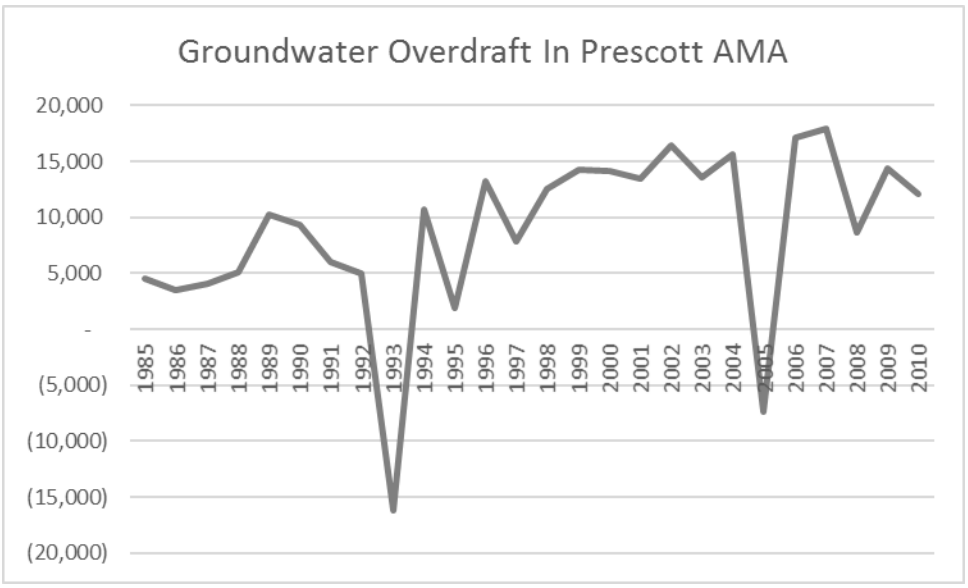


*Figure 6*. Prescott AMA Groundwater Overdraft
Note: According to ADWR's groundwater model, 1993 and 2005 are years of high net natural recharge.

The results provided in this chapter present ways that governance actors interact across levels (vertical governance) and at the local level (horizontal governance), and what these interactions mean for sustainable water governance. Details of how power is wielded in water governance are presented within the results of vertical and horizontal governance, but these are cumulatively presented in a separate section for power. A discussion of the findings of all three research questions is provided in Chapter 5.

**Research Question One: Vertical interactions in governance**

This section presents results for the research question: *What interactions exist among governance actors involved in water management across local to state levels, and how do these interactions affect sustainable water governance?*

In order to achieve this, I examined interactions between governance actors at different levels of the jurisdictional scale. The jurisdictional scale of this study consists of

the state level, AMA level, and local level. The Arizona Department of Water Resources (ADWR) is the governance actor at the state level and is a government actor. ADWR is an institutional body created by the 1980 Groundwater Management Act (GMA) to administer water resources in Arizona. There are two governance actors at the AMA level namely, Groundwater User Advisory Council (GUAC) and Citizens Water Advocacy Group (CWAG). GUAC was created by the GMA to advise the Prescott AMA director, make recommendations on groundwater plans, and comment on proposed management plans. The GUAC is made up of members that are appointed by the Governor (Groundwater Management Act, 1980, p. 1401-1402). In contrast, CWAG was formed by citizens and is a non-government actor within the study area that aims to promote a "sustainable water future in the Upper Verde River basin and the Prescott Active Management Area. [They] educate the public, encourage citizen action, and advocate for responsible governmental decision-making" (Citizens Water Advocacy Group, n.d., p. 1). At the local level, I focus on the four municipalities in the region, which are City of Prescott, Town of Prescott Valley, Town of Chino Valley, and Town of Dewey-Humboldt.

In the following sections, I first present vertical interactions between the state level (ADWR) and the regional level (GUAC, CWAG); second between the regional level (GUAC, CWAG) and the local level (municipalities); and third between the state level (ADWR) and the local level (municipalities). Through the presentation of interactions in the following sections, I detail ways through which AMA governance actors interact in the region's water governance and, specifically regarding the AMA's management goal of safe yield.

**Interactions between State and Regional Levels.** The qualitative analysis of in-depth interview transcripts conducted for this study identified four primary means of interaction between ADWR, GUAC, and CWAG. These are meetings, management plans, technical resources, and funding.

***Meetings.*** The bulk of interaction between ADWR and GUAC occurs during GUAC meetings. Prior to 2011, the meetings took place mostly on a monthly schedule. However, according to ADWR records, meetings have taken place about three times a year between 2012 and 2016, since the regional ADWR office within Prescott AMA was closed due to state budget cuts[10]. Hence, the frequency of meetings is impacted by ADWR's small Active Management Area section staff and the fact that ADWR staff have to commute to the Prescott Area from Phoenix.

GUAC meetings are open to the public and are attended by CWAG members. A typical agenda for each meeting involves a specific presentation by ADWR staff (that often has a discussion component), a report from ADWR's State-wide AMA director, a call to council, and a call to the public. One previous presentation given by ADWR staff focused on the use of ADWR's groundwater flow model for water management in the AMA. Most meetings have an update discussion on potential conservation, augmentation, and monitoring projects meant to help achieve the AMA's safe yield goal. Overall, the GUAC meetings are an avenue for all attendees (council members and the public) to ask questions of ADWR staff, and thus serve a very informational function between water

[10] Instead of having a local office in each AMA, as of February 2017, ADWR has one Statewide AMA Director and three staff members in its Active Management Areas section, who are responsible for all five AMAs in the state.

governance actors at the state and local levels. The following interview excerpts illustrate the goal of and attendance at GUAC meetings:

> The GUAC meetings, part of the function of them is to provide information; like, we might have an update of hydrologic conditions in the AMA or for some of the AMAs, we've had someone from out hydrology section talk about land subsidence and monitoring of land subsidence. We might have an update on AMA water budget, supply, and demand, that type of thing. (ADWR, October 2015)

> The meetings were all public and they were well advertised. We always had ten or twelve interested individuals. (GUAC, March 2016)

The effectiveness of GUAC meetings in supporting any form of sustainable water governance or safe yield management goal within Prescott AMA is hindered partly due to the infrequency of meetings and lack of a local ADWR office. The infrequent meetings are a result of the closure of ADWR's Prescott AMA office and the administration of the state's five AMAs by one AMA director where there had been five AMA directors.

The closure of ADWR's Prescott AMA office followed the state's economic downturn and subsequent cuts to the Agency's budget by the state government. This AMA office closure not only constrains ADWR's work with GUAC but also ADWR's enforcement of groundwater rules at the AMA level. For instance, past records from the AMA show that despite being aware of legal allocations, users go over their groundwater allocations (Arizona Department of Water Resources Prescott AMA, 2007). However, situations like this can no longer be directly monitored by ADWR with the closure of its Prescott office. Thus, limited GUAC capacity and the closure of ADWR's Prescott AMA office limits interactions between ADWR and regional water governance actors.

In addition to GUAC meetings, CWAG organizes its own monthly meetings. These are not typically attended by ADWR staff unless there is a need, but by inviting

ADWR to address attendees, CWAG meetings serve as a forum for interaction between ADWR and the group. These meetings are informational in nature. An example of one of such informational interactions is presented in the excerpt below:

> We [ADWR] have been requested by CWAG in the past to speak at some of their meetings. Our Director, Tom Buschatzke, has on a couple of occasions spoken to them, I think I have once or twice. I remember one that comes to mind, CWAG had a question about salinity issues, what's going on with that… I think some other things that have been talked about are: what are some of the water budget issues within the Prescott AMA... It's been kind of general informational. (ADWR, October 2015)

Thus, in-person meetings provide a platform for information exchange and discussions between governance actors at the state and AMA levels on the region's safe yield mandate. These interactions (especially in recent years[11]) revolve around water augmentation pursuits and components of the AMA's Fourth Management Plan[12] (2010-2020) which was completed in 2014 and went into effect in 2017.

***Management Plans.*** Development of the AMA's management plan is another avenue for interaction between ADWR, GUAC, and CWAG. ADWR develops the water management plans for Prescott AMA, as required by the Groundwater Management Act (GMA) while both GUAC and CWAG provide comments to ADWR on drafted plans before they are adopted. GUAC is statutorily required to advise the AMA director and comment on management plans before they are adopted by ADWR's director (Groundwater Management Act, 1980), while CWAG provides its comments voluntarily. The procedure set forth in the GMA requires ADWR to formulate the management plan,

[11] I obtained GUAC meeting recordings for 2013-2016 from ADWR. I was informed by ADWR staff that these recordings were the only GUAC meeting records available.

[12] The significance of this pursuit with respect to Prescott AMA can be seen in the fact that at the time of this writing (2017), Prescott is the only AMA with a Fourth Management Plan (4MP) arguably because it is the only one of the safe yield AMAs without access to external water supplies. A goal for which power is being coordinated across governance levels to accomplish.

hold public hearings to receive comments on its content, and adopt the plan after comments have been received and addressed in some fashion.

Interviewees held varying degrees of convictions about how much advising GUAC provides to ADWR, both generally and regarding the management plans. These variations in opinion are possibly due to how each actor views the state of water governance in the AMA, and the varied opinions correlate with their impressions of achieving safe yield. Below are two exemplar quotes from GUAC members:

> We also monitored the management plans for the AMA, and that sort of thing is advisory, but we didn't do a whole lot of advising. We monitored what was going on mostly… [Safe yield is] a goal that just kind of floats around in the air because there are things that should happen that aren't. (GUAC, March 2016)

> We are advisors to, like, the Third Management Plan, the Fourth Management Plan. Going forward, if we have some issue that is raised or something that we don't like or something that we do like, we give feedback through our AMA coordinator who goes directly to ADWR's director. So, we have a very direct line of communication… We firmly believe that reaching safe yield by the year 2025 is very important… (GUAC, March 2016)

Development of the Fourth Management Plan was delayed due to ADWR's staff cuts in 2010. To date, three 10-year management periods have occurred, and the AMA is in the middle of its fourth period (2010-2020). ADWR completed the Fourth Management Plan for Prescott AMA in 2014, but its conservation requirements do not become effective until 2017 due to a reduction in the Agency's staffing.

The two main strategies within Prescott AMA's management plans for reaching safe yield are conservation requirements (for municipal, agricultural and industrial) and water augmentation measures, both of which are stipulated by the GMA. The conservation requirements of the Act do not apply to exempt well owners in the region,

who are estimated to withdraw 14% of the AMA's groundwater annually (Groundwater Users Advisory Council, 2006) due to exemptions provided in the Groundwater Management Act (GMA). According to the Act, the intent of the management plans is to progressively reduce groundwater withdrawals (Arizona Department of Water Resources, 2008). However, due to population growth, overall groundwater withdrawals have mostly remained constant despite reductions in agricultural withdrawals (Figure 7).

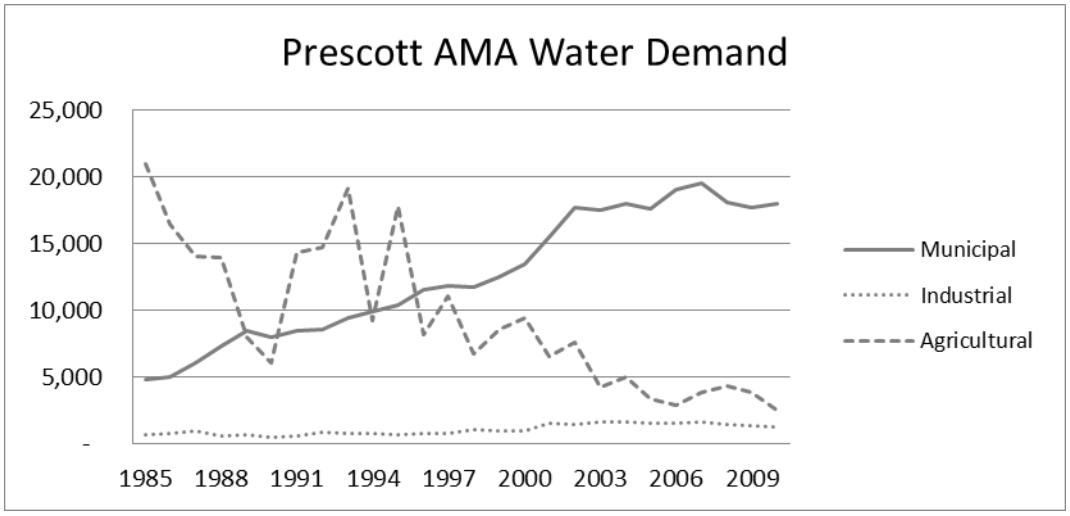


*Figure 7.* Prescott AMA Demand

The interaction between ADWR, GUAC, and CWAG regarding the management plans is limited to the period of their development and not their implementation. ADWR is responsible for monitoring water provider compliance to the management plans' conservation requirements. However, in the Fourth Management Plan, possibly due to its reduced staff capacity and insufficient political will (Larson et al., 2009), ADWR plans to approach enforcement of the management plan's conservation requirement with voluntary compliance. GUAC and CWAG provide feedback during GUAC meetings and through emails and/or letters to ADWR. Overall, ADWR's limited capacity as a result of limited budget, staff, and insufficient political will hinders the Agency's contribution

towards the region's safe yield goal and water sustainability through on-time development of management plans and enforcement of plan requirements.

***Technical Resources.*** Another avenue for interaction between ADWR and regional level actors is ADWR's provision of scientific expertise, which the Agency provides only within the stipulations of the GMA. Specifically, the GMA requires that the ADWR AMA director provide "technical and clerical and such other assistance to the groundwater users advisory council as is needed" (Groundwater Management Act, 1980, p. 1401). This requirement is fulfilled through ADWR's attendance at GUAC meetings and provision of, for example, groundwater modeling presentations. In its interactions with other governance levels, ADWR does not oversee or implement any programs that are not directly related to one of its specific statutory responsibilities.

As part of the technical expertise that ADWR provides to AMA municipalities, the Agency computes annual groundwater overdraft, which is used to determine if the region is at safe yield or not. In the final decision and order published after ADWR's director declared Prescott AMA out of safe yield in 1999, the director explained that calculating safe yield without considering base flow would be at odds with the intent of the GMA:

> The Department cannot accept the proposition that the legislature adopted a comprehensive Groundwater Management Act to protect the state from depleting its groundwater supplies, but adopted a management goal for the majority of the population of the state which allows those groundwater supplies to be drained. The long-term balance between groundwater withdrawals and recharge, specified by A.R.S. § 45-561(12), cannot be obtained without considering the significant loss of groundwater from the aquifers caused by natural discharge. (Arizona Department of Water Resources, 1999, p. 29)

The above quote is an example of how ADWR uses its technical expertise to interpret the GMA's safe yield mandate. As will be discussed in research question three, ADWR does

not always pursue scientific positions in its enforcement of the GMA. However, in this section, it is sufficient to note that ADWR's technical expertise is a major factor that promotes interaction across state to regional levels with respect to Prescott AMA's water governance.

In the mid-level governance role occupied by GUAC and CWAG, access to groundwater flow modeling information (MODFLOW) is provided by ADWR. For GUAC, MODFLOW data provided by ADWR helps keep GUAC members up-to-date on the technical aspects of the region's safe yield management goal. According to one of the GUAC members interviewed:

> What we don't know about the aquifer is huge, all right. I think that fellow's name is Abram, the one who comes up and talks to us in GUAC and shows us the underground hydrology. Apparently, there are currents like underground rivers down there. (GUAC, March 2016, pseudonym used)

CWAG, on the other hand, has members who are scientists but request information from ADWR from time to time. In this way, they stay current on technical aspects of the region's safe yield management goal. In addition, CWAG has access to ADWR's technical expertise through their attendance at GUAC meetings. The technical information that CWAG obtains from ADWR is part of the information that the group provides to AMA residents about the region's water resources through its website, meetings, and other outreach events.

***Funding.*** Another source of interaction between state and regional actors is funding, specifically Water Management Assistance Program (WMAP) funds from the groundwater withdrawal fees instituted by the GMA. The idea for WMAP originated during the Second Management Plan (1990-2000) as a "Conservation and Augmentation

Fund" but became known as the "Water Management Assistance Program" during the Third Management Plan (2000-2010). As included in the Fourth Management Plan:

> The Water Management Assistance Program (WMAP) is intended to provide financial and technical resources to assist water users in the development and implementation of conservation programs, facilitate augmentation and renewable water supply utilization, and obtain information on hydrologic conditions and water availability in the PRAMA. A.R.S. § § 45-567(A)(5) and (A)(7). (Arizona Department of Water Resources, 2014a, p. 9-1)

Currently, the sources of WMAP are (1) groundwater withdrawal fees collected from operators of non-exempt wells; (2) one-half of the annual surcharge paid by persons holding an interim groundwater use permit in the AMA (Arizona Department of Water Resources, 2014a, p. 9-2); and, (3) application fees for water storage and recovery permits. Groundwater withdrawal fees are the main source of the fund. Thus, the WMAP is a funding mechanism for conservation assistance, supply augmentation, and hydrologic monitoring within the AMA.

The GMA makes provision for non-exempt groundwater users in the AMA to be levied a withdrawal fee determined by ADWR's director, which should not exceed five dollars per acre-foot of water withdrawn and used beneficially. The GMA does not specifically state that GUAC be involved in the administration of these funds. However, in the Fourth Management Plan for the AMA, ADWR reiterates that GUAC's role is to advise and make recommendations to the AMA director on water management programs, which makes GUAC responsible for being involved with administration of the groundwater withdrawal fees. In any case, ADWR is statutorily responsible for ensuring that the funds are used for only those expenses allowed in the state's statutes, as shown in the quotes below from both ADWR staff and GUAC member:

> …One thing I'll mention is groundwater right holders within the Prescott AMA that measure and report their water use and they pay a pump tax, a withdrawal fee based on how much water they withdraw annually. Part of that withdrawal fee goes into a conservation or augmentation fund. Those funds can be used for projects within the Prescott AMA for either conservation, augmentation, monitoring or accessing water availability. So, if there are projects that would fit into one of those categories that could make use of some of those funds and would benefit users within the Prescott AMA, we do have some money available for that. (ADWR, October 2015)

> …we had some funds that were used for certain purposes that had do with what the AMA was doing... The funds came from the charge to mainly the municipalities. (GUAC, March 2016)

**Interactions between Regional and Local Levels.** The AMA is the middle level of governance in the study area and comprises only GUAC and CWAG since closure of the local ADWR office. The local level comprises of the four municipal governments in the study area, that is City of Prescott, Town of Prescott Valley, Town of Chino Valley, and Town of Dewey-Humboldt.

At the time of this study, the majority of Prescott AMA GUAC members were government actors in some capacity, for example, municipal staff. The only member of the GUAC who was not a government actor was a recently retired municipal staff. As a result of the GUAC's composition, regional level actors are the same people at local level water governance. The GUAC members interviewed identified the monitoring of municipal efforts towards safe yield as one of their responsibility on the Council. However, this arrangement where GUAC members are also directly involved in water management means that local municipalities are essentially monitoring themselves through their involvement in the regional GUAC. Even though this strategy might be viewed as participatory governance, it does not necessarily provide objective and effective governance assessments. Notwithstanding, this governance structure is

maintained possibly because GUAC members know that there are no legal consequences to failing to reach safe yield. Thus, efficiency of water governance 'man-power' is valued over effective water governance.

GUAC does not have a statutory enforcement authority in ensuring that municipalities fulfill requirements of the AMA management plans. Municipal water managers perform the same activities they would have under the GMA, in the absence of a GUAC. With respect to vertical governance, the GUAC in Prescott AMA exists mainly to advise the AMA Director during preparation of the AMA management plans and on items such as conservation activities within the AMA. Except for their input regarding the AMA management plans, the presence or absence of the GUAC does not increase Prescott AMA's likelihood of achieving safe yield.

Even though CWAG at the regional level and municipal actors at the local level provide another avenue for vertical governance, there is more tension between both groups than cooperation. CWAG members are AMA residents, many of whom are retirees that moved into the region in recent decades. The strained relationship between CWAG and municipal actors stems mainly from disagreements on how growth should occur with the region's limited water supplies. Specifically, CWAG advocates for moderate growth based on the principle that the region's water resources should determine its growth projections. This view is built on the idea of carrying capacity. The following quotes are from two members of CWAG on growth and carrying capacity:

> …Don't get the idea that I am anti-growth. I think growth should occur, but I think it should occur at a rate that is consistent with the water that's indigenous to the area. The carrying capacity – if you have X amount of water, then you can have X amount of growth and no more. We know that one of the challenges in communicating that opinion, based on

> experiences that I've had for many years with powerful people, is pick your fights. One of the fights that we did not want to pick when we first started this thing was the growth fight. We're too little to fight the developers and the monolithic things that are going on to make growth happen. (CWAG, June 2015)

> I just think carrying capacity is fundamental in any analysis of growth. In Arizona back in the 1970s, it was one of the leaders in the country as far as looking at carrying capacity as a fundamental part of the whole growth equation. Unfortunately, the legislature decided that they really shouldn't be spending any money looking at carrying capacity, so they cut that program, which was too bad... I think it's really unfortunate to see the results in Phoenix, which just followed Los Angeles. The Los Angeles growth paradigm – growing, growing, growing, bringing water from the Colorado, looking for other water sources… You know, chaotic. (CWAG, June 2015)

This CWAG position is not popular with Prescott, Prescott Valley, and Chino Valley actors who are promoting unrestrained growth. The three municipalities generally see population growth as inevitable and economically beneficial to their municipalities. The differing positions between CWAG and the municipalities weaken water governance cooperation across regional to local levels.

Despite the principles of socio-ecological system integrity and resource maintenance being advocated by CWAG members and the contrary opinions of municipal actors, Prescott AMA water resources exceeded its carrying-capacity decades ago. The pursuit of growth by municipalities and the claim of managing water resources for safe yield at the same time are thus contradictory. Whether growth slows down in Prescott AMA or not, safe yield cannot be achieved with the region's current water demand and supplies (Figures 6 and 7).

Related to the conflict around growth is the issue of protecting property rights, which some municipal actors claim the CWAG position on growth violates. According to

proponents of private property rights, landowners have the right to do whatever they want with their land and its water, for example:

> Arizona as a state at the constitutional level, at the foundational level, is adamantly opposed to limiting private property rights. It will never happen in Arizona… CWAG doesn't understand how their notion of population growth relates back to denying somebody a right to do something with their land… The whole thing is ridiculous. Arizona will never limit population growths like that. We will look at desalination plants, we will look at water resources. Arizona as a whole, we will look at how to bring water in for increased population growth. Which is why I do not agree with CWAG. (Chino Valley, June 2015)

Another dimension to the conflict between CWAG members and municipal actors is the argument that many CWAG members are part of the 'growth' that happened. In the interviews conducted, there was a recurring theme of "new arrivals closing the door on those behind them" as seen in the following interview excerpts:

> CWAG and I do not see eye-to-eye on virtually anything. I've met with them a dozen and a half times in my career here with this town. And, no, I don't have any doings with CWAG…when you meet most of the people in CWAG, they are not from Arizona. They are from California, they are from New York, they are from Wisconsin, they are from Michigan. They are from all over the country, out of Arizona. I'm a fourth-generation Arizona boy... CWAG is populated by people from other worlds, moved here, who take the attitude I've come here now. We have to close the door so that no one else can come here. (Chino Valley, June 2015)

The argument above suggests that first generation Arizonans have different viewpoints on water sustainability than multi-generational Arizonans. This finding is interesting because even among the government actors interviewed, first generation Arizonans were more open to stricter water management measures than multi-generational residents. Overall, given that CWAG is an active non-government actor group indigenous to the AMA, the conflicts between CWAG and municipal governments put a strain on

cooperative interactions between CWAG, GUAC, and municipal governments with regards to working concertedly towards sustainable water governance.

**Interactions between State and Local Levels.** In this sub-section, I discuss the interactions between ADWR (state level) and municipal governments and residents (local level). Interactions between state and local level actors in the AMA occur around water-related permits and reports.

Many aspects of water resource governance in Prescott AMA require permits before water can be appropriated. There are different types of permits required by water governance actors at the local level. For example, municipal water providers obtain permits from ADWR to operate wastewater treatment plants, store water underground, and recover the stored water. Moreover, individual residents also relate directly with the ADWR state office on issues of exempt wells within any of the communities in Prescott AMA. According to an ADWR staff, "if someone wants to drill a well within the active management area, then they would need to go to our agency for the permitting on that." (ADWR, October 2015). These permits give a sense that efforts are being made at the state level in getting the region towards safe yield. While these practices are important because they provide records of who is using water and for what purposes, they are inadequate in promoting water sustainability.

In addition to the permitting process that occurs directly between ADWR and individual residents, there is direct reporting required of municipal staff to ADWR that does not go through GUAC. This direct reporting relationship is mandated by state law. According to a municipal staff, "We couldn't not [sic] work with them [ADWR]. There are state laws, so we are required to work with them" (Municipal staff, June 2015).

Specifically, municipalities that provide water (in this case, City of Prescott, Prescott Valley and Chino Valley) have to report their water withdrawals and use annually.

Overall, interactions between the state and local levels in the receipt of permits and submissions of reports are mandated by state statutes. These elements (permitting and reporting) are important because they provide records to help evaluate progress on water sustainability goals but they are not enough for promoting sustainable water governance.

**Summary.** Water governance interactions occur between state and regional level actors through GUAC meetings and around management plans, WMAP funds, and ADWR's scientific expertise. These interactions are mostly informational, with actors at both levels obtaining and transmitting information. The outcome of these informational interactions is that the region's safe yield management goal is supposedly pursued through conservation and water augmentation. Yet, the region is not achieving safe yield, for instance, annual overdraft more than doubled between 1985 and 2010 (Figure 6). Meanwhile, the perpetual search for more water and the current pursuit of water augmentation with non-renewable groundwater are problematic as "spatial fixes" (Bolin et al. 2008) that will delay long-term sustainability.

Interactions between regional non-government actors and local level actors are mostly contentious. The informational interactions summarized above are not contentious. Instead, contentious interactions exist due to disagreements on how growth should occur with respect to the region's limited renewable water. This contentious relationship (for example, between CWAG and the municipalities) contributes to ongoing conflicts in the study area and limits the extent to which water resource cooperation

occurs between regional non-government actors and the municipalities. Finally, interaction between state and local level actors regarding water governance and sustainability revolve around water permitting and reporting. Water permits provide a record of who is using water, although not all permit holders report their water use.[13] Conversely, Water reports provide a record of water demand by users such as municipal and private water providers. Water permits and records are not making the region's water resources sustainable because, as implemented, they maintain — and in some years, increase — historic water withdrawal levels from groundwater resources that are essentially non-renewable.

Overall, the avenues for interaction across state, regional, and local levels all relate to the GMA either in how the Act is interpreted or from its specific mandates. For instance, in the Groundwater Code overview published by ADWR, the agency notes that one of the goals of the Groundwater Code is to help the state allocate groundwater based on its changing demand (ADWR, 2008). Although not identified in this document, in most urban areas, and in Prescott AMA specifically, water demand is moving from an agriculturally-intensive economy to a residential one. In Prescott AMA, this 're-allocation' of groundwater helps maintain groundwater overdraft without sufficiently improving the area's water sustainability.

[13] According to the GMA, exempt well owners are exempt from reporting requirements. Instead, exempt well owners file a Notice of Intent (NOI) to drill with ADWR. In addition, ADWR keeps a database of registered wells and their location (Arizona, State Senate, 2015).

**Research Question Two: Horizontal interactions in governance**

In this section, I present results for the question: *In what ways do actors at the local level coordinate (or not) in governing water resources, and how do these interactions affect sustainable water governance?*

The qualitative analysis of in-depth interviews conducted for this study shows that interactions at the local level occur around shared-interest and due to shared groundwater basins. The Big Chino Water Ranch project is the major shared-interest that exists between Prescott and Prescott Valley. Meanwhile, bilateral interactions occur between municipalities that share the same groundwater basin.

Beyond the local level, broad regional collaborations exist between Prescott, Prescott Valley, and Chino Valley. These three municipalities are currently members of the Northern Arizona Municipal Water Users Association (NAMWUA) and Upper Verde River Watershed Protection Coalition (UVRWPC). However, interaction among the municipalities within these groups involves water resource issues beyond the governance jurisdiction of the AMA.

Focusing on the aim of assessing the coordination of local level governance actors, this section is divided into two parts. In the first part, I discuss the *shared interest pursuit* (Big Chino Water Ranch) advancing collaborations between Prescott and Prescott Valley. In the second part, I discuss contentious interactions due to *shared groundwater basins* prevalent between pairs of municipalities located in the same groundwater basin. Prescott and Chino Valley make up one pair, while Prescott Valley and Dewey-Humboldt make up the other.

**Shared-Interest Pursuit: Big Chino Water Ranch Project.** The City of Prescott and Prescott Valley are currently in partnership to bring in water from the Big Chino basin, which is outside the AMA. Chino Valley voluntarily withdrew their participation in the project, while Dewey-Humboldt never showed an interest in participating. The Big Chino Water Ranch (BCWR) project is a supply augmentation strategy for both communities (which is supported by the GMA). The water transfer is made possible because the Arizona Revised Statutes, Section 45-555 allows a designated water provider in Prescott AMA to transport water from a neighboring basin. This legal permission is an exception included in the Groundwater Transportation Act of 1991, as the Act otherwise restricts inter-basin water transfer. The City of Prescott is the only municipal water provider in the AMA with a designation of Assured Water Supply (AWS), and thus is the only municipality legally capable of conducting such transfer. The AWS designation is granted to water providers that are able to provide ADWR with proof of availability and access to a 100-year amount of water supplies to meet current and projected demand.

In order to access water in the Big Chino basin, Prescott purchased 10.2 square miles of land within the Big Chino basin where it intends to drill its wells (City of Prescott, n.d.). This property has been named the Big Chino Water Ranch. Prescott Valley is sharing costs of the entire water supply project in exchange for part of the imported water. According to an official from the City of Prescott,

> Big Chino Ranch was bought by the city [Prescott]... Prescott Valley pays whatever we need to do: repair fences, things like that but the city owns the ranch. They [Prescott Valley] contribute the percentage almost half the cost to kind of own it but not to purchase it. We [Prescott] will be the ultimate owners of it, because in state law, you had to meet certain requirements to even go into the Big Chino because it was a neighboring groundwater basin. The city was the only one, Prescott Valley didn't have

> the standing to do it. The best they could do was partner with us so they could get water through us over to them. (Prescott, 15 June 2015)

The BCWR is actually a compromise solution to securing alternate supplies for communities in Prescott AMA. This is because when the State's imported Colorado River water (that is, CAP) was allocated, the City of Prescott got an allocation but was never able to bring it into its service area. The allocation "was intended to be realized through exchange, with Prescott taking water from the Verde River, presumably, and giving CAP water to SRP. All such exchanges proved impossible to complete due to environmental concerns" (Crystal Thompson, Personal communication, May 05, 2016). The environmental concern cited here is the effect of upstream Verde River withdrawals on the endangered spikedace fish population (U.S. Department of Interior, 1990). This environmental concern is the reason why Prescott could not trade their CAP allocation with a downstream Verde River rights holder.

The decision for Prescott to realize its allocation through exchange was made due to the prohibitive cost of constructing the CAP canal to the city. The CAP canal alignment had been chosen by the U.S Bureau of Reclamation and represents the most efficient route for transferring CAP water to Arizona's AMAs. According to a representative from CAP:

> The canal did not go through Prescott primarily because the elevation of that city is 5,367 feet. The Phoenix area elevation is approximately 1,000 feet (and Tucson higher than 2,000 feet). Elevation matters because the water has to be lifted by pumping, which requires energy (which is costly). The canal follows the most efficient route from both economic and engineering perspectives. (Crystal Thompson, Personal communication, May 05, 2016)

Eventually, Prescott's CAP allocation was sold to Scottsdale with funds from the sale kept in a trust fund for the development of alternate supplies such as BCWR (Arizona Department of Water Resources, 2014a).

As part of the joint efforts on BCWR, the City of Prescott and Prescott Valley entered into an agreement with Salt River Project (SRP) and are undertaking monitoring of flows in the Verde River to identify if pumping in the Big Chino basin would affect those flows. The agreement was made after several court proceedings when SRP, in efforts to protect its downstream rights to the Verde River, sued Prescott and Prescott Valley. After repeated court proceedings, City of Prescott, Prescott Valley, and SRP made a decision to negotiate outside of the courts. This led to the creation of Comprehensive Agreement Number One (CA-1) in 2012, a forum formalizing the commitment of all three parties to carry out monitoring on the Verde River before both City of Prescott and Prescott Valley start pumping groundwater from BCWR.

BCWR water is important to the City of Prescott and Prescott Valley communities because it supposedly represents a way for them to reach safe yield (Arizona Department of Water Resources, 2014a) and provides supplies for new growth in both municipalities. The joint efforts between both municipalities ahead of the construction of any pipeline from BCWR is ongoing and planned to continue until at least 2019 (Town of Prescott Valley, n.d.a). The excerpt below provides further details on CA-1, from the perspective of Prescott Valley:

> So SRP sued us. We went in and we negotiated a settlement. Part of that settlement is what we call Comprehensive Agreement Number One. Within that agreement, we're monitoring hydrologic conditions within the basin. We're developing groundwater models, and this is so that we can lead to a plan for mitigating impacts… So, we have $5.5 million

> committed to this program between three parties… We do the modeling. We do the mitigation plan. And we're supposed to collect five years of data from all of these points before we're allowed to pump from the Big Chino. So, at the earliest, we could pump water from the Big Chino in about 2022. (Prescott Valley, June 2015)

In terms of coordination at the local level, BCWR represents a shared-interest pursuit around which the City of Prescott and Prescott Valley are having positive interactions and are in cooperation.

This water import that helps Prescott AMA reduce its dependence on local groundwater can eventually lead to groundwater overdraft in the Big Chino basin as that region grows. Prescott's current Decision and Order (which documents the city's water portfolio) signifies that withdrawing water for 100-years from the Big Chino basin will not lead to overdraft, based on the depth-to-static water level of the basin's wells. What the Decision and Order does not incorporate is the effect of development that occurs in the Big Chino and unregulated use of groundwater on overall water sustainability in that area. Thus, regarding water sustainability, a successful BCWR project might lead to safe yield being achieved temporarily (possibly post-2025) but not sustained in Prescott AMA, at a cost to communities in the neighboring groundwater basin. The geographic scale of impact is critical here, as importing water into the AMA from the Big Chino basin is not sustainable from a broader perspective inclusive of Big Chino. In fact, the water governance conflict discussed by Bolin et al. (2008) is tied to this project which civil society groups claim would eventually impact Verde River flows (one of Arizona's last flowing perennial rivers).

The effects of Big Chino pumping on Verde River flows have been a subject of debate since BCWR was purchased. By jumping scales in order to obtain some form of

legitimacy in an issue supported by state statutes, civil society groups argue for the effects of the BCWR pumping on endangered species by invoking federal ESA laws, while BCWR proponents counter those claims, as shown by the following quotes from Bolin et al. (2008):

> … we're the voice for wildlife and places that can't speak up themselves. So, knowing that there are endangered species in the river, knowing that you know, hydrologic reports by USGS and retired USGS geologists up in that area assure me that there will be impacts to the river. We don't know...if it will be months, years, five years, ten years, twenty, fifty...a hundred years before the full impacts. But any loss of water to the river is going to impact the endangered species, is going to impact the Middle Verde communities and the water supply throughout. So, our suit is based on Endangered Species Act violation because the cities will be guilty of future[violations], as the water draws down the species will be impacted. (Center for Biological Diversity, Verde Project Leader quoted in Bolin et al. (2008, p. 1505)

> The first twenty-five miles. The first twenty-five miles? Well, are you going to dry up the first twenty-five miles? That is what everybody is focused on. And that is what we are all working on, you know, is there any federal nexus with the Endangered Species Act on those first twenty-five miles? We don't think there is. There are no endangered species along that first twenty-five. (Prescott Water Manager quoted in Bolin et al., 2008, p. 1505)

These quotes show how proponents of the BCWR project focus on scales that advance the project. Moreover, environmental groups invoke the federal level Endangered Species Act to validate their claims of the BCWR project's harm to the Verde River and watershed.

Another issue relating to this project is the problem of arsenic in the water which would cost the municipalities approximately $23 million in building treatment facilities (Bolin et al., 2008). The City of Prescott's 2009 Decision and Order from ADWR requires the City to show evidence of pipeline construction approval from the Arizona Department of Environmental Quality on or before December 31, 2019, in order to have Big Chino water count in the city's water portfolio. However, the contract entered into by

Prescott, Prescott Valley, and Salt River Project require an eight-year monitoring and modeling program to determine the impacts of Big Chino pumping on Verde River flows. Thus, water quality and surface water impacts are two of different challenges to the importation project.

In what could be considered a concession of the hydrologic connection between the Little Chino (Prescott's sub-basin), the Big Chino (basin of water import), and the Verde River (one of the last flowing perennial rivers in Arizona), a published report that involves Prescott and Prescott Valley actors acknowledges that about 14% of Verde River's base flow comes from the Little Chino basin (Upper Verde River Watershed Protection Coalition (2010) citing Wirt (2005)). This acknowledgment is important because Prescott and Prescott Valley had previously denied any such connections and avoided discussions of mitigation. For instance, in Bolin et al.'s (2008) study, the then-current City of Prescott's BCP manager, while referring to civil society claims about adverse impacts, had commented that, "They don't have scientific evidence to suggest that there will be impacts, nor do we have scientific evidence to conclude that there won't be impacts" (p. 1504). Bolin et al. (2008) had concluded the following:

> Most of the PrAMA interests interviewed for this study recognized that the BCP is, at best, a temporary palliative to the AMA's overdraft problem; they also tended to minimize likely effects or favored postponing the development of mitigation plans for the socio-ecological impacts of pumping. (p. 1505)

**Shared Groundwater Basin Interactions.** Shared groundwater has created contentious interactions bilaterally between municipalities that share the same groundwater basin. As noted by Collins and Bolin (2007) and confirmed in this study, many residents of Dewey-Humboldt, for example, haul water to their homes. Also, legal tussles between Prescott and Chino-Valley dating to the late 1970s reveal Chino Valley's

desire to control its water resources by ensuring that the majority of water obtained within its borders is used within the municipality (Town of Chino Valley v. City of Prescott, 1981). Meanwhile, the need to control water is fed both by the fear of water scarcity and libertarian values. Conflicts around shared groundwater between bilateral municipalities result from the physical evidence of water scarcity, desire to maintain municipal control of water, and the fear of increased water scarcity.

Hydrologically, Prescott AMA straddles two neighboring groundwater basins that are located within Verde River and Agua Fria River watersheds. The groundwater basins are the Little Chino and the Upper Agua Fria (see Figure 8). The City of Prescott shares groundwater with Chino Valley in the Little Chino basin, while Prescott Valley shares groundwater with Dewey-Humboldt in the Upper Agua Fria basin. In this sub-section, I present *intra-basin water transfer* interactions between City of Prescott and Chino Valley, *groundwater recharge* interactions between the pairs of municipalities, as well as interactions around *growth and/or exempt wells* between the pairs of municipalities.

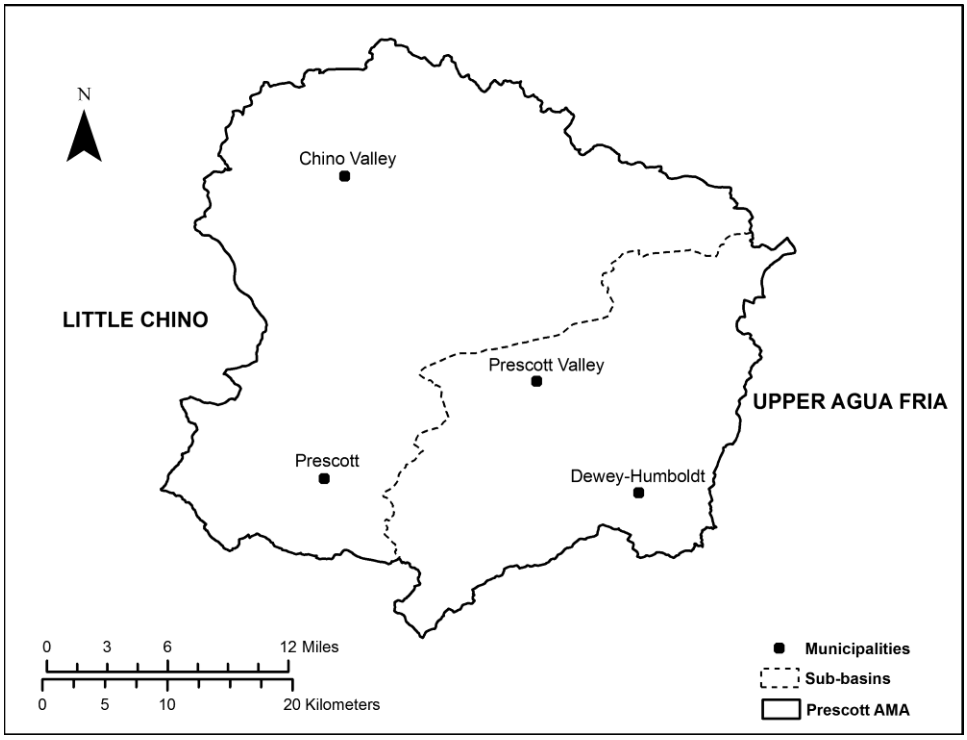


*Figure 8.* Prescott AMA Groundwater Basins

***Intra-basin Water Transfer.*** The City of Prescott and Chino Valley have not always worked cooperatively regarding water resources. The two municipalities are neighbours that share the Little Chino basin. However, due to the mountainous terrain of the City of Prescott, its municipal wells are not drilled in Prescott but are located in Chino Valley. Prescott drilled wells on its Chino Valley property in 1948 and has since transported water through a seventeen-mile pipeline to its service areas. Chino Valley, incorporated in 1970, filed a court injunction against Prescott two years later to restrict the City's groundwater pumping and water export. In 1981, the case was dismissed in Prescott's favor because the court adjured that percolating water is not owned until it is withdrawn. According to the court, "like wild animals free to roam as they please, they [percolating waters, in this case] are the property of no one" (Town of Chino Valley v. City of Prescott, 1981). In 1985, the City of Prescott initiated legal action against Chino

Valley due to the latter's transaction privilege tax on Prescott's water pipeline. In 1989, this case was decided in Chino Valley's favor as the court upheld Chino Valley's tax on Prescott's water pipeline (City of Prescott v. Town of Chino Valley, 1989). A summary description of interactions between both municipalities regarding intra-basin water transfer is provided in the following Chino Valley interview excerpt:

> Chino Valley and Prescott have not played well together on water. Chino Valley and Prescott got involved on a lawsuit back in the '70s that did not get resolved until the '90s. It's Arizona's longest Supreme Court case over water. It's funny, because the U.S. Supreme Court, the longest case is between Arizona and California over water. The Arizona case is between Chino Valley and Prescott over water. So, it is truly that water is for fighting things. The town [of Chino Valley] and the town of Prescott in the last two years have gone to great lengths to bury hatchets. This town has been in lawsuits with Prescott ad nauseam. As a result of it, we've gotten nowhere but made lawyers very wealthy. So, we are trying now, Chino Valley is trying to bury old hatchets with Prescott. The last two to three years we have tried to bury these hatchets. But Chino Valley and Prescott do not play well when it comes to water. (Chino Valley, June 2015)

One way that Prescott and Chino Valley appear to be "burying hatchets" is by pursuing conversations about water issues rather than employing legal confrontation. For example, in 2015, Chino Valley approached Prescott to purchase the portion of Prescott's water distribution system in Chino Valley, with which the Prescott served some Chino Valley residents. While the purchase was unsuccessful, Chino Valley views this attempt at negotiation as one way to overcome past negative interactions between both municipalities around water.

Prescott's intra-basin water transfer is not a strategy for achieving safe yield but is seen as necessary for water provision. This is because the city's terrain makes it prohibitively expensive to withdraw water from many areas within its boundaries. However, these intra-basin transfers have led to conflicts between Prescott and Chino

Valley that have put coordination in achieving safe yield or regional water sustainability on the backburner. In summary, intra-basin water transfer is a contentious subject that has affected water governance interactions between Prescott and Chino Valley.

***Groundwater Recharge.*** Disagreements, that are not being actively deliberated, exist between municipalities that share the same groundwater basin on the subject of groundwater recharge. Hence, groundwater recharge serves as another avenue for interactions, albeit contentious ones, among Prescott AMA municipalities.

Recharge and recovery is one of the water management strategies overseen by ADWR in Prescott AMA. Recharge and Recovery was included in the state's statutes through enactment of the Underground Water Storage, Savings, and Replenishment Act in 1994, but the program had been established by state legislature since 1986 (Arizona Department of Water Resources, 2014a; Arizona Department of Water Resources, 2014b). Generally, Arizona's statutes allow some flexibility around where water is stored underground and where it is withdrawn. This storage, despite being earmarked for near-term withdrawal, is referred to as groundwater recharge and conflates the idea of water recharged to boost the groundwater system versus water temporarily stored for use. Typically, water retains the legal classification it is stored as. Effluent recharged at a recharge facility can later be recovered from nearby wells not as groundwater, but as effluent (Pearce, 2007). Within the state's system of recharge and recovery, water providers gain credits for the water they recharge.

Within Prescott AMA, all the municipalities except Dewey-Humboldt have Waste Water Treatment Facilities (WWTF) and Underground Storage Facility (USF) permits from ADWR. The lack of participation by Dewey-Humboldt could be due to the current

lack of a central water or sewer system; therefore, the municipality has no wastewater to treat and no treated wastewater to recharge. Recharge by the three municipalities with permits for recovery is done with treated effluent. The water treatment and recharge facilities operated by each municipality are located within their specific municipal boundaries.

The location of recharge facilities within each municipality's boundary, combined with the flexibility allowed in the state's recharge and recovery program, has influenced how municipalities within the same basin interact on issues of groundwater recharge, storage, and recovery. The City of Prescott pumps its water from Chino Valley wells but recharges within its city boundaries. Prescott Valley recharges effluent, gains credits for this recharge from ADWR, and is able to sell the stored water rights to new development coming into the Town. Such a move would appear to support safe yield in the near-term. However, this strategy ultimately contributes to groundwater overdraft when the stored water is accessed for development as the current level of overdraft from current residents continues.

Against this background, responses by Chino Valley and Dewey-Humboldt officials showed skepticism about the efficacy of groundwater recharge within their respective basins due to the practices of their partner municipalities. The City of Prescott has a recovery permit from ADWR, and nearly all the water recovered within the AMA has been withdrawn by the city independently and through its ownership of Chino Valley Irrigation District (CVID) (Arizona Department of Water Resources, 2014a). Meanwhile, Prescott Valley has only recovered a small portion of its stored groundwater. Instead of giving water away to subdivisions or projects (such as a new factory), Prescott Valley

sold the rights of its remaining stored water to Water Management Assets LLC, a New-York investment company.

In addition to the skepticism about groundwater recharge efficacy that was revealed during interviews, Chino Valley and Dewey-Humboldt officials showed concern about how water use by the bigger communities potentially reduces the water available to the smaller ones, especially with regard to the municipality which shared their groundwater. According to officials from these two municipalities:

> We get along fine with Prescott Valley because we don't have any water problems with them, but Prescott, right across the street is where Prescott takes water out of the ground and pumps it into Prescott. About seven out of every ten gallons that leaves the little Chino aquifer goes to Prescott and they say "well, we are recharging it back into the ground". Well … we will see all right. At any rate, the aquifer continues to drop. (Chino Valley, March 2016)

> I'm sure you heard what they do. They recharge effluent back to the aquifer so that they can get points. If you asked the Prescott Valley people, they're going to tell you "Safe use, no problem because we produce effluent. We recharge back. We are very responsible. We capture all the water. We don't want to waste water on anything. We charge it back. And through the cycle, you're going to produce drinkable water, potable water." That's what they're going to tell you… On paper you have rights, but in reality, do you really have wet water there? You have dry water, which is your rights – water rights. You have points, but that doesn't correlate still, which means you have overburdened whatever the supplies are because they are upstream. They pump water, and we don't have any. (Dewey-Humboldt, June 2015)

This finding is consistent with previous research where BCWR proponents argued that it would help the region achieve safe yield but only a few governance actors were forthcoming with the information that this is not the case, as seen in the following quote from Bolin et al. (2008),

> The idea was to bring in Big Chino water to stabilize [the PrAMA] water supply and to allow for growth. The fact is that bringing in Big Chino water will not stabilize the water situation because that water is going to be used for growth. So

> how the hell can it stabilize when we are already over-pumping? The other fact is that we are over-pumping our existing supply so much that if we brought all the Big Chino water in and put it into our source, it wouldn't be enough. So, we're still behind. (Former YCWAC member quoted in Bolin et al. (2008, p. 1503)

Thus, despite groundwater recharge being a strategy to increase the region's water sustainability, there are conflicting views among municipalities on how current practices affect long-term water availability.

With regards to safe yield, the current flexibilities around groundwater recharge and recovery are not necessarily contributing to the goal. This is because groundwater recharge is more storage for later use than actual recharge. The only groundwater that actually contributes towards safe yield in the current system are *cuts to the aquifer* that are required for all long-term storage. To date, less than 1,000 acre-feet have been accounted for as cuts to the aquifer within the AMA, compared with over 200,000 acre-feet of groundwater overdraft recorded since 1985. Groundwater recharge contentions between municipalities in the same basin suggests the lack of coordination that still exists in joint efforts within the region towards achieving safe yield.

***Disputes over Growth and/or Exempt Wells.*** Apart from the differing opinions and desire for growth among different actors within the study area, there are also differing desires and pathways for growth among the municipalities. With regard to municipalities sharing the same groundwater basin, both Prescott and Chino Valley support growth. The difference between both municipalities' growth visions is that Prescott's municipal government generally does not think exempt wells are a sustainable system for growth, while Chino Valley residents want to grow on exempt wells. Currently, the Chino Valley water system serves a small portion of its residents unlike the City of Prescott. One of the reasons given for Chino Valley's small water system is the

low-density development within the municipality, especially on the outskirts of town. The other is that Chino Valley residents would rather grow their town by keeping exempt wells free of regulation than developing the town's water system. The interview excerpt below from an official in Chino Valley details the town's growth vision and choice to grow on exempt wells:

> Chino Valley has a very limited water and sewer system. The town went out in 2014 to see if the citizens wanted to bond to put water and sewer up and down the highway to spark economic development and the vote went down – the vote did not pass, 68% were against it, 32% were in favor of it. So as a community, Chino Valley isn't interested in the engineering side of water resources, i.e. getting water and sewer into areas to spread economic growth. As a result of that, Chino Valley is very anemic in what they are able to do on the water resource side beyond DWR water conservation programs, those kinds of things… They are okay with the growth; they just don't want a central water system. They want to do it through exempt wells. (Chino Valley, June 2015)

Hydrologically, groundwater flows northwards in the Little Chino basin; that is, from Prescott to Chino Valley (Figure 8) and further north to contribute about 14% of Verde River's base flow (Wirt, 2005). However, since Prescott serves most of its customers by pumping groundwater from the Prescott's Chino Valley wells, both municipalities are impacted by lower water tables in Chino Valley.

Within the Agua Fria basin, Prescott Valley wants growth (Bolin et al., 2008) while Dewey-Humboldt does not. Prescott Valley sees exempt wells as the problem to water sustainability while Dewey-Humboldt sees growth as the problem. Generally, Prescott Valley's municipal government sees exempt wells as a hindrance to water sustainability. The town does not have as many exempt wells as Dewey-Humboldt, possibly due to its more compact development and minimal irrigated agriculture (Arizona Department of Water Resources, 2014a). On the other hand, Dewey-Humboldt does not

want growth, nor does it want its water resource affected by the growing Prescott Valley. In not wanting growth, the community decided not to develop a central system, which also supports its decision to remain rural. However, there are parts of the town with dry wells, whose residents have to haul water to their homes (Collins and Bolin, 2007). The interview excerpt below reveals the town's stance on growth and how AMA neighbors who are promoting growth are generally viewed:

> We are not…like Prescott and Prescott Valley. They have to do something to guide their growth, how they want to grow and then have these programs to be put in place to encourage growth or one or the other. But we don't... Also, our growth policy here - the town in general, the town council are divided, but in general you probably have four councilmembers on the council that will tell you that they want to keep it the way it is. So, they don't want to encourage growth. That is kind of suitable with our situation because we don't have water or sewer [services]. Utility services - where you have that, you invite growth. There are many reasons we don't have that. Right now, it's a good balance because they [Dewey-Humboldt residents] don't want more growth. (Dewey-Humboldt, June 2015)

In terms of the hydrologic connection between both municipalities, groundwater flows southwards from Prescott Valley to Dewey-Humboldt (Figure 8) to eventually contribute some of Agua Fria River's base flow. Thus, groundwater pumping in Prescott Valley could affect the groundwater available to both Dewey-Humboldt and the Agua Fria River, due to the hydrologic connection described.

Overall, the differing visions of what constrains water sustainability, whether growth, growth on exempt wells, or just the presence of exempt wells plays an important role in how the municipalities work together towards a common vision of water sustainability for the AMA. The differing perspectives on growth and exempt wells are a disincentive to collaboration between all four municipalities. It is important to note, however, that there have been discussions towards achieving safe yield between three of

the four municipalities (Prescott, Prescott Valley, and Chino Valley) who are part of a regional government coalition (Upper Verde River Watershed Protection Coalition, 2010). However, the issue of dealing with exempt wells is a major touch point identified in those discussions and which the municipal governments have lacked adequate political will in addressing.

**Summary.** Local-level water stakeholders in the study area do not coordinate unless coordination supports municipal visions, and the municipalities differ in their visions. Within the study area, Prescott and Prescott Valley municipalities—which are in different groundwater basins—cooperate over a local water development project due to shared interests in supply augmentation that is being mutually sought to support continued growth. In other words, shared water interests have encouraged cooperation. However, contentious interactions exist between municipalities in the same hydrologic basin with respect to shared groundwater. These contentious interactions coalesce around dissatisfaction over volumes of groundwater withdrawal versus recharge, differing urban and rural visions, and the proliferation of exempt wells. These issues stymy cooperative efforts among all four municipalities toward regional water sustainability.

Overall, the region's safe yield management goal is not a priority for any of the municipalities except to the extent that safe yield supports their larger priorities, which are economic growth for Prescott and Prescott Valley, individual control over water for Chino Valley, and remaining rural for Dewey-Humboldt. The inability to work together to achieve the region's goal of safe yield is mostly due to insufficient political will in the face of more dominant interests (economic growth, individual water control, remaining

rural). Consequently, the inability to work together means that sustainable water governance is not being pursued with innovation and leadership at the local level.

**Research Question Three: Power in Water Governance**

This section addresses the research question: *How is power exercised among a variety of water governance actors across levels, and what are the implications for sustainable water governance?*

In this section, I focus on the different ways in which the various actors involved in Prescott AMA's water governance have exercised power and the implication of these activities on the region's safe yield management goal and water sustainability. Narratively, I present the results of how artefactual, mental, monetary, and natural resources are mobilized by governance actors thereby leading to the exercise of innovative, reinforcive, transformative, and destructive power. Table 8 in the summary of this section presents how the different activities discussed in this section align with resource mobilization and different forms of power. In the following sub-sections, I discuss resource mobilization and the exercise of power in Prescott AMA's water governance under the following headings: *Big Chino groundwater importation*; *rescaling of governance boundaries*; *water supply development*; *citizen power, growth narratives, and libertarianism*; *the Groundwater Users Advisory Council's regional governance*; and *Prescott AMA's safe yield management goal*.

**Big Chino Groundwater Importation.** The City of Prescott largely follows the state's model of seeking external supplies (which, in the case of Big Chino water, is a non-renewable resource) as a way to ensure the city's water future. As detailed in the

previous section, Prescott received Central Arizona Project (CAP) water allocations along with municipal applicants such as Phoenix, Tucson, Glendale, among others (Department of Water Resources, 1982). Prescott allocations were meant to be exchanged with Salt River Project (SRP) for Verde River water (Arizona Water Commission, 1978, p. VI-6). However, this exchange proved impossible due to environmental concerns, one of which was the predicted harm to the Spikedace fish population − an endangered species found in the Verde River.

The water exchange with SRP was a preferable option because SRP, a downstream water provider, has senior rights to about 85% of Verde River flows (Bolin et al., 2008). This water right proceeds from the prior appropriation doctrine that governs surface water in Arizona – a rule also known as 'first in time, first in right'. Farmers in the Phoenix region started using Verde River water as early as the 1860s (Autobee, 2011) and have priority over Upper Verde Watershed communities on use of the River's water. In other words, Upper Verde communities are legally restricted in their ability to use Verde River water despite their proximity to its headwaters.

By 1990, the City of Prescott, though with CAP allocation, could not exchange their allocation with a Verde River downstream water rights holder due in large part to the effect of such exchange on the endangered Spikedace fish population. Legislative intervention was sought, leading to the inclusion of ARS §45-555 in state statutes. This statute adds an exemption to the GMA's restriction on groundwater transfer into AMAs that would legally allow the City of Prescott to import water from the neighboring Big Chino basin. Unlike Phoenix-Tucson's water import which is surface water, Prescott's water import would be non-renewable groundwater – a plan that will increase

groundwater overdraft in the Big Chino basin. The Big Chino basin is not part of any of the Active Management Areas (AMAs) and thus lacks any statutory groundwater governance rules. The legislation that authorized Prescott AMA's water project was SB 1055 sponsored by Gus Arzberger (first signer) and nineteen other state senators in 1991. Within the Senate, vote on the legislation was somewhat bipartisan (Table 6).

Table 6.
*Final Vote by State Senate Members on Water Bills*

| 40th Legislative, First Regular Session (1991) | | | | | | |
|---|---|---|---|---|---|---|
| Senate Bill 1055 | | | | | | |
| Democrats | | | | Republicans | | |
| Yes | No | Non-Voting | | Yes | No | Non-Voting |
| 17 | 0 | 0 | | 7 | 4 | 2 |
| | | | | | | |
| 43rd Legislature, Second Regular Session (1998) | | | | | | |
| Senate Bill 1124 | | | | | | |
| Democrats | | | | Republicans | | |
| Yes | No | Non-Voting | | Yes | No | Non-Voting |
| 12 | 0 | 0 | | 17 | 0 | 1 |

According to the GMA, ADWR is given authority to execute the Act while the agency's director has decision-making authority (ARS §45-103, 45-105, 45-106). So far, ADWR has limited its activities to the express dictates of the GMA. In concluding the AMA's Fourth Management Plan, the agency states that, "[i]n order for ADWR to close these 'holes in the bucket,'- uses of groundwater that can persist or increase without replenishing the aquifer - additional statutory authority and rule changes are required" (Arizona Department of Water Resources, 2014a, p. 12-11). In adherence to the GMA, ADWR provides oversight to the mandatory conservation requirements of selected water providers and users and provides technical support for water augmentation in the AMA. The GMA's emphasis on water augmentation somewhat explains why ADWR acknowledges on its website that the Big Chino supplies base flows to the Verde River

but still includes water import from the Big Chino basin as an essential way for the AMA to reach safe yield in its Fourth Management Plan. Thus, the GMA's emphasis on water conservation for selected water providers and users, and water augmentation, guides ADWR's activities within the AMA but does not promote comprehensive water sustainability.

Whenever questions of regulation arise, ADWR publications often deny the agency's ability to either make or enforce rules (Hirt et al., 2008). The Prescott AMA Fourth Management Plan provides an example that applies to this study: in comments to ADWR ahead of the drafting of the AMA's Fourth Management Plan, CWAG suggested that ADWR use existing authorities and request new authorities as needed to minimize the effects of exempt wells on the aquifer, as well as to ensure the accomplishment of safe yield by 2025. In what could be considered a reply, the agency explicitly states in the management plan that "ADWR has no regulatory authority over exempt wells" (Arizona Department of Water Resources, 2014a, p. 3-2). However, the GMA provides the agency director with the authority to issue regulations if they help protect the state's water resources.

Despite claims of not having authority on many issues, in 1995, ADWR laid the groundwork for Prescott AMA's out-of-safe yield declaration through its rulemaking. According to rules proposed and adopted by the Agency, data would be collected for three years to determine empirically if Prescott AMA was out of safe yield. Afterwards, an initial determination would be made and the Agency would accept comments from the public and Prescott AMA communities before a final determination was made. According to schedule, after the initial safe yield determination was made in 1998, comments were

submitted by various parties, some protesting the determination and others supporting it. Plats for 32,000 new residences were approved in the AMA between the hearings and the agency's final out-of-safe yield declaration (Bolin et al., 2008). The number of applications received for new residences in two months was more than that of applications received in the preceding 17 years (Bolin et al., 2008). Given that Prescott's population according to the 2010 US Census was 39,843, these plat approvals guarantee that Prescott's (future) doubled population are legally allowed to use mined groundwater[14].

At the same time, SB 1124 was approved by the state legislature during the second regular session of the 43rd legislature. Support for this bill was bipartisan (Table 6). SB 1124 adjusted AAC R12-15-705(F) to provide Prescott AMA with a "groundwater allowance," which is the amount of (overdrafted) groundwater the City can pump but which is considered to be consistent with the AMA's safe yield management goal. This groundwater allowance would increase as approved plats are recorded and submitted to ADWR. For example, Prescott's groundwater allowance increased from 8,090 acre-feet per year in 1999 to 9,371.53 acre-feet per year in 2008. As a result, despite using overdrafted or mined groundwater, Prescott will not be considered out of compliance with the AMA's safe yield management goal.

The agency successfully declared Prescott AMA out of safe yield in 1999. The out-of-safe yield declaration resulted in two main outcomes in Prescott AMA. First, it provided justification for the urgent need to import water from the Big Chino basin in

[14] Mined groundwater is the same as overdrafted groundwater and refers to groundwater used in excess of recharge. This is a situation that the safe yield management goal should ideally address by bringing groundwater withdrawal and recharge (natural and artificial) into balance.

order to achieve safe yield and ensure a sound economy[15]. Prescott purchased its Big Chino property in 2004. Second, the declaration allowed Prescott to receive a groundwater allowance. In 1999, Prescott received a Designation of Assured Water Supplies despite the AMA's annual overdraft, which will continue to increase as preliminary and approved plats are developed. Yet, the region will legally be considered as 'consistent or compliant' with the AMA management goal due to this groundwater allowance.

The City of Prescott applied to ADWR to update its Assured Water Supply portfolio to include BCWR water in 2008; early the following year, SRP filed a legal complaint against Prescott and Prescott Valley. The legal complaint was regarding claims that pumping from BCWR would affect flows in the Verde River, to which SRP had senior downstream water rights. Also, SRP provided support to environmental groups who were also against the BCWR project. During this period, SRP was a "politically powerful 'ally' of local environmental groups" (Bolin et al., 2008, p. 1506). After a number of legal proceedings, the courts decided the filed cases in the Prescott's favor without resolving the contention with SRP. Another victory for the municipalities was that ADWR approved the City of Prescott's application to update the water portfolio of their Designation of Assured Water Supply.

After losing its legal challenge against AMA municipalities, SRP, Prescott, and Prescott Valley agreed to settle outside the courts. The result of the parties' deliberation is that work on the BCWR would be delayed while monitoring and modeling of the effects of pumping in the BCWR on Verde River flows are carried out. This monitoring

[15] ADWR's recent publications continue to point to the AMA's need for BCWR water (Arizona Department of Water Resources, 2014a, 2014c).

and modeling is ongoing and expected to continue till 2019, after which construction of the BCWR pipeline can start if the completed studies showed that Verde River flows will not be affected by pumping in BCWR. However, if the agreed upon studies reveal impact on Verde River flows, then the municipalities would mitigate those effects in proportion to the extent that withdrawals by other water users also affect Verde River flows leading to first, an Agreement in Principle, then later, the Comprehensive Agreement Number One. As part of the new partnership, SRP agreed to support the AMA municipalities with changes that AMA communities wanted in ARS 45-555. One of the main modifications made to ARS 45-555 in 2010 was adding language that clarified Prescott Valley's right to use part of BCWR water as this type of right was not granted in the initial legislation.

Overall, Prescott's Big Chino water importation pursuits continue to progress due to coordination among the different governance actors involved. The state legislature has made rules, ADWR has made its own rules where necessary and enforced statutory ones, and SRP is working with the municipalities to ensure that everyone (Prescott, Prescott Valley, and SRP) receives the water they want. In terms of water sustainability, preservation of Verde River's perennial flow is important. SRP, with its downstream water rights and as a party to the agreements with Prescott AMA municipalities, has an opportunity to ensure that the River continues to flow year-round. It remains to be seen whether the Verde River will be protected in the midst of current negotiations and compromises. The foregoing presents a situation where state legislators, ADWR, and Prescott AMA municipalities are coordinating and exercising power to make BCWR a reality, within the enabling institutional environment provided by the GMA and maintained by subsequent legislation.

**Rescaling of Governance Boundaries.** At the request of Governor Brewer, ADWR developed the Strategic Vision for Water Supply Sustainability in 2014. This vision divided the state into 22 planning areas. Prescott AMA was grouped with other communities within Verde Watershed and termed the Verde Planning Area (Figure 9). Based on historical precedence, boundaries of the Verde Planning Area suggest an attempt to resolve conflicts in the Upper Verde and expand the water frontier of Prescott AMA communities by having Prescott AMA communities and those in the Big Chino basin within the same planning area. This strategy finds precedence in previous state-wide rescaling activities. Prior to 1980, Chino Valley (by its own election) was part of the Granite Creek Critical Groundwater Area, but Prescott was not. However, both were brought under the same rules with the passage of the Groundwater Management Act.

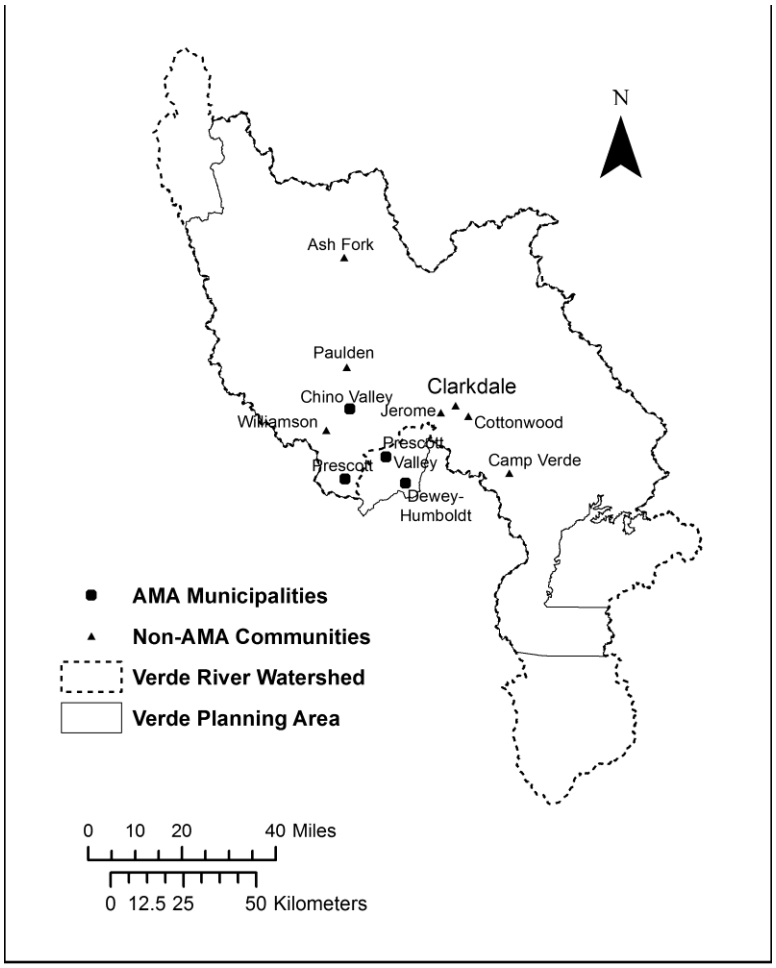


*Figure 9.* Rescaling of AMA Boundaries – Verde Planning Area

The Critical Groundwater Areas (CGAs) were a result of Arizona's 1948 Groundwater Management Code. However, the code was weak with no regulation of groundwater (Connall, 1982). The Code had been passed amidst calls to regulate Arizona's groundwater due to the overdraft occurring in many parts of the state (Connall, 1982). Chino Valley incorporated in 1970 and mounted a legal challenge against Prescott two years later for exporting more than its entitled allocation from the Granite Creek CGA (Arizona Water Commission, 1978, p. V1-5). This matter was dismissed in Prescott's favor in 1981. Having both Prescott and Chino Valley in the newly created Prescott AMA provided statutory support for Prescott's groundwater import from Chino

Valley. Prescott Valley, another rapidly growing Central Highlands community (located in the Agua Fria Watershed) was included in the Prescott Active Management Area under the premise of governance by groundwater basins. This scaling effort promoted a mismatch of ecological and management scales that is being repeated with the creation of the Verde Planning Area.

The Verde Planning Area, though with a form of governing within the watershed, does not fully match watershed boundaries; therefore, scalar mismatches exist. If implemented at the sunset of the Groundwater Management Act, governance at the level of the Verde Planning Area could have detrimental effects on the region's water resources and sustainable governance.

**Supply Development in Prescott AMA.** In this sub-section, I discuss how Prescott Valley, ADWR, and the AMA municipalities have mobilized resources to promote water supply development. By water supply development, I refer to the ways through which governance actors manage current supplies and seek to increase water supplies.

According to Prescott Valley's General Plan 2025, service privatization is one of the core strategies to be employed in managing development. This strategy is being applied to water governance and affects the region's safe yield goal, due in no small part to its promotion of market forces for a scarce but crucial resource. Specifically, in 2007, an auction was held for recharged effluents that the town had credits for future with ADWR. Out of the three parties qualified to bid, Water Property Investors[16] won based

[16] Water Property Investors is one of the investment vehicles of Water Assets Management, an investment company with offices in New York and California.

on a bid of $24,650 per acre-foot for 2,724 feet of effluent water[17] which "(1) will be physically available for 100 years, (2) will satisfy applicable water quality criteria [sic], and (3) can be used to support CAWS applications"[18] (Town of Prescott Valley, 2014, p. 4). The money obtained from this transaction is expected to contribute towards the town's BCWR costs.

In gaining public support for the municipality's goal to auction its effluents, the town's mayor mobilized mental resources (in this case, information) to garner support for the sale by linking it directly with the AMA's goal of safe yield. According to the following newspaper announcement by the town's mayor:

> In essence, it [Prescott Valley] can use 2,700 acre-feet of reclaimed water to obtain 4,000 acre-feet of Big Chino water and better reach the goal of safe-yield. An auction helps ensure that the town will receive high value for this resource. Even in the thirsty West, people historically have considered water a free commodity with users paying just the cost to pump and deliver it but not for the water itself. To our knowledge, an auction is unique and may establish a whole new approach to water allocation and use. It certainly will help move water from being just a regulatory tool to being an actual commodity in the free enterprise system. (Skoog, 2006, p. 1)

Apart from the fact that Prescott Valley's share of BCWR water will not be used directly to achieve safe yield, the contract with Water Property Investments inhibits the progress of Prescott AMA, and other AMAs with the management goal of safe yield. Specifically, the asset management company (with rights to 2,724 acre-feet of water for 100-years) lies beyond the reach of the GMA and any requirements towards safe yield. The following example illustrates this disadvantage: ADWR in 2013 proposed ways of

[17] This water is currently stored underground and supposedly helping in reaching safe yield but was also recharged for credit, which is why it can be later withdrawn through pumping not as groundwater but as effluent.

[18] CAWS is the Certificate of Assured Water Supply issued by ADWR to non-designated municipal water providers, private water providers, or developers that are adjudged to be able to provide 100-years water supply.

increasing water that actually go towards safe yield through the existing 'recharge and recovery' program by creating a staggered requirement between 0% to 20%, such that cuts to the aquifer are lower, based on how close recovery wells are to recharge facilities. This proposal was partly to encourage credit holders to recover their water closer to the point of recharge while potentially benefitting the aquifer at the same time. Many governance actors, including Prescott Valley, resisted this move. A key objection of the town was the impact of any policy changes on their contract with Water Property Investments.

In the Strategic Vision developed by ADWR at the request of Governor Brewer, ADWR suggested the following ways for ensuring water for future demand in the Verde Planning Area: resolution of water rights claims, watershed management, weather modification, reclaimed water reuse, enhanced stormwater recharge and water importation (temporarily from Harquahala INA or desalinated water from the Pacific Ocean on a long-term basis[19]). These supply augmentation options feature prominently in ADWR's recommendations, arguably due to its execution of the GMA's stipulations.

Water importation from either Harquahala INA or the Pacific Ocean (which were popular options during Bolin et al.'s (2008) study) are options that Prescott AMA municipalities could not afford financially. Arizona's large water projects have historically been funded mainly by the federal government. For instance, the first project authorized under the federal government's 1902 Reclamation Act was the Theodore Roosevelt Dam, which was initially valued at $13 million in 1915 but bargained to a $10,279,191 repayment amount between the Bureau of Reclamation and Salt River

[19] I discuss the problems with the AMA's emphasis on supply augmentation in Chapter 5.

Valley Water Users' Association (Autobee, 2011). Moreover, in the late twentieth century, CAP cost approximately $4 billion to construct and delivers an average of 1.5 million acre-feet of water/year. Arizona's repayment share of the construction cost was hinged at $1.65 billion over a 50-year period starting 1993 (Central Arizona Project, 2016b). The Yuma Desalination plant for agricultural wastewater that was completed in 1993, sponsored by federal tax dollars, cost approximately $245 million dollars to build. The plant has a capacity to treat agricultural runoff from the Wellton-Mohawk Irrigation and Drainage District before delivery to Mexico. This water delivery was to fulfill the US government's obligation to deliver 1.5 million acre-feet of Colorado River water to Mexico (Central Arizona Project, 2016a).

Due to higher costs of desalting the runoff and relatively normal Colorado River supplies in the early 1990s, Mexico's obligation was fulfilled with water from Lake Mead rather than the desalination plant (Ferris, 2014; United States Bureau of Reclamation, 2015). The San Diego desalination plant completed in 2016 cost approximately $922 million despite its proximity to the Ocean and power generating plant (Water Technology, 2017). Due to distance and other operational logistics, water importation from Harquahala INA and desalinated water from the Pacific Ocean are options that Prescott AMA municipalities would likely not be able to finance without external funds. Non-government actors interviewed in this study showed high skepticism for successful desalinated water imports, while government actors showed high optimism. For example:

> … they talk about desalination plants in Mexico and California, but the citizens of Yavapai county could never afford even if that happened. Could never afford the pipeline from the Pacific coast to Yavapai County. It's not a reasonable prospect. (VRBP, June 2015)

> When I first heard of desalinization, I thought, "you got to be kidding me." You

> know, talk about expensive water, that makes CAP water look like a joke. But we don't have to do the transportation of it… we would help fund the D-sal plants and provide the power because they use a lot of power. We would provide the power and then as they [California] got water from the D-sal plants for their cities, we would get their water allotment off of the Colorado River. That way you don't have the transportation cost and that's still gaining along. (Chino Valley, March 2016)

The temporary option of water importation from Harquahala INA that is proposed by ADWR is currently not on the radar of local communities like the BCWR, though with a price tag of over $175 million, it is the cheapest water augmentation option currently available to Prescott AMA communities.

Recently, rainwater harvesting gained interest in Prescott AMA as a means for increasing water supplies. A coalition of governments in the region estimate that capturing 1% of precipitation within the AMA would contribute about 4,500 acre-feet of water per year. This harvested water is expected to reduce the region's estimated annual overdraft of 11,00 acre-feet/year by more than a third (Upper Verde River Watershed Protection Coalition, 2010). One way to formalize rainwater as a water source is through legislative action. Thus, in 2012, Karen Fann – a representative of Prescott (and former mayor of Chino Valley), sponsored HB-2363, which approved a joint legislative study committee on macro-harvested water. If successful, macro-harvested water was to allow Prescott AMA governance actors to augment the region's water supply through rainwater harvesting − an increase that AMA actors argued would help the region attain safe yield. The bill was passed by the state's legislature and signed by the governor in 2012. However, the committee designated to study the potentials of rainwater as a new legal water source filed an empty report arguably due to concerns about SRP's downstream surface water rights.

Whether proponents acknowledge it or not, under Arizona's existing rules supply, development increases water demand. Historical data from Phoenix, Pinal, and Tucson show that between 1995-2010, increased supplies of CAP water allowed demand to increase without substantially reducing groundwater dependence. The other challenge with non-renewable supplies is that if there is ever a shortage or inability to export water from Big Chino (due to growth in that area), demand on Prescott AMA aquifers would have increased by 8,067.4 acre-feet per year.

Prescott AMA does not need 8,067.4 acre-feet/year for 100 years (or 806,740 acre-feet) of Big Chino water given that they still have 3,527 registered plats that are yet to be built out and which would (unsustainably) be allocated overdrafted groundwater. Prescott Valley also has 2,724 acre-feet/year for 100 years (or 272,400 acre-feet) of water from effluents to allocate to new residents. However, CAP availability to Phoenix metro and Prescott wanting to receive its share appears to be part of the conundrum driving cries for water importation. In the next chapter, I offer recommendations to deal with this conundrum.

**Citizen Power, Growth Narratives, and Libertarianism.** Although state level actors, especially the state's legislators, exercise a lot of power over water resources, citizens have also exercised power that has either contributed to water sustainability in the region or been detrimental. Specifically, three narratives driving local and regional water governance activities involving residents are growth, libertarian, and sustainability narratives. In this sub-section, I discuss how the resources (monetary, artefactual, natural, mental) available to residents influence the power they exercise and how different

narratives (growth, libertarianism, sustainability) influence water governance activities that affect the AMA's water sustainability.

***Citizens Water Advocacy Group (CWAG).*** One of the ways in which CWAG is involved in water sustainability discussions is by participating in GUAC meetings, which are a forum for conversations between GUAC members, the public, and ADWR. In 2012, CWAG provided comments to ADWR ahead of the drafting of the AMA's Fourth Management Plan. Among its comments, CWAG suggested public education on safe yield, increasing effluent cuts to the aquifer, among others as ways of ensuring that safe yield is achieved. Specifically, one of the group's suggestions was for ADWR to use existing authorities and request new authorities as needed to minimize the effects of exempt wells on the aquifer, as well as to ensure the accomplishment of safe yield by 2025.

CWAG uses editorials, letters, and similar communication channels in addition to GUAC meeting attendance to communicate with ADWR, municipal governments, and AMA residents. Through these communication mediums, CWAG advocates that the municipalities develop actionable steps in achieving safe yield. Another subject the group has been vocal about is mitigating the impacts of BCWR pumping on the Verde River and calling parties to actively protect the river's flows. Regarding the goal of safe yield, the group has criticized municipal governments for inaction despite the reports of two separate regional safe yield workgroups that recommended establishing a water conservation/replenishment district that comprises of all water users in the AMA. In terms of the group's particular conservation efforts, CWAG, along with its partners,

installed a rainwater harvesting system at a downtown Prescott location in 2015 to sensitize residents on the use and benefits of rainwater harvesting.

CWAG is funded by member dues. This state of financial independence gives CWAG full control of its advocacy agenda. CWAG programs include monthly meetings with local or invited speakers, community outreaches, and participation at events organized by order groups to educate citizens on the region's water issues. As a non-profit, CWAG's organizational structure does not allow it to lobby. However, many CWAG members are residents of Prescott and can influence water discussions in their neighborhoods.

***Prescott.*** In 2005, a group of residents concerned about the region's safe yield goal worked together to develop the Reasonable Growth Initiative (Prop 400) which requires that effluents from the City's annexed development of 250 acres or more be used for permanent recharge as opposed to the current system of recharge and recovery, which does not benefit the region's safe yield goal. The initiative was successfully passed and represents an example of citizen power wielded through the political process.

In 2009, residents pushed for a Taxpayer Protection Initiative (Prop 401) which requires a public vote for municipal project expenditures over $40 million. Proponents of the initiative pointed to the Big Chino Water Ranch (BCWR) as a major incentive for the proposal. At that time, the BCWR project was estimated to cost around $175 million, with Prescott's share of the bill going well over $40 million. The initiative was approved by voters in the November 2009 elections. However, since then, ambiguities have been pointed out in the initiative that possibly make it inapplicable to the BCWR project. One criticism is the lack of a 'retroactivity provision'. Specifically, opponents argue that the

2009 initiative cannot retroactively apply to the BCWR because the ranch was bought in 2004. However, there is still a possibility that Prop 401 would be relevant in future discussion regarding BCWR.

***Chino Valley.*** Chino Valley government sees growth as inevitable, and many Chino Valley residents would like the town to grow economically but want to retain individual control of water resources. More than 50% of housing units in Chino Valley have an exempt well (approximately 1642 wells), making up 23.6% of exempt wells in the AMA (Collins and Bolin, 2007). In 2014, Chino Valley residents voted down the development of its water system, which could have encouraged or mandated residents to abandon exempt wells and connect to the municipal water system. Thus, through combined citizen action and despite their support of growth, residents resisted any interference to the continuous usage of exempt wells.

Even though most government actors in the town agree that conservation, water and sewer system expansion, and increased recharge (from rain, stormwater, or treated wastewater) are ways through which the town could contribute to safe yield; residents have only supported strategies in line with the prevalent water sustainability narrative of maintaining individual control of water. Efforts to control exempt well proliferation have been strongly opposed by residents, as was the case in 2009 when the town's water manager proposed a 'water sustainability and conservation code'.

One of the points contested in the proposed ordinance was paragraph B-5 in section 60.07 (Town of Chino Valley, 2010, p. 13), which would prohibit new multi-family residential developments from using potable water from the town's supply or an existing well for irrigation. These new residences would also be prohibited from drilling

new exempt wells if located in the town's water service area. Overall, the ordinance would require most new developments to connect to the town's water supply rather than drill new exempt wells, and encouraged existing residences to connect to the town's supply. Also, recurring within the proposed ordinance, and sometimes phrased differently but with similar intent, was the statement that "as a condition of Town water service no new wells may be drilled upon property being served. Any existing well(s) that were providing water supplies prior to the connection shall be allowed in accordance with ADWR well usage rules" (Town of Chino Valley, 2010, p. 15). Opponents of the ordinance found fault with this language that prohibits the drilling of new wells within the town's service area. Another argument against the ordinance was that it deprived landowners of their statutory rights. State statutes within the AMA allow landowners to drill up to two exempt wells on their property, but the proposed ordinance would take away that right. Even though proponents maintained that the ordinance would protect exempt well owners by ensuring there was water in their wells, the ordinance was permanently tabled and arguably cost the incumbent mayor re-election. In this instance, power was exercised through political process.

Those who opposed the ordinance further argued that exempt wells do not hinder safe yield; instead, maintaining the status quo protects an individual's control over water, and keeps water costs down. An interviewee stated the following:

> The big cry among the political folks is it's these darn water wells that's the problem. We will know that's not the problem because if you are using municipal water and take a fifteen-minute shower or you are using a well and taking a fifteen-minute shower, it is the same amount of water out of the aquifer. A lot of that is the ability to control the water… if I have my private well, number one, the city cannot shut my water off, which is very important. So, it is a freedom issue. Number two, my cost of living is

> much lower. I don't have to pay for all the infrastructure that's required − the pumps and the tanks and all that − because I have my own well pump. (Exempt well owner, March 2016)

However, citizen action in this case, though successful, actually increases the vulnerability of exempt well owners to water scarcity due to drawdown resulting from increased density of exempt wells in the municipality (Collins and Bolin, 2007; Table 7).

Table 7.
*Exempt wells and estimated drawdown in Prescott AMA municipalities*

| **Municipality** | **Housing Units** | **% Housing units with Exempt wells** | **Estimated annual exempt well drawdown* (acre-feet)** |
|---|---|---|---|
| Prescott | 17,431 | 3.2 | 184 |
| Chino Valley | 3,251 | 50.5 | 821 |
| Prescott Valley | 9,481 | 0.3 | 12 |
| Dewey-Humboldt | 3,400 | 82.3 | 1,399 |

Source: Collins and Bolin (2007)
*ADWR estimates exempt well water use at 0.5 acre-feet/year in basin-fill areas and 0.33 acre-feet/year in hard rock areas (Arizona Department of Water Resources, 2005).

***Prescott Valley.*** Similar to government actors in Prescott, Prescott Valley's government views water sustainability as having water for current population as well as anticipated population and economic growth. However, unlike Prescott, Prescott Valley requires new residents to pay a one-time fee for each new home built to cover water capacity and water resource acquisition costs. As of 2011, this fee was $1,526. The main water acquisition project to be funded by this fee is BCWR. In effect, water from BCWR has been crucial to support new residents from at least 1999 when the AMA was declared out of safe yield. Given the claim that water from BCWR is required to take the AMA to safe yield and the knowledge that it is also meant to serve growth, the town has stated on its website that effluents from using BCWR is what would be used to achieve safe yield

(Town of Prescott Valley, n.d.b, p. 1). However, this strategy is questionable if the town would eventually receive credits to withdraw that water for future growth.

Meanwhile, Prescott Valley officials and staff often claim that BCWR is needed to achieve safe yield when, in fact, they plan to use BCWR water to support the Town's new population. The Town's government actors influence resident perception by presenting often-misleading information about the region's water resources. The Town Mayor's an announcement published in a regional paper stated the following:

> Prescott Valley needs to reach safe-yield by 2025… However, all of the current sources of recharge put together (including the reclaimed water Prescott Valley will produce in the near term) are inadequate to reach safe-yield. In fact, the Arizona Department of Water Resources (ADWR) concluded some time ago that Yavapai County can't reach safe-yield without importing water from other areas… The project will be expensive; perhaps the most expensive public works project either community [Prescott and Prescott Valley] has undertaken. But it mutually ensures our long-term future and is our best chance to meet safe-yield. (Skoog, 2006, p. 1)

In the above statement, the Prescott Valley Mayor suggests that BCWR will bring Prescott Valley and Yavapai County into safe yield. However, BCWR is within Yavapai County, and this attempt to legitimize the project by incorrectly invoking ADWR and the vertical scale of the County is misleading. Official documents submitted by the City of Prescott and approved by ADWR show that the 8,067.4 acre-feet/year (for 100 years, or 806,740 acre-feet) of imported Big Chino water will serve expected new demand in Prescott and Prescott Valley. Overall, the information being communicated by Prescott Valley officials and staff lead to a misinformed public who are unaware of the true state of the region's water resources and complacent in their water governance participation.

In Bolin et al.'s (2008) study, the municipal official interviewed argued that new residents were needed (who would pay for BCWR) to achieve safe yield. Meanwhile,

during this study, municipal interviewees expressed optimism about reaching safe yield, but noted that this required Big Chino water; the comparative quotes below illustrate this:

> So, what we have to do is import more water to get us to safe-yield. So, it is a simple concept. And would all these people that now live in the Town of Prescott Valley or the City of Prescott go ahead and be willing to pay a great deal of money to...reach safe-yield all by itself [via the BCP]? The answer is no. Okay? So, what you do is put it on the backs of new people that are going to come and they build the appropriate infrastructure and then they use the water, they dedicate the water that they recover from their use [effluent reuse] and add it to safe-yield. It is very simple. But it means that we have to build more houses. (quoted in Bolin et al., 2008, p. 1504).

> The steps to reach that [safe yield] are that we have to bring in the Big Chino water. That's the primary source to reach safe yield and to do that we have to complete the various steps that are outlined in that Comprehensive Agreement Number One with SRP. (Municipal staff, June 2015)

Generally, the town uses various communication outlets in assuring the public of long-term water availability and progress towards safe yield despite the actual water demand-supply (im)balance in the region. Through its publications, Prescott Valley government projects an image of 'we have adequate water resources for the future'. One such messaging culled from their website is quoted below:

> A huge body of water is less than 500 feet of you just about anywhere you go in Prescott Valley. Beneath the ground is an aquifer that contains enough water to last hundreds of years at the current level of use. The current rate of use (2014) is about 0.2% of the volume in storage per year. However, the Town of Prescott Valley and other water users are working hard to reduce this overall use to zero – a level that means the aquifer will be sustainable for an indefinite time (Town of Prescott Valley, n.d.b, p.1)

The above statement presents a vision of water supplies that ignores the region's increasing overdraft. Bolin et al. (2008) suggested that the Little Chino basin at current and projected use rates had, at the time of their writing, about 130 years of water. However, scientific data on the Upper Agua Fria basin – where Prescott Valley is located – are limited. Despite the numbers and amount of stored water that scientific studies

provide, sustainable water governance requires maintaining a measure of groundwater underground and not exhausting aquifer storage. Maintaining groundwater underground is important to prevent land subsidence, ground fissures, and resulting economic losses resulting from long-term increased overdraft.

Even though one interviewee from Prescott Valley complained that residents are not interested in water resources, the foregoing suggest that this is most likely a false notion since the public will not participate in water governance when they are given an impression that 'everything is alright'. Whitmire (2013) notes that progress is not made in resolving Yavapai County water conflicts because residents are either uninformed or misinformed. The foregoing illustrates how misinformation prevents citizen involvement in the region's water governance.

***Dewey-Humboldt.*** Dewey-Humboldt, comprised of two previously unincorporated communities, incorporated in 2004. Historically, Dewey was an agricultural community while Humboldt was a mining community. One of the reasons given for the town's incorporation was to avoid absorption into Prescott Valley through the latter's annexation (Town of Dewey-Humboldt, n.d). Residents of Dewey and Humboldt did not want urbanization, and incorporating both communities into one provided a means to retain the town's rural character.

However, in recent times, only 1.5% of the town's workforce are employed by agriculture, forestry, fishing, hunting, and mining. Construction, retail/wholesale trade, manufacturing, finance, insurance and real estate employs 40%; education, healthcare and social assistance employs 27.4%; and service industries employ the rest of the workforce (Arizona Commerce Authority, 2015). In spite of its goal at incorporation, the

town's 'Vision 2028' acknowledges that growth would occur in the municipality but that the town desires to maintain its rural character. According to the Vision, the local government expects population growth to occur due to the "predicted megalopolis that will extend from Prescott to Nogales," but they know (and expect) that water supply would be a limiting factor in the Town's growth (Town of Dewey Humboldt, 2009, p. 2).

The prevailing water narrative in the Town is 'keep them from using our water so that we can have adequate water'. The "them" in this instance being the neighboring Town of Prescott Valley with whom Dewey-Humboldt shares the Agua Fria sub-basin. Dewey-Humboldt is not doing anything specifically towards safe yield. About 80% of residents have individual (exempt) wells, while other residents are either served by one of two private water companies (Humboldt Water and Wilhoit Water Company) or haul water from a standpipe maintained by Wilhoit Water Company. The town itself does not have a central water system, and residents do not want one because it would supposedly spark growth, which they do not want. An interviewee stated the following:

> The town council are divided, but in general you probably have four councilmembers on the council that will tell you that they want to keep it the way it is, so they don't want to encourage growth, which is kind of suitable with our situation because we don't have water or sewer - utility services. Where you have that, you invite growth, …and they don't want more growth. (Municipal staff, June 2015)

Thus, residents would rather keep exempt wells and not have a central water system in order to avoid population/economic growth. The following excerpt summarizes the town's position/overall role in the region's safe yield goal:

> Safe yield to us is more a volunteer. As a town, we don't really do much to promote safe yield, even though everybody knows… everybody has their own private well or go to a private company. To us, it's really not much. (Municipal staff, June 2015)

This volunteer position is only tenable because the GMA restricts municipal contributions towards safe yield to public and private water providers.

Meanwhile, the water narrative of Dewey Humboldt government and residents is generally that low-density development makes more water available (that remain unused) and thus supports safe yield. Unlike other AMA municipalities, the town acknowledges in its community vision that limited water resources would limit growth but is not making any efforts to augment water supply. One could argue, however, that this is because it is important to the town to remain rural, and this preference influences the town's water narrative and water governance contributions (or lack thereof) to safe yield. Even though the town sees its low-density residential development as creating a sustainable water future within the greater region (Town of Dewey-Humboldt, 2009), this claim is difficult to evaluate as there are no records of water use vis-à-vis the people served.

Similar to Chino Valley, Dewey-Humboldt residents are more vulnerable to water scarcity than Prescott and Prescott Valley residents due to their high dependence on exempt wells (Table 7). This vulnerability is also impacted by the inadequate capacity of residents to address issues of contaminated water supplies, unlike municipal providers (Collins and Bolin, 2007). As noted by Bolin et al. (2008), naturally occurring arsenic in groundwater is a water quality threat to which groundwater users in the AMA are susceptible. In addition, ADWR reports that naturally occurring radon is also a water quality threat, especially for dry lots in the region (Arizona Department of Water Resources, 2014a). These water quality issues are financially and medically expensive. Radon in water can be released into the air, and radon is the second highest cause of lung cancer (World Health Organization, 2016). Promoting water sustainability by ensuring

residents are not unnecessarily exposed to health hazards would require a better understanding by residents of the upsides and downsides of exempt well dependence.

**Regional Water Governance – The Groundwater Users' Advisory Council.** As noted in previous sections, the Groundwater Users Advisory Council is a statutory five-member council whose members are appointed by the governor and expected to be from different sectors within the AMA. By state statutes, GUAC has no independent decision-making authority within the region's water governance, but it appears that such is desired among GUAC members, as shown in the excerpt below:

> If you really want to come right down to it, the GUAC was just, in my mind, a gesture to give the impression that there's some public control over what goes on in the AMA, but it really doesn't do much. We didn't have any authority to do anything except make recommendations [to ADWR] ... and most of the time they didn't listen to you easily. (GUAC, March 2016)

In 2006, Prescott AMA's GUAC safe yield sub-committee published a report titled "Safe-Yield Impediments, Opportunities, and Strategic Directive." According to the report, groundwater in the AMA is legally over-allocated, as groundwater demand was estimated to be 24,00 acre-feet/year with an annual overdraft of approximately 11,000 acre-feet/year (Groundwater Users Advisory Council, 2006). The report concluded that voluntary reductions in water demand, participation of exempt well owners in reaching safe yield, securing alternate water supplies, and development of enforcement provisions were needed to achieve safe yield (Groundwater Users Advisory Council, 2006). This report by GUAC has been cited widely in the region and beyond by governance actors, including CWAG and ADWR. Part of the recommendations from the report that was presented in the Fourth Management Plan developed by ADWR for the AMA is the suggestion of a water conservation/replenishment district involving all water users within

the AMA. However, most recommendations have not been acted upon despite their validity. This state of affairs is due to an absence of political will to act and a lack of authority by GUAC to initiate coordination among local level actors. The first recommendation made by the report is 'stakeholder engagement' alongside highlights of GUAC's lack of statutory authority, as seen in the following excerpt:

> The GUAC, and by extension the Safe-Yield Subcommittee, are limited by statute to a role as a local advisor to ADWR on PrAMA issues. As such, the GUAC can provide recommendations to the Governor or ADWR, but does not have the legal authority to act on many of the recommendations listed in this section. An action team comprised of the affected stakeholders may be required to continue with the required work on the other recommended next steps and opportunities. The stakeholders could then develop a best management strategy, agree to promote or implement specific actions and lobby the state legislature if deemed necessary. A stakeholder process should include representatives of all affected water users and providers in the PrAMA. (Groundwater Users Advisory Council, 2006, p. 11)

GUAC advises ADWR in the use of the Water Management Assistance Program (WMAP) fund. This fund is made up of contributions by groundwater right holders in the AMA such as municipal and private company water providers. Exempt well owners do not contribute to this fund. The fund was instituted by the GMA to finance water conservation and supply augmentation projects within the AMA. Due to having municipal water systems, Prescott, Chino Valley, and Prescott Valley are contributors to the fund, but Dewey-Humboldt is not. Given this situation, WMAP inadvertently tilts the power structure regarding conservation and water augmentation projects away from Dewey-Humboldt, thereby expanding the gulf of no direct contribution by Dewey-Humboldt in decisions on achieving safe yield or more comprehensive sustainable water governance.

In recent years, the Council has not been involved in outreach to its communities, but its members typically provide input to ADWR (through the AMA director) during the

drafting of AMA's management plans. According to the GMA, GUAC has an advisory role to the AMA director and is not institutionally given authority to do much more. Even though there are members that would like to play more active role in the region's water governance, the GMA has no such provisions and inadvertently limits the decision-making ability of regional water governance actors.

**Prescott AMA's safe yield management goal - Is Safe Yield a Placeholder?**

One common conclusion drawn by both government and non-government actors in Prescott AMA is that, despite being mandated by the Groundwater Management Act (GMA), safe yield is simply a goal – a voluntary one, too – not a requirement, as shown in the quotes below:

> *Citizen involvement is particularly important for this issue* [safe yield] *because achieving safe yield is merely a goal and not a requirement.* There are no legal penalties. Citizens' demand for a sustainable water supply is critical. (Citizens Water Advocacy Group, 2007, emphasis in original)

> The AGMA [Arizona Groundwater Management Act] defines safe yield as a goal and not as a requirement. The ADWR (Arizona Department of Water Resources) has confirmed that there are no regulatory penalties for not meeting safe yield. As such, the residents of the PrAMA [Prescott AMA] must voluntarily reach safe yield or suffer the eventual physical and economic penalties of a depleting aquifer. (Upper Verde River Watershed Protection Coalition, 2010, p. 5)

Consequently, current governance for safe yield is ineffective for the following reasons:

> (1) Insufficient commitment and coordination exists at the local level to collectively pursue safe yield;
>
> (2) State law creates loopholes that circumvent efforts to achieve safe yield, such as the unlimited and protected development of unregulated (exempt) wells;
>
> (3) There are no consequences for not reaching it; and
>
> (4) The incorporation of non-government actors (such as GUAC) and devolution of responsibility to the regional level of governance is not accompanied by commensurate authority.

In recent times, especially, ADWR's strategy for enforcing stipulations of the GMA has been voluntary compliance. One possible explanation for this policy's focus on voluntary compliance could be the reduction in ADWR's staff strength and capacity since 2008, when the state experienced economic downturn. Another possible explanation is that after the GMA was enacted but Prescott could not utilize its CAP allocation through exchange, state level officials and ADWR realized achieving safe yield in the AMA by 2025 would be near impossible and thus have promoted the idea that achieving safe yield is voluntary. Alongside this message about safe yield being voluntary is the message about damages that would occur if safe yield was not accomplished, in order to galvanize regional actors to act. In the AMA's Fourth Management Plan, the following consequences of non-safe yield conditions are identified:

> Groundwater storage capacity is reduced; Future reliability of water supplies is less certain; Water levels decline; Wells may require deepening; Water quality problems may increase; Wells may go dry; Pumping and drilling costs increase; Natural discharge to springs and streams diminish; Land subsidence and earth fissuring may occur. (Arizona Department of Water Resources, 2014a)

So far, expectations of voluntary action by regional and local governance actors in achieving safe yield have not resulted in substantial progress towards the goal.

The argument that imported water would move the AMA out of overdraft to safe yield is questionable; water planned for the study area's safe yield is the same water reserved for future growth. One probable approach is for Prescott and Prescott Valley to store Big Chino water underground within the AMA in order to move out of overdraft status to safe yield if water importation can be started ahead of 2025. Since recovery credits are granted for water stored this way, perpetual safe yield would probably not be achieved in the AMA; instead, water supplies would simply have been increased to

accommodate future growth, while current levels of overdraft would continue with the potential to increase if there are any reductions in the amount of Big Chino water available for importation.

The arid geo-climate, ongoing drought (now in its twenty-third year), and effects of global climate change on Arizona as a whole and Prescott AMA in particular make it imperative for the study region to re-examine and change its current ways of governing water. As the foregoing paragraph shows, sustainable water governance is needed *before* water augmentation is considered, not the pursuit of water augmentation to achieve sustainable water governance. Generally, sunbelt states have experienced increasing periods of droughts and reductions in annual precipitation, both of which are attributed to the effects of a warming climate (Bates et al., 2008). Meanwhile, climate projections suggest that annual precipitation may continue to decrease in the Sunbelt region until 2100 (Bates et al., 2008). Given the predicted climate variability and change, both surface water and groundwater storages across the western United States are dwindling rapidly, thereby making dependence on imported water an unreliable option.

There seems to be an unspoken acknowledgment that safe yield is impossible to achieve in Prescott AMA, with or without imported water. However, this knowledge is not acknowledged verbally by most governance (especially government) actors in the region. Instead, it appears that an emphasis on 'attempts'[20] in the statutory definition of safe yield is how the GMA and safe yield's success will be adjudged in Prescott AMA (see Jacobs and Megdal (2004) for more on this argument regarding all safe yield

[20] Safe yield is a "groundwater management goal which *attempts* to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn in an active management area and the annual amount of natural and artificial groundwater recharge in the active management area" (Groundwater Management Act, 1980, p. 1437, emphasis mine).

AMAs). According to an ADWR staff member, the GMA requires a date on or before January 1, 2025, when safe yield is declared accomplished, even if it is only for that snapshot in history (Anonymous, personal communication, 2017).

Overall, the GMA's emphasis on water conservation and supply augmentation for selected parts of the state does not promote comprehensive water sustainability and is a major barrier in the study area achieving sustainable water governance. Specifically, governance actors across levels have focused on water conservation (for all water users except exempt well owners) and supply augmentation as the strategies for achieving safe yield. Given the region's high overdraft, conservation is inadequate. Meanwhile, the AMA's source of supply augmentation is non-renewable groundwater, which is earmarked for growth (as earlier noted). Thus, the guiding policy for water governance in the AMA, the Groundwater Management Act, is insufficient as a tool for moving the AMA towards sustainable water governance.

Given this chapter's results, the GMA's application in Prescott AMA provides an appearance of water stewardship while being incapable of accomplishing a sustainable balance between water demand and supplies. This ineffectiveness is due to a watering down and lack of enforcement for positive water management strategies (Hirt et al., 2008). Thus, Arizona's GMA and related water management strategies are ineffective in ensuring Prescott AMA's water sustainability.

**Summary.** Regarding the study area's water resources, power is exercised by both government and non-government actors across state, regional, and local levels through litigation, legislation, and the political process. Deliberation among parties usually occurs after litigation regarding current water issues. For example, SRP issued a

legal challenge to Prescott and Prescott Valley, aimed at protecting SRP's Verde River water rights, before the parties pursued deliberation. Interviewees suggested that in Arizona's water politics, disagreements or grievances are often first taken to the courts before other avenues of relief are sought.

Yet my triangulation of interview data with documents reveal that litigation is not *always* the first step in resolving conflict. Instead, governance actors pursue whatever means (litigation or the legislative or other political processes) that gives them the most advantage based on the resources (legal, financial, etc.) available to them. For instance, municipalities will not pursue litigation if it is possible to obtain relief through legislative intervention such as ARS 45-555, which was passed to allow Prescott's import of groundwater from the Big Chino basin. Also, governance actors generally pursue litigation first if they can financially afford the process and foresee good chances of obtaining a ruling in their favor.

Political processes at the local level—including electing government offices, preventing the establishment of municipal rules, or establishing municipal rules—have been used to avoid regulations on exempt wells and to enhance groundwater recharge with the use of effluent. Overall, this study shows that the different actors connected to Prescott AMA's water governance exercise power through litigation, legislation, or the political process based on the options most accessible to them (Table 8). However, the preference for litigation (based on the conditions identified) over deliberations is problematic given the inefficiency of litigation in resolving natural resource conflicts.

Furthermore, mobilization of resources and the exercise of power in the study area's water governance is guided by diverse water narratives. These narratives are either

growth related, libertarian, or sustainability-focused. These growth, libertarian, and sustainability water narratives determine the goals of actors or their anticipated outcome in mobilizing resources. For instance, growth-focused governance actors have pursued water augmentation through legislative intervention that allows the importation of water from the Big Chino basin into Prescott AMA. Also, governance actors with libertarian values have opposed potential exempt well regulations resulting from municipal codes through the political process of voting for a mayor that supported zero regulation of exempt wells. Finally, sustainability-focused governance actors used the political process to pass local-level initiatives that would require the permanent recharge of treated effluent from subdivisions with 250 or more acres.

Mental, artefactual, natural, and monetary resources have been mobilized by both government and non-government actors across state, regional, and local levels in promoting each of these diverse water narratives (Table 8). For example, coordination exists in how power is exercised by governance actors across levels, specifically with respect to water augmentation. In this example, coordination occurs because state, regional, and local level actors desire economic growth and view augmented water supplies as essential to maintaining local to state level economic growth. To further this growth goal, government actors across levels present safe yield as the reason for water augmentation even though imported water supplies will not help the region reach safe yield or achieve water sustainability. Overall, the diverse water narratives of governance actors serve to satisfy their different goals but are barriers to sustainable water governance in the region due to the emphasis of growth and libertarian proponents on

water augmentation and zero water management. These management emphases result in asymmetric water governing practices where minimal demand management is enforced.

Table 8.
*Water Narratives and Power in Prescott AMA's Water Governance*

| **Water Narrative** | **Actors** | **Means of Exercising Power** | **Form of Power/Resources Mobilized** | **Outcome** |
|---|---|---|---|---|
| New water to support growth – *Growth Narrative* | Municipality (Prescott and Prescott Valley); state government (legislators and governor) | Legislation (using structural power) | Innovative Power/ human, mental, natural, monetary resources | Exemption authorizing transportation of groundwater from Big Chino into Prescott AMA passed by state legislature |
| Maintaining individual control of water – *Libertarian Narrative* | Individuals (Chino Valley residents) | Political process | Destructive Power/ human, mental, natural, monetary resources | Ensuring that Chino Valley exempt wells remain unregulated and unrestricted |
| Achieving safe yield and maintaining surface water flows – *Sustainability Narrative* | Individuals (Prescott residents) | Political process | Innovative Power/ human, mental, natural, monetary resources | Use of 250+ acre new development effluent for permanent recharge in Prescott (Reasonable Growth Initiative, Prop 400) and failed attempt to ensure Prescott residents' approval before upcoming BCWR expenditures despite passed Initiative (Taxpayer Protection Initiative, Prop 401) |

| | | | | |
|---|---|---|---|---|
| | Civil society (Center for Biological Diversity noted by Bolin et al. (2008)) | Litigation (using federal law) | Reinforcive Power/ human, mental, natural, monetary resources | Provides legal opposition to BCWR pumping and water importation by Prescott and Prescott Valley using the Endangered Species Act of 1973 |

Out of the three narratives (growth, libertarian, and sustainability), the more powerful narrative is a function of the power of its proponents. Similar to Whitmire (2013), I found that state level actors (comprising legislators, judiciary, and the governor) exercise the most power in Prescott AMA and the Central Highland's water governance. This is because, as a result of the authority constitutionally vested in their offices, these actors are able to mobilize artefactual, mental, monetary, and natural resources. Because the state is the most powerful actor in the region's water governance, the narrative they support is inevitably the most powerful narrative in the region.

Although all actors exercise a measure of power, not all actors are equally powerful (Table 9). In my case study, non-government actors exercised the least power in water governance due to their limited ability to mobilize different resources. Also, due to their institutional structure, non-government actors (both organizations and residents) are unable to exercise different forms of power (innovative, reinforcive, transformative, destructive) simultaneously (Table 9). For instance, CWAG, an active non-government actor in the study area, is classified as a 501(c)(3) organization by the Internal Revenue Service (IRS). Due to this classification, organization members are limited in the political

and legislative (including lobbying) activities the organization can be involved in (Internal Revenue Service, 2017). Overall, non-government organizations are engaged in regional water governance to the extent of their capacity but are limited in collaboration with government actors due to unresolved debates, for example, over growth.

Table 9.
*Forms of power exercised, and resources mobilized by actors linked to Prescott AMA's water governance*

| **Levels** | **Governance Actors** | **Form of Power** | **Resources Mobilized** |
|---|---|---|---|
| State | Governor, legislators, judiciary | Innovative power<br>Reinforcive power<br>Transformative power<br>Destructive power | Artefactual, Mental, Monetary, Natural resources<br>Artefactual, Mental, Monetary, Natural resources<br>Artefactual, Mental, Monetary, Natural resources<br>Artefactual, Mental, Monetary, Natural resources |
| | ADWR | Innovative power<br>Reinforcive power<br>Transformative power | Mental resources<br>Mental resources<br>Mental resources |
| Regional | Prescott AMA GUAC | Innovative power<br>Transformative power | Mental resources<br>Mental resources |
| | CWAG | Innovative power<br>Reinforcive power<br>Transformative power | Mental, Monetary resources<br>Mental, Monetary resources<br>Mental, Monetary resources |
| Local | Municipal government and staff | Innovative power<br>Reinforcive power<br>Transformative power | Artefactual, Mental, Monetary resources<br>Artefactual, Mental, Monetary resources<br>Artefactual, Mental, Monetary resources |
| | Residents | Innovative power<br>Destructive power | Artefactual, Mental, Monetary resources<br>Mental, Natural resources |

ADWR: Arizona Department of Water Resources
GUAC: Groundwater Users Advisory Council
CWAG: Citizens Water Advocacy Group

## Conclusion

In this chapter, I presented results to the three research questions posed in Chapter 1. Regarding question one, this research shows that the majority of the avenues for interaction across levels are either mandated by the GMA or are a result of ADWR's interpretation of the GMA. Interactions between the state and regional levels are mostly informational, with actors at both levels obtaining and transmitting information. With these informational interactions, safe yield is supposedly pursued through conservation and proposed water augmentation. Interactions between regional non-government actors and local level actors (for example, between CWAG and the municipalities) are mostly contentious. This contentious relationship possibly contributes to the ongoing conflicts in the study area. Finally, interaction between the state and local level actors, regarding water governance and sustainability, revolve around water permitting and reporting.

For the second research question, the municipalities had potential to collaborate around shared interest goals, but safe yield is not a shared interest goal among all municipalities in the AMA. Instead, there is a lack of cooperation in pursuing safe yield and sustainable water governance due to shared groundwater. Cooperation currently exists between Prescott and Prescott Valley around their joint water importation. However, contentious interactions exist bilaterally between municipalities that share the same groundwater basin on issues of intra-basin transfers, the state's framework for recharge and recovery, exempt wells, and disputes on the relationship between growth visions and the region's water sustainability.

The third research question reveals that governance actors exercise power through litigation, legislation, and the political process. Furthermore, any of these three means of

exercising power are employed by governance actors irrespective of their water narratives – whether libertarian, growth, or sustainability-focused. I found that coordinated resource mobilization exists among governance actors across levels with respect to water augmentation.

In the next chapter (Chapter 5), I elaborate on the findings of this research in relation to water governance literature. I also make recommendations for water governance interactions and resource mobilization that support water sustainability.

# CHAPTER 5

# DISCUSSION AND CONCLUSION

This chapter is divided into four parts. In the first part, I discuss the findings of this research and my contributions to water governance literature under the following headings: governance interactions and implications for water sustainability, power and ideological divides among governance actors, and revisiting the conceptual framework. Second, I highlight areas for future research. Third, I provide a summary of recommendations for Prescott AMA's water governance. Finally, I offer concluding thoughts on the conditions for and barriers to water sustainability within specially instituted water governance structures where conflict persists among governance actors.

## Discussion of Findings

**Governance interactions and implications for water sustainability.** In this study, vertical governance interactions were either informational, contentious, or administrative, and occurred because of both the stipulations and interpretations of Arizona's Groundwater Management Act (GMA). Informational interactions revolved around the Groundwater Users Advisory Council's (GUAC) meetings, 10-year management plans, Water Management Assistance Program (WMAP) funds, and Arizona Department of Water Resources' (ADWR) expertise. Although actors in Prescott AMA interact in these ways to share information, safe yield and sustainable water governance are not being achieved because informational interactions are aimed at providing water for new growth, rather than promoting a balanced demand-supply water management approach. In other words, state mandates have led to governance

interactions among actors across local to state levels, but these interactions have not been productive in meeting the regional goal of safe yield or sustainable water governance otherwise.

The informational interactions in the study area are not contentious. Instead, contentious interactions are due to disagreements on how growth should occur with respect to the region's limited renewable water. Particularly, I found that disappointing past experiences that were never addressed, and the tendency to attack the messenger rather than debate the message, were key elements that eroded trust and the ability of governance actors to work together in reducing the region's overdraft. For instance, undeliberated disagreements on growth currently limit the collaboration of both government and non-government actors in the region on conservation activities. In other words, debates about whether or not the region should grow currently limit the ability of regional non-government actors and municipalities to work together in establishing regional sustainable water governance.

Whereas Sayles and Baggio (2017) show that funded relationships can be more productive than mandated ones, this research suggests that decision-making authority is important to members in funded relationships and influences their perception of the relationship's productivity. With respect to governance interactions, I found that perceptions of low productivity by GUAC members were influenced by how much authority for decision making the members possess. Specifically, unlike county Board of Supervisors or municipal council members, GUAC has no statutory authority to make and enforce rules. Instead, the GUAC's statutory responsibility is limited to advising ADWR's director through the AMA director, while ADWR decides, for example, on

what projects are funded with WMAP funds. The effect of GUAC's lack of authority is seen in the council's inability to implement its recommendations for pursuing safe yield at the Active Management Area (AMA) level (Groundwater Users Advisory Council, 2006). Thus, GUAC's lack of decision-making authority undermines sustainable water governance in Prescott AMA.

With respect to horizontal governance, water governance coordination among municipalities was influenced by shared interests. However, out of the prevailing municipal interests in the study area (economic growth, individual water control, remaining rural), only one, economic growth, is shared by two municipalities. Prescott and Prescott Valley share economic growth interests and, thus, are collaborating on a local water augmentation project that involves groundwater importation from the neighboring Big Chino basin. However, as noted by Bolin et al. (2008), this water import is a spatial fix that only temporarily resolves the problem of insufficient supplies for one place by extracting water from another. If successful, the water importation project could trigger water scarcity in the Big Chino area. Overall, the absence of shared interests in water sustainability[21] means that neither safe yield nor sustainable water governance are being collaboratively pursued by the AMA municipalities. I discuss the problems with seeking more supplies later in this chapter.

Meanwhile, contentious interactions between municipalities in the same hydrologic basin are due to dissatisfaction over volumes of groundwater withdrawal versus recharge, differing urban and rural visions, and the proliferation of exempt wells. These issues, also undeliberated, limit cooperative efforts among all four municipalities

[21] That is, water sustainability pursuits that maintain the integrity of socio-ecological systems

toward regional water sustainability. With respect to local actors, Prescott AMA residents generally engaged in water issues to the extent that they perceived its impact on their lives. At such points, residents have taken steps to protect water either for their own individual control (prompted by libertarian narratives as seen in Chino Valley) or for the common good (as seen in sustainability narratives from Prescott residents). It is noteworthy that even though libertarian narratives are dominant in Chino Valley and 'won' in contributing to the sitting Mayor's re-election loss, the municipality has residents with sustainability narratives (mostly those affiliated with non-government groups such as the Citizens Water Advocacy Group, CWAG). Similarly, in Prescott, although sustainability narratives 'won' in the passing of Prop 400 and 401 Initiatives (which were about effluent recharge and public votes for municipal expenditures above $40 million respectively), there are residents with either libertarian or pro-growth narratives in the municipality. In any case, within both Chino Valley and Prescott, residents have exercised power in the region's water governance through the political process. I discuss these narratives and power further in the next sub-section.

Given the foregoing, I support Whitmire's (2013) call for deliberative platforms in resolving the Central Highlands' water conflicts. Based on this study's focus on water sustainability, I argue that deliberative platforms are an important means for fostering the sustainable water governance principle of socio-ecological civility and democratic governance proposed by Wiek and Larson (2012). Specifically, designing deliberative avenues to debate the options for, types of, and extent of growth could help bridge the current divide that exists between government and non-government actors in Prescott AMA to foster joint pursuits of water sustainability. This could involve shifting dialog

away from whether to pursue population growth or not and toward a more productive dialogue that stresses how to ensure the region thrives economically and otherwise. In the recommendation section below, I offer ideas for promoting collaboration between government and non-government actors.

The GUAC could serve as a platform for this deliberative forum, but it would mean including actors such as environmental organizations[22] who are not formally included on the current council. Changing the mode through which representatives are appointed to the GUAC, and providing the Council with decision-making authority[23], are other important requirements for transforming the GUAC into a platform where conflicting interests can be deliberated with a view of developing a collaborative approach to regional water governance. I recommend modifying the GUAC rather than creating a different governance entity for two reasons. First, the current GUAC structure is weak in terms of its lack of authority and has limited effectiveness as a mid-level governance entity (between state and local governance actors). Second, mostly the same individuals are involved in water governance within the Central Highlands. Thus, it is better to restructure the current council rather than create a new council with a different name but the same people. For a newly constituted GUAC to be effective, sufficient access to financial resources would be essential. In the recommendation section, I further discuss these suggested changes to the GUAC's structure.

[22] Megdal et al. (2011) argues that the environment is a water user that is not currently recognized in Arizona. Since the GUAC is a council of water users and the environment is a water user, it is imperative that the environment is represented on a restructured GUAC.

[23] This would mean changing the GUAC's structure from an advisory council to a different governance structure with decision-making authority.

**Power and ideological divides among governance actors.** Drawing on Avelino and Rotmans' (2011) conceptualization of power, I define power as the mobilization of mental, monetary, artefactual, and natural resources by actors to achieve a goal. My approach is distinct in that I focus on mobilization, as opposed to the 'capacity' to mobilize resources (Avelino and Rotmans 2011). I focus on the actual mobilization of resources by governance actors to better understand how power has been and is being exercised in Prescott AMA's water governance. In this section, I discuss resource mobilization by state, regional, and local actors, and the implications for Prescott AMA's water sustainability.

The water narratives found in this study are growth, libertarian, and sustainability narratives. The most dominant narrative was pro-growth due to it being favored by state level actors, who are the most powerful actors in the study area's water governance. The power of state level actors (governor, legislators, judiciary, ADWR) stem from their constitutional and statutory authority, which largely enables them to mobilize artefactual, mental, monetary, and natural resources simultaneously. The exception is ADWR, whose ability to mobilize resources is mostly subject to the support of other state level actors, especially the governor. Specifically, ADWR's director is appointed by the governor and serves at the governor's pleasure (ARS 45-102). This relationship promotes coordination between the governor's office and ADWR. Also, the relationship arguably places ADWR's guiding ideology in alignment with those of the incumbent governor. Yet, the traditional pro-growth narrative is detrimental to water sustainability since perpetual supply augmentation is unsustainable (Larson et al., 2009; Hirt et al. 2017).

In this study, the promoters of libertarian and sustainability narratives were non-government actors who exercised power through the political process to keep exempt wells unregulated and to increase permanent aquifer replenishment. Non-government actors generally had the least power due to, for example, legal limitations regarding political lobbying for organizations, and the limited ability of both organizations and residents to mobilize artefactual, mental, monetary, and natural resources simultaneously. Although libertarian and sustainability narratives were less dominant overall, the non-government actors who espouse them still exercised power and influenced water governance.

Specifically, citizen resistance within the study area has been effective in keeping the regulation of exempt wells off the agenda, which is an exercise of destructive power (Avelino and Rotmans, 2011). However, in opposing the regulation of exempt wells, residents inadvertently increase their own vulnerability to water scarcity. Collins and Bolin (2007) show that households on exempt wells are generally more vulnerable to water scarcity than those who receive water from municipal and private water providers. Their study reveals that households on exempt wells are also more vulnerable to arsenic exposure than those served by municipal and private water providers due to the prohibitive costs of removing arsenic from groundwater. Thus, residents have exerted political power to serve their short-term ideological interests in not being regulated. Yet in the long-run, the lack of monitoring for exempt wells heightens their own vulnerability to water scarcity since the status quo increases the likelihood of lowered water tables and declining water quality. Thus, libertarian ideologies may ultimately be detrimental to personal interests.

The seeming disinterest of Prescott Valley residents regarding safe yield and water sustainability is likely linked to the messaging of 'sufficient supplies and good water management' advertised by Prescott Valley government through various communication media, such as the Town's website (Town of Prescott Valley, n.d.b). Prescott Valley's messages are misleading and are resulting in a citizenry that is ignorant of the true state of water sustainability—or more accurately, unsustainability—in the region, thereby hampering citizen-instigated activities that contribute to sustainable water governance. Thus, even though citizens can wield power through political processes, the wielding of power (through resource mobilization) by residents depends at least somewhat on the type of information and messaging they receive.

In effect, the direction and urgency of citizen action appears to correlate strongly with the type of information communicated to citizens and how that information is communicated. Even though interviewees noted that GUAC public meetings are not well attended by AMA residents, the citizen initiatives discussed in Chapter 4 show that residents *are* interested in water governance to the extent that they see a need for their involvement. For instance, the sitting Mayor of Chino Valley arguably lost re-election because residents perceived threats to their control or ownership of water. Thus, GUAC public meetings might be better attended if residents see the need for their engagement. Otherwise, as Whitmire (2013) noted, residents expect their elected officials to act on their behalf in making water governance and sustainability decisions.

According to Mann's (1986) sources of power[24] cited by Avelino and Rotmans (2011), this dissertation shows that *ideological power* influences water governance in the

[24] Mobilization of mental, human, and artefactual resources (ideological power); human and artefactual

study area. This ideological power serves as both a condition for and barrier to Prescott AMA's water sustainability. However, while Avelino and Rotmans (2011, 798) identify "information, concepts, ideas, beliefs" as examples of mental resources, I found that beliefs (or water narratives as I describe them in this study) determine what 'information' is communicated. In other words, beliefs are not only a mental resource that can be mobilized in exercising power, they are also key in determining which mental resources are mobilized, and how the mental resources are mobilized. Furthermore, I argue that ideological power trumps Mann's (1986) military or economic power in the study area's water governance due to the decentralized water governance regime and individualistic social and political culture in Prescott AMA and the western United States generally.

Meanwhile, building on Whitmire (2013), this study shows that more important than the power that exists with citizens is the goal for which such power is exercised. For instance, citizen power in Chino Valley was successful in overturning proposals to limit the proliferation of exempt wells. Citizens in this instance exercised power based on libertarian values of control over water. Though it is important that citizens were able to exercise power, exercising power based on libertarian values of water control serves to hinder sustainable water governance in the study area. The finding about libertarian narratives extends Bolin et al.'s (2008) research by showing that apart from growth narratives, libertarian narratives are influencing conflicts and water sustainability in the Central Highlands.

Moreover, emphasizing broad value-based ideologies such as growth, individual property rights, and environmentalism in governance deliberations perpetuates a gridlock

---

resources (military/physical power); mental, human, and natural resources (geopolitical power); human, artefactual, natural, and monetary resources (economic power).

in the pursuit of sustainable water governance. Instead, breaking these values down into specific concerns could help illuminate the nuances of individual or group perceptions of the specific issues. Within the study area, growth is a point of contention that divides residents into one of two camps: pro-growth or anti-growth. Yet this framing is insufficient in breaking the stalemate of inaction in regional collaborative water governance. In fact, rather than a clear-cut resistance to economic and population growth, regional and environmental groups like CWAG appear to be advocating for a different type of economic growth that is not dependent on continuous residential development that will place additional pressure on the region's water resources. Thus, again, deliberating the nuances of the type of growth desired—with an emphasis on the most sustainable pathways for economic development— could help move beyond the current gridlocks to collaboration among governance actors.

Overall, value-based ideologies can hide barriers to sustainable water governance, as with the issue of exempt well regulation. Similar to the issue of growth, an argument framed around property rights hinders, for example, conversation about the vulnerability[25] of exempt well owners relative to people dependent on municipal or private water providers (Collins and Bolin, 2007). Yet conversations on specific issues rather than broad ideologies could help residents understand the value of enforcing deliberated rules on individual well operation, which might help overcome the current polarized stand on exempt well regulation. As discussed by Whitmire (2013), science is not the problem in the Central Highlands' water governance; instead, diverse values

[25] Given the overallocation of Arizona's water resources (both groundwater and surface water), a first step in better managing the state's water resources will require keeping records of actual water demand from all water users including current exempt well owners.

perpetuate conflict and thwart water sustainability. Thus, the proposed recommendation aims to provide opportunity for non-polarizing deliberation on water governance activities that would support sustainable water governance. In the case of exempt wells, regulation will need to be clearly and fully defined. In addition, the tradeoffs of individual control over increased costs due to dry wells and the need to drill new ones, plus the costs of treating contaminated water, will need to be considered by exempt well owners.

**Revisiting the conceptual framework: governance interactions and power.** In this sub-section, I discuss the reciprocal relationships between vertical governance, horizontal governance, and power. I conclude this section by summarizing the utility of the proposed conceptual framework.

As expected, vertical interactions across state, regional, and local levels did not influence horizontal interactions—that is, at the local level among municipalities. However, rules that guide vertical governance, or rules formulated at the state level (in this case, ARS 45, the state's water statutes) do affect horizontal governance. Regarding interactions, the state's water statutes (Arizona Revised Statutes, Title 45) and conflicts between municipal priorities served as a basis for the cooperative and contentious interactions that exist among municipalities (local level). For instance, the BCWR project being pursued by Prescott and Prescott Valley is made possible by ARS 45-555, which mandates Prescott's groundwater import from the Big Chino basin. Meanwhile, contentions around intra-basin water transfer, groundwater recharge, and exempt wells occur due to conflicting municipal priorities. Furthermore, the decentralized nature of water governance by each municipality means that, even though competing

municipalities share the growth narrative of state level actors, the cooperating municipalities are not necessarily more powerful than other municipalities at the local level. Thus, even though vertical interactions did not directly influence horizontal interactions, I found that vertical governance affected horizontal governance through rules and regulations made at the state level that influence local level water governance.

Horizontal interactions did not affect vertical interactions. However, similar to the preceding paragraph, horizontal interactions possibly influence the values, decisions, and policies at the state level. For example, the protection of exempt well owners is one of the identified shortcomings of the GMA (Connall 1982, Maguire 2007). However, the example of citizen resistance in Chino Valley shows that there is local support for unregulated exempt wells that could have been a precursor to the GMA clause that allowed exempt wells. This clause now limits moving beyond the status quo to sustainable water governance.

In theory, horizontal governance could influence vertical governance to the extent that local actors move into positions of authority at other levels. This movement could lead to the transfer of ideologies prevalent in the local areas being transferred to or maintained, for example, at the state level. For instance, if a governance actor with libertarian water values is elected to the state's legislature, they could work to maintain the status quo of unregulated exempt wells, thereby reinforcing that locally prevalent ideology at the state level. Since state level ideologies influence state statutes and vertical governance, this is one way horizontal governance could affect vertical governance[26].

[26] I do not have proof that this instance currently exists in the study area. However, it is noteworthy that one of the state's senators is a former Mayor of Chino Valley.

In this study, vertical and horizontal governance did not determine how resources were mobilized or power exercised. Instead, vertical and horizontal interactions reinforced the current mode of resource mobilization and power exercise through litigation, legislation, and the political process, thereby maintaining the status quo. Breaking the status quo in water governance practices would require shifts in the narratives or ideologies that influence the mobilization of resources (that is, exercise of power). For instance, even though growth, libertarian, and sustainability narratives simultaneously exist in the study area, the dominance of growth narratives is responsible for the current management asymmetry that favors supply augmentation rather than a balanced approach that pursues demand and supply management, while cognizant of the limitations to sustainable supply development (discussed later in this section)

In terms of the influence of power on vertical and horizontal governance, I found that ideologies and narratives of growth, individual water control, and sustainability determine how actors mobilize resources in their interactions with others across levels. None of these ideologies are explicitly stated by actors in their interactions but the divergent ideologies and water narratives foster water conflicts between actors, across levels. Because conflicting ideologies are not being or have not been explicitly deliberated by actors, there is room simultaneously for informational, contentious, and administrative (e.g., permitting and reporting) interactions due to the GMA's mandates.

At the local level, contentious interactions were a result of different municipalities exercising powers in ways that contradict the municipal priorities of others. Specifically, divergent municipal priorities determined how resources were mobilized. For example, the contentions over intra-basin transfer, groundwater recharge, and exempt well

proliferations were due to each municipality mobilizing the resources it had control over through litigation, legislation, and the political process to accomplish its municipal vision. Although there are studies that show how power asymmetry causes conflicts when less powerful actors engage with more powerful actors on environmental or natural resource governance issues (for example, Paulson et al., 2003), this study suggests that power in itself is not the cause of cooperation or contentions. Instead, power aids cooperation or worsens conflict based on whether interacting actors have shared or divergent goals.

The finding that state level government actors are the most powerful with respect to Prescott AMA's water governance is likely to be found in other places within Arizona and possibly across the United States due to a prevalent individualistic culture. In other words, individuals would usually act in their personal interests without thoughts of how their actions might affect neighbors, making regulations from other levels of authority, such as the state, necessary. These regulations putatively provide a safeguard to protect all users dependent on shared water resource (for example, groundwater in Arizona). However, the water sustainability outcome of state level government oversight or rules appears to depend more on the ideologies that guide implementation of the rules than the rules themselves.

In terms of the outcomes of governance interactions, the most prevalent ideology, that is, the ideology of the most powerful actors determined the outcome of vertical interactions. For example, in this study's vertical governance, state level actors (comprising governor, legislators, judiciary, ADWR) have interpreted the GMA and created associated rules to make room for economic growth without adequate regard for

the long-term integrity of regional water resources. Thus, the influence of power (that is, resource mobilization) on governance interactions is determined by the ideologies and narratives that drive the actions of governance actors.

Meanwhile, the search for more water is problematic with respect to long-term sustainability. Specifically, freshwater in the Western United States is limited. Colorado River water, which meets about 32% of Central Arizona's annual water demand (ADWR, 2014d), cannot be relied on to supply increased population that are projected to need 18.1 million-20.4 million acre-feet, while the Colorado River produces an average 15 million acre-feet annually (Hirt et al., 2017). Besides insufficient river flows, it was recognized when Prescott received Central Arizona Project (CAP)[27] water allocations that the water could not be transported to the Central Highlands due to the prohibitive infrastructural costs (e.g., to pump water uphill over a long distance)—a situation that has not changed and is not likely to change in the future.

In addition, dependence on Colorado River water and other surface water supplies is unreliable due to climate change-induced extended droughts which are reducing annual river flows. Climatic projections for the Southwest forecast severe and frequent droughts due to the impacts of climate change (Cook et al., 2015). Continuous attempts to move groundwater between basins is unreliable due to the non-renewable nature of Arizona's groundwater, a condition that would only worsen if climate projections hold. Overall, *non-renewable* groundwater is a poor option to depend on for supply augmentation, as is being planned with the import of Big Chino groundwater into Prescott AMA.

[27] CAP water is Arizona's portion of Colorado River water.

Meanwhile, the proposals for desalination being considered for Prescott AMA are prohibitively expensive for the municipalities to afford. Instead, those funds could be better spent on demand management strategies that reduce the need for supply augmentation. However, even with cheaper desalination technologies, Hirt et al. (2017) extensively discuss the social, environmental, political, and equity implications that make reliance on desalinated water an unreliable pursuit for Arizona. Given the unreliability of various supply augmentation options, it is imperative that AMA and state level governance actors invest in demand management strategies as opposed to the current emphasis on supply augmentation.

The conceptual framework utilized in this dissertation and explicit analysis of power reveals that coordination occurs not just because of water policies or mandated relationships but due to non-sustainability focused, interest-based water narratives (growth and libertarian). Yet, the emphasis of growth proponents on supply augmentation and libertarian opposition to regulations pose significant barriers to water sustainability. A conceptual framework that explicitly analyzes vertical governance, horizontal governance, and power is important because it helps identify the conditions for and barriers to water sustainability in different water governance regimes. Overall, based on the findings of this study, successful policy-based pursuits of water sustainability require an acknowledgment of the management asymmetries within current water policies and commitments to addressing them. In the next section, I discuss two important areas for future research based on the findings of this study.

**Areas for future research**

Given the foregoing discussion, in this section, I highlight two important areas of future research needed to build on the findings of this study. These research needs relate to, first, rural versus urban water use, and second, research that explores the decoupling of economic and population growth with respect to water demand.

There is a need for current research on rural water use due to the increasing tension between rural and urban areas sharing water resources. Within this study, residents of Dewey-Humboldt, a mostly rural municipality within Prescott AMA, advance the notion that remaining saves water. However, sufficient and current rural area research are not available to evaluate this notion. With respect to non-AMA water use, about 20% of Arizona's population use over 40% of the state's water (Jacobs and Megdal, 2004). This means that, per capita, non-AMA residents use up to three times the water used by AMA residents—in large part due to agricultural irrigation. Overall, a better understanding of rural water use could provide insight into ways to better manage the conflicts between rural and urban areas while otherwise coordinating water resource management across the state. Attention to non-AMA areas is also critical considering growth in regions such as Flagstaff, which has received little attention among water researchers.

Also, there is a need for research that evaluates economic development options (asides from retail and agriculture) that are feasible in water-scarce regions (like the study area). The study area currently relies heavily on the retail industry and so population growth is important to its economic sustenance (Bolin et al., 2008). Given the extended droughts and reduced water supplies expected in arid regions due to climate variability

and change (Bates et al., 2008), decoupling economic and population growth is very important for the future. Such research will need to be interdisciplinary to be both comprehensive and meaningful. Also, interdisciplinary research is preferable so that sustainability outcomes in one sector do not lead to unsustainability in another and so that multifaceted trade-offs are considered in research and planning. Overall, future research needs to look at ways through which water sustainability can be supported at destination areas in spite of growth, especially in arid and fast-growing regions.

**Recommendations**

Prescott AMA provides a case where an institution supposedly created to promote water sustainability and resolve conflict among users instead legitimizes a culture of groundwater mining and perpetuates water conflicts. Many authors (for example, Jacobs and Holway, 2004; Maguire, 2007; Bolin et al., 2008; Hirt et al., 2008; Megdal et al., 2011) have provided important thoughts on Arizona's water law(s). In this section, I offer recommendations specific to Prescott AMA but which in certain respects would require policy changes at the state level.

As mentioned earlier, the GUAC can become more effective in the AMA's regional water governance and a platform for deliberative governance at the regional/AMA level if it includes non-government actors who would represent the water use sectors in the region. Furthermore, groundwater users and sectors should determine their representatives rather than having them appointed by the governor. At the very least, there should be representatives for each of the following groundwater users: public and private water providers and residents on private (exempt) wells, as well as agricultural,

industrial, environmental, and other special interest groups. In terms of voting structure, which is important to ensure fairness in water governance, municipal water users could be entitled to only one vote despite having representatives for both exempt and non-exempt well owners. More importantly, feasible and measurable goals should be commonly determined so that activities of all water use sectors are promoting and not hindering water sustainability. An example could be a goal to reduce overall demand by a certain amount in 12 months. In addition, a framework for the periodic evaluation of goals is needed to ensure that set goals are being met.

Water planning should involve residents, in part to monitor water levels and quality at particular wells. Given anti-government ideals in the region, Homeowner Associations (HOAs) or other non-government entities could help facilitate the installation of water meters for individual water providers with exempt wells. This data collection is important in any pursuits of water sustainability. Engaging exempt well owners in this manner helps them fulfill their responsibilities as resource managers in the state's decentralized governance structure. Also, data on actual water use would remove some of the uncertainties in water resource planning, especially because people often think they need more water than they do (Seckel, 2017) or use less water than they do (Balling and Gober, 2007).

If achieving safe yield requires eliminating a certain amount of overdraft, then reducing the current legal allocation of current water users would be a probable means of eliminating overdraft. Such a policy would require defining the actual allocation of exempt well owners, which is currently unknown and ranges anywhere from zero to 56

acre-feet/year[28]. Also, there may be need for water rights to be leased rather than allocating water to new users. However, a leasing of rights would maintain current levels of overdraft, which are not sustainable. Two actions that can be pursued simultaneously is to first, re-adjudicate (and possibly reduce) water rights across the board while records of previous allocations are kept. The second action would be to lease or transfer parts of adjudicated water rights, as needed, to new users instead of allocating water to new users. If/when the state has surplus water, initial water right owners can temporarily receive the rest of their allocation (pending another shortage) before water is allocated to new users/owners. However, it would be preferable to leave any surplus water in storage due to Arizona's arid climate where annual demand would mostly always exceed supply.

Finally, focusing on small wins would provide an opportunity to build trust among contending parties. One such win could form around river rafting, birding, and other outdoor activities (that is, Verde River tourism). A number of environmental groups in the area are developing these activities. Municipal governments can partner with these groups to not only stimulate economic growth but to also develop relationships that would foster meaningful discussions about water sustainability. In addition, the Central Highlands has a lot of history that could serve as tourist attractions (for example, the Sharlot Hall Museum). Developing these alternative economies provide substitutes for municipal dependence on a residential growth economy. Irrespective of the alternate growth pathways adopted, the Central Highlands would need to continually plan with an awareness of the region's 'water bucket'.

[28] 56 acre-feet of water would serve 280 individuals in a year, as one acre-feet serves a family of five annually (Arizona Department of Water Resources, 2009).

## Conclusion

In this dissertation, my goal has been to assess the conditions for and barriers to water sustainability in the face of persistent conflicts by investigating vertical and horizontal interactions among governance actors in Prescott AMA, as well as how power is wielded by different actors in the region's water governance. Assessing sustainable water governance with a framework of vertical governance, horizontal governance, and power reveals that there is coordination across levels based on specific interests such as growth, libertarianism, and sustainability. However, of these interests, growth and libertarian water narratives are dominant, leading to an emphasis on water augmentation pursuits and zero water management preferences. These management emphases are promoting an asymmetric water management regime where demand management practices are minimal.

Whether intentionally or not the GMA and associated rules are being used to legitimately increase Prescott AMA's groundwater mining, a situation that is detrimental to the region's water sustainability. Overall, this case study shows how outcomes at the regional level are a result of not only regional actions but local and state level ones as well. Overall, Prescott AMA's water sustainability is tied to Arizona's water sustainability especially given the GMA, which guides the AMA's water governance. Thus, sustainable water governance policies are needed at the state level to promote water sustainability in Prescott AMA.

## REFERENCES


Abraham, J. S. (2007). *Assessing drought vulnerability*: The University of Arizona.

Alley, W. M. (2006). Tracking US Groundwater: Reserves for the Future? *Environment: Science and Policy for Sustainable Development, 48*(3), 10-25.

Alley, W. M., and Leake, S. A. (2004). The journey from safe yield to sustainability. *Ground Water, 42*(1), 12-16.

Alley, W. M., Reilly, T. E., and Franke, O. L. (1999). *Sustainability of ground-water resources* (Vol. 1186): US Department of the Interior, US Geological Survey.

American Association of Geographers. (2017). Annals | AAG. Retrieved from http://www.aag.org/cs/publications/journals/annals

Anderson, M. T., Pool, D. R., Leake, S. A., Colby, B. C., and Jacobs, K. L. (2007). The water supply of Arizona: The geographic distribution of availability and patterns of use. *Arizona Water Policy*.

Arizona State Legislature. Transportation of groundwater withdrawn in Big Chino subbasin of the Verde River groundwater basin to initial active management area; exception. In (Vol. 2017, pp. Section 45-555).

Arizona Commerce Authority. (2015). Community Profile for Dewey-Humboldt. Retrieved from http://www.azcommerce.com/a/profiles/ViewProfile/50/Humboldt-Dewey/

Arizona Department of Water Resources. (1999). *Report on the Final Decision and Order that the Prescott Active Management Area is no Longer at Safe-Yield*. Retrieved from http://www.azwater.gov/azdwr/WaterManagement/documents/finrepweb.pdf

Arizona Department of Water Resources. (2005). *Prescott Active Management Area 2003-2004 Hydrologic Monitoring Report* Retrieved from http://www.azwater.gov/AzDWR/Hydrology/Library/documents/HMR_PrescottAMA_03_04.pdf

Arizona Department of Water Resources. (2008). *Overview of the Arizona Groundwater Management Code*. Retrieved from http://www.azwater.gov/AzDWR/WaterManagement/documents/Groundwater_Code.pdf.

Arizona Department of Water Resources. (2009). *Arizona's Water Supplies and Water Demands*. Retrieved from http://www.azwater.gov/AzDWR/PublicInformationOfficer/documents/supplydemand.pdf.

Arizona Department of Water Resources. (2014a). *Fourth Management Plan. Prescott Active Management Area 2010-2020*. Retrieved from http://www.azwater.gov/azdwr/WaterManagement/AMAs/PrescottAMAFourthManagementPlan.htm

Arizona Department of Water Resources. (2014b). Recharge Program Overview. Retrieved from http://www.azwater.gov/AzDWR/WaterManagement/Recharge/RechargeProgramOverview.htm

Arizona Department of Water Resources. (2014c). Verde Planning Area. In *Arizona's Next Century: A Strategic Vision for Water Supply Sustainability*.

Arizona Department of Water Resources. (2014d). Water Supply - Central Arizona Project. Retrieved from http://www.azwater.gov/AzDWR/StatewidePlanning/WaterAtlas/ActiveManagementAreas/PlanningAreaOverview/WaterSupply.htm

Arizona Department of Water Resources Prescott AMA. (2007). Arizona Department of Water Resources Prescott Active Management Area (Newsletter, June 2007).

Arizona State Senate. (2015). *Issue Brief. Arizona's Groundwater Management Code: Exempt Wells*. Retrieved from https://www.azleg.gov/briefs/Senate/EXEMPT%20WELLS.pdf

Arizona Water Commission. (1978). *Projected water uses, supplies and groundwater conditions in selected basins in Arizona: a baseline conditions report to the Groundwater Management Study Commission*.

Autobee, R. (2011). Salt River Project. Retrieved from https://www.usbr.gov/projects/pdf.php?id=183

Avelino, F., & Rotmans, J. (2009). Power in transition: an interdisciplinary framework to study power in relation to structural change. *European Journal of Social Theory, 12*(4), 543-569.

Avelino, F. (2011). *Power in transition: empowering discourses on sustainability transitions.* (Doctoral Dissertation Dissertation), Erasmus Universitiet Rotterdam.

Avelino, F., and Rotmans, J. (2011). A dynamic conceptualization of power for sustainability research. *Journal of Cleaner Production, 19*(8), 796-804.

Baker, S., and Edwards, R. (2012). How many qualitative interviews is enough? Expert voices and early career reflections on sampling and cases in qualitative research. *Review paper, ESRC National Centre for Research Methods, NCRM, Southampton*.

Bakker, K. (2010). *Privatizing water: governance failure and the world's urban water crisis*: Cornell University Press.

Balling Jr, R. C., and Gober, P. (2007). Climate Variability and Residential Water Use in the City of Phoenix, Arizona. *Journal of Applied Meteorology and Climatology, 46*(7).

Bates, B., Kundzewicz, Z. W., Wu, S., and Palutikof, J. (2008). *Climate change and water*: Intergovernmental Panel on Climate Change (IPCC).

Berkes, F. (2006). From community-based resource management to complex systems: the scale issue and marine commons. *Ecology and Society, 11*(1), 45.

Bernard, H. R., and Ryan, G. W. (2009). *Analyzing qualitative data: Systematic approaches*: SAGE publications.

Biermann, F., and Pattberg, P. (2008). Global environmental governance: Taking stock, moving forward. *Annual Review of Environment and Resources, 33*, 277-294.

Biermann, F., Pattberg, P., Van Asselt, H., and Zelli, F. (2009). The fragmentation of global governance architectures: A framework for analysis. *Global Environmental Politics, 9*(4), 14-40.

Biswas, A. K. (2004). Integrated water resources management: a reassessment: a water forum contribution. *Water International, 29*(2), 248-256.

Biswas, A. K. (2008). Integrated water resources management: is it working? *Water Resources Development, 24*(1), 5-22.

Blomquist, B. (2016). *Implementing California's Sustainable Groundwater Management Act (SGMA).* Paper presented at the Ostrom Workshop Colloquium, Indiana University.

Bolin, B., Collins, T., and Darby, K. (2008). Fate of the Verde: Water, environmental conflict, and the politics of scale in Arizona's central highlands. *Geoforum, 39*(3), 1494-1511.

Bolin, B., Seetharam, M., and Pompeii, B. (2010). Water resources, climate change, and urban vulnerability: a case study of Phoenix, Arizona. *Local Environment, 15*(3), 261-279.

Bouwer, H. (2000). Integrated water management: emerging issues and challenges. *Agricultural Water Management, 45*(3), 217-228.

Bouwer, H. (2002). Integrated water management for the 21st century: problems and solutions. *Journal of Irrigation and Drainage Engineering, 128*(4), 193-202.

Bredehoeft, J. (1997). Safe yield and the water budget myth. *Ground Water, 35*(6), 929-930.

Bredehoeft, J. D. (2002). The water budget myth revisited: why hydrogeologists model. *Ground Water, 40*(4), 340-345.

Bredehoeft, J. D., Papadopulos, S. S., and Cooper Jr, H. H. (1982). Groundwater: the water-budget myth. *Studies in Geophysics: Scientific Basis of Water-Resource Management*, 51-57.

Brenner, N. (2001). The limits to scale? Methodological reflections on scalar structuration. *Progress in Human Geography, 25*(4), 591-614.

Brown, C. J., and Purcell, M. (2005). There's nothing inherent about scale: political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum, 36*(5), 607-624.

Brown, R., Keath, N., and Wong, T. (2009). Urban water management in cities: historical, current and future regimes. *Water Science and Technology, 59*(5), 847-855.

Bryman, A. (2012). *Social research methods*: Oxford university press.

Cash, D. W., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., . . . Young, O. (2006). Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society, 11*(2), 8.

Central Arizona Project. (2016a). CAP Background. Retrieved from https://www.cap-az.com/about-us/background

Central Arizona Project. (2016b). FAQ. Retrieved from https://www.cap-az.com/about-us/faq

Charmaz, K. (2014). *Constructing grounded theory*: Sage.

Citizens Water Advocacy Group. (2007). CWAG Bulletin #1: Safe Yield. Prescott, Arizona.

City of Prescott. (n.d.). Big Chino Water Ranch. Retrieved from http://www.prescott-az.gov/services/water/chino.php

City of Prescott v. Town of Chino Valley (1989). 790 P. 2d 263, Ariz: Court of Appeals, 1st Div., Dept. B.

City of Prescott v. Town of Chino Valley (1990). 803 P. 2d 891, Ariz: Supreme Court.

Cohen, A., and Bakker, K. (2014). The eco-scalar fix: Rescaling environmental governance and the politics of ecological boundaries in Alberta, Canada. *Environment and Planning D: Society and Space, 32*(1), 128-146.

Collins, T. W., and Bolin, B. (2007). Characterizing vulnerability to water scarcity: the case of a groundwater-dependent, rapidly urbanizing region. *Environmental Hazards, 7*(4), 399-418.

Connall Jr, D. D. (1982). History of the Arizona Groundwater Management Act. *Ariz.St.LJ*, 313.

Cook, B. I., Ault, T. R., & Smerdon, J. E. (2015). Unprecedented 21st century drought risk in the American Southwest and Central Plains. *Science Advances, 1*(1), e1400082.

Corbin, J., and Strauss, A. (2014). *Basics of qualitative research*: Sage.

Corbridge, S. (2009). Power. In D. Gregory, R. Johnston, G. Pratt, M. Watts, and S. Whatmore (Eds.), *The Dictionary of Human Geography* (pp. 575-576).

Corkhill, E., and Mason, D. (1995). *Hydrogeology and simulation of groundwater flow, Prescott Active Management Area, Yavapai County, Arizona*. Retrieved from http://repository.usgin.org/sites/default/files/dlio/files/2010/u17/PrescottManagementArea_AzDWR_Hydrogeology_ModelingReport9.pdf

Creswell, J. W. (2013). *Qualitative inquiry and research design: choosing among five approaches*. Los Angeles: SAGE Publications.

Cutter, S. L. (1996). Vulnerability to environmental hazards. *Progress in Human Geography, 20*(4), 529-539.

Cutter, S. L., Mitchell, J. T., and Scott, M. S. (2000). Revealing the vulnerability of people and places: A case study of Georgetown County, South Carolina. *Annals of the Association of American Geographers, 90*(4), 713-737. doi:10.1111/0004-5608.00219

Cutts, B. B., Muñoz-Erickson, T., Darby, K. J., Neff, M., Larson, E. K., Bolin, B., and Wutich, A. (2010). Ego network properties as a way to reveal conflict in collaboration's clothing. *Procedia-Social and Behavioral Sciences, 4*, 93-101.

Department of Water Resources. (1982). *Central Arizona Project Allocation Decision*. Retrieved from https://www.cap-az.com/documents/departments/water-operations/ADWR-allocation-decision-1-18-1982.pdf.

Emerson, K., Nabatchi, T., and Balogh, S. (2012). An integrative framework for collaborative governance. *Journal of Public Administration Research and Theory, 22*(1), 1-29.

Feldman, D. L. (2009). Preventing the repetition: Or, what Los Angeles' experience in water management can teach Atlanta about urban water disputes. *Water Resources Research, 45*(4).

Feldman, D. L. (2012). *Water*. Cambridge, UK; Malden, MA: Polity.

Ferris, K. (2014). Desalination: Is It A Practical Solution For Arizona's Future Water Supplies? Retrieved from https://amwua.wordpress.com/2014/12/01/desalination-is-it-a-practical-solution-for-arizonas-future-water-supplies/

Gay, L., and Airasian, P. (2000). Educational research: Competencies for analysis and experience. In: New Jersey: Prentice-Hall.

Gay, L. R. (1996). *Educational research: Competencies for analysis and application* (5th ed.. ed.). Englewood Cliffs, N.J.: Merrill.

Glennon, R. J. (1991). Because that's where the water is: retiring current water uses to achieve the safe-yield objective of the Arizona groundwater management act. *Ariz.L.Rev., 33*, 89.

Global Water Partnership. (2000). *Towards Water Security: A Framework for Action*. Retrieved from http://www.gwp.org/globalassets/global/toolbox/references/towards-water-security.-a-framework-for-action.-mobilising-political-will-to-act-gwp-2000.pdf

Grigg, N. S. (2008). Integrated water resources management: balancing views and improving practice. *Water International, 33*(3), 279-292.

Groundwater Management Act, Ariz. Sess. Laws '80 Bd. Vol. -44 § 86 1392 (1980).

Groundwater Users Advisory Council. (2006). *Final report on safe-yield impediments, opportunities, and strategic directive*. Retrieved from http://www.uvrwpc.org/Downloads/SafeYieldReport110806.pdf

Gupta, J., and Pahl-Wostl, C. (2013). Editorial on global water governance. *Ecology and Society, 18*(4), 54.

Harlan, S. L., Yabiku, S. T., Larsen, L., and Brazel, A. J. (2009). Household water consumption in an arid city: Affluence, affordance, and attitudes. *Society and Natural Resources, 22*(8), 691-709.

Hirt, P., Gustafson, A., and Larson, K. (2008). The mirage in the Valley of the Sun. *Environmental History, 13*(3), 482-514.

Hirt, P., Snyder, R., Hester, C., & Larson, K. (2017). Water Consumption and Sustainability in Arizona: A Tale of Two Desert Cities. *Journal of the Southwest, 59*(1), 264-301.

Internal Revenue Service. (2017). Exemption Requirements Section 501(c)(3) Organizations. Retrieved from https://www.irs.gov/charities-non-profits/charitable-organizations/exemption-requirements-section-501c3-organizations

Jacobs, K., and Megdal, S. (2004). Water management in the active management areas. *chap, 6*, 71-91.

Jacobs, K. L., and Holway, J. M. (2004). Managing for sustainability in an arid climate: lessons learned from 20 years of groundwater management in Arizona, USA. *Hydrogeology Journal, 12*(1), 52-65.

Jones III, J. P., Marston, S. A., and Woodward, K. (2011). Scales and networks. *The Wiley-Blackwell Companion to Human Geography*, 404-414.

Jones, J. P., Woodward, K., and Marston, S. A. (2007). Situating flatness. *Transactions of the Institute of British Geographers, 32*(2), 264-276.

Jones, K. T. (1998). Scale as epistemology. *Political Geography, 17*(1), 25-28.

Kalf, F. R. P., and Woolley, D. R. (2005). Applicability and methodology of determining sustainable yield in groundwater systems. *Hydrogeology Journal, 13*(1), 295-312.

Keeler, L. W., Wiek, A., White, D. D., and Sampson, D. A. (2015). Linking stakeholder survey, scenario analysis, and simulation modeling to explore the long-term impacts of regional water governance regimes. *Environmental Science and Policy, 48*, 237-249.

Knüppe, K., and Pahl-Wostl, C. (2011). A framework for the analysis of governance structures applying to groundwater resources and the requirements for the sustainable management of associated ecosystem services. *Water Resources Management, 25*(13), 3387-3411.

Larsen, T. A., and Gujer, W. (1997). The concept of sustainable urban water management. *Water Science and Technology, 35*(9), 3-10.

Larson, K. L., Gustafson, A., and Hirt, P. (2009). Insatiable thirst and a finite supply: an assessment of municipal water-conservation policy in greater Phoenix, Arizona, 1980–2007. *Journal of Policy History, 21*(02), 107-137.

Larson, K. L., Wiek, A., and Withycombe Keeler, L. (2013). A comprehensive sustainability appraisal of water governance in Phoenix, AZ. *Journal of environmental management, 116*, 58-71.

Lebel, L., Nikitina, E., Pahl-Wostl, C., and Knieper, C. (2013). Institutional fit and river basin governance: a new approach using multiple composite measures. *Ecology and Society, 18*(1), 1.

Lee, K. N. (1993). Greed, scale mismatch, and learning. *Ecological Applications, 3*(4), 560-564.

Lubell, M., Leach, W. D., and Sabatier, P. A. (2009). Collaborative watershed partnerships in the epoch of sustainability. *Toward sustainable communities: transition and transformations in environmental policy*, 255-288.

Mackenzie, F. (1995). 'A Farm Is Like a Child Who Cannot Be Left Unguarded': Gender, Land and Labour in Central Province, Kenya. *IDS Bulletin*, *26*(1), 17-23.

Maguire, R. P. (2007). Patching the holes in the bucket: safe yield and the future of water management in Arizona. *Ariz.L.Rev.*, *49*, 361.

Mann, M. (1986). The Sources of Social Power, 2 vols. *Cambridge: Cambridge Univ. Press*, *1*, 38.

Markard, J., Raven, R., and Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*, *41*(6), 955-967.

Marshall, G. (2008). Nesting, subsidiarity, and community-based environmental governance beyond the local scale. *International Journal of the Commons*, *2*(1), 75-97.

Marshall, R. M., Robles, M. D., Majka, D. R., and Haney, J. A. (2010). Sustainable water management in the southwestern United States: reality or rhetoric? *PloS one*, *5*(7), e11687.

Marston, S. A. (2000). The social construction of scale. *Progress in Human Geography*, *24*(2), 219-242.

Marston, S. A., Jones, J. P., and Woodward, K. (2005). Human geography without scale. *Transactions of the Institute of British Geographers*, *30*(4), 416-432.

Mays, L. W. (2013). Groundwater resources sustainability: past, present, and future. *Water Resources Management*, *27*(13), 4409-4424.

McKay, J. M. (2007). Water governance regimes in Australia: implementing the National Water Initiative. *Journal of the Australian Water Association*, *34*(1), 150-156.

Medema, W., McIntosh, B. S., and Jeffrey, P. J. (2008). From Premise to Practice: a Critical Assessment of Integrated Water Resources Management and Adaptive Management Approaches in the Water Sector. *Ecology and Society, 13*(2).

Megdal, S., Nadeau, J., and Tom, T. (2011). The forgotten sector: Arizona water law and the environment. *Arizona Journal of Environmental Law and Policy, 1*, 243-243.

Meyer, W., and Wolfe, E. W. (2007). Why Big Chino pumping threatens the Verde. *Upper Verde Water Resource Issues*. Retrieved from http://cwagaz.org/images/Reports/RefLib/Why%20Big%20Chino%20Pumping%20Threatens%20the%20Verde%205-6-07.pdf

Mitchell, V. G. (2006). Applying integrated urban water management concepts: a review of Australian experience. *Environmental Management, 37*(5), 589-605.

Moore, A. (2008). Rethinking scale as a geographical category: from analysis to practice. *Progress in Human Geography, 32*(2), 203-225.

Mukhtarov, F. G. (2008). Intellectual history and current status of Integrated Water Resources Management: A global perspective. In *Adaptive and integrated water management* (pp. 167-185): Springer.

Muñoz-Erickson, T. A., Cutts, B. B., Larson, E. K., Darby, K. J., Neff, M., Wutich, A., and Bolin, B. (2010). Spanning boundaries in an Arizona watershed partnership: information networks as tools for entrenchment or ties for collaboration. *Ecology and Society, 15*(3), 22.

Nastar, M. (2014). What drives the urban water regime? An analysis of water governance arrangements in Hyderabad, India. *Ecology and Society, 19*(2), 57.

Neumann, R. P. (2009). Political ecology: theorizing scale. *Progress in Human Geography, 33*(3), 398-406.

Norman, E. (2012). Cultural politics and transboundary resource governance in the Salish Sea. *Water Alternatives, 5*(1), 138-160.

Norman, E. S., and Bakker, K. (2009). Transgressing scales: water governance across the Canada–US borderland. *Annals of the Association of American Geographers, 99*(1), 99-117.

Orlove, B., and Caton, S. C. (2010). Water sustainability: Anthropological approaches and prospects. *Annual Review of Anthropology, 39*, 401-415.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change, 19*(3), 354-365. doi:10.1016/j.gloenvcha.2009.06.001

Paulson, S., Gezon, L. L., and Watts, M. (2003). Locating the political in political ecology: An introduction. *Human organization, 62*(3), 205-217.

Pearce, M. J. (2007). Balancing competing interests: the history of state and federal water laws. *Arizona Water Policy: Management Innovations in an Urbanizing, Arid Region*, 26-44.

Phillips, J. D. (2004). Independence, Contingency, and Scale Linkage in Physical Geography. In E. Sheppard and R. B. McMaster (Eds.), *Scale and geographic inquiry: Nature, society and method* (pp. 86-100): Wiley Online Library.

Rahaman, M. M., and Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. *Sustainability: Science, Practice and Policy, 1*(1), 15-21.

Saldaña, J. (2012). *The coding manual for qualitative researchers*: Sage.

Sayles, J. S., and Baggio, J. A. (2017). Who collaborates and why: Assessment and diagnostic of governance network integration for salmon restoration in Puget Sound, USA. *Journal of environmental management, 186*, 64-78.

Sayre, N. F. (2005). Ecological and geographical scale: parallels and potential for integration. *Progress in Human Geography, 29*(3), 276-290.

Seckel, S. (2017). 8 people, 30 days and 100 degrees in the Mojave desert: An ASU water experiment to remember. Retrieved from https://asunow.asu.edu/20170721-creativity-drylab-asu-experiment-rationed-water

Skoog, H. (2006). Talk of the Town. Retrieved from https://www.dcourier.com/news/2006/oct/29/talk-of-the-town/

Smith, N. (Ed.) (2000) The Dictionary of Human Geography. Oxford: Blackwell.

Sophocleous, M. (1997). Managing water resources systems: why "safe yield" is not sustainable. *Groundwater, 35*(4), 561-561.

Sophocleous, M. (2012). The evolution of groundwater management paradigms in Kansas and possible new steps towards water sustainability. *Journal of Hydrology, 414*, 550-559.

Swyngedouw, E. (2006). Power, water and money: Exploring the nexus. *Human Development Occasional Papers (1992-2007).*

Taylor, S. J., and Bogdan, R. (1998). Introduction to qualitative methods: A guide and resource. In: New York: Wiley.

Termeer, C. J. A. M. (2009). Barriers to new modes of horizontal governance: A sense-making perspective. *Public Management Review, 11*(3), 299-316.

Theis, C. V. (1940). The source of water derived from wells. *Civil Engineering, 10*(5), 277-280.

Town of Chino Valley. (2010). *Water Sustainability and Conservation Code. Draft for Council Discussion*. Chino Valley, Arizona.

Town of Chino Valley v. City of Prescott. (1982). 457 US 1101, Ariz: Supreme Court.

Town of Dewey-Humboldt. (n.d). About Dewey-Humboldt. Retrieved from http://www.dhaz.gov/2170/About-Dewey-Humboldt

Town of Dewey-Humboldt. (2009). *Town of Dewey-Humboldt 2009 General Plan*. Retrieved from http://www.dhaz.gov/DocumentCenter/Home/View/120

Town of Prescott Valley. (n.d.a). Big Chino Water Ranch. Retrieved from http://www.pvaz.net/241/Big-Chino-Water-Ranch

Town of Prescott Valley. (n.d.b). Water Resources | Prescott Valley, AZ - Official Website. Retrieved from http://www.pvaz.net/240/Water-Resources

Town of Prescott Valley. (2014) "Resolution No. 1873." Retrieved from http://pvaz.granicus.com/MetaViewer.php?view_id=5&clip_id=1321&meta_id=59546

Travers, M. (2001). *Qualitative research through case studies*: Sage.

Trein, P. (2016). A new way to compare horizontal connections of policy sectors:"Coupling" of actors, institutions and policies. *Journal of Comparative Policy Analysis: Research and Practice*, 1-16.

Trochim, W. M. K., and Donnelly, J. P. (2009). *The Research Methods Knowledge Base*. Ohio: Cengage Learning.

Turner, V. K., and Ibes, D. C. (2011). The impact of homeowners associations on residential water demand management in Phoenix, Arizona. *Urban Geography, 32*(8), 1167-1188.

U.S. Census Bureau. (2010). United States Census 2010. Retrieved from http://www.census.gov/2010census/

U.S. Census Bureau. (2017). Estimates of Resident Population Change and Rankings: July 1, 2015 to July 1, 2016 Retrieved from https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

U.S. Department of Interior. (1990). *Memorandum: Biological Opinion. Central Arizona Project, Water Exchange Project, Upper Verde River, Arizona*. Retrieved from https://www.fws.gov/southwest/es/arizona/Documents/Biol_Opin/86087_CAP_H2OExchange_Upper_Verde.PDF

UN Water. (2006). *Water: A Shared Responsibility*. Paris: UNESCO Division of Water Sciences.

United States Bureau of Reclamation. (2015, April 23, 2015). Yuma Desalting Plant. Retrieved from https://www.usbr.gov/lc/yuma/facilities/ydp/yao_ydp.html

Upper Verde River Watershed Protection Coalition. (2010). *Safe Yield Workgroup Final Report*. Retrieved from http://www.uvrwpc.org/Downloads/SafeYield.FINAL.Report.032410.pdf

Van der Brugge, R., and Rotmans, J. (2007). Towards transition management of European water resources. *Water Resources Management, 21*(1), 249-267.

Van der Brugge, R., Rotmans, J., and Loorbach, D. (2005). The transition in Dutch water management. *Regional Environmental Change, 5*(4), 164-176.

Van der Brugge, R., and Van Raak, R. (2007). Facing the adaptive management challenge: insights from transition management. *Ecology and Society, 12*(2), 33.

Van der Zaag, P. (2005). Integrated Water Resources Management: Relevant concept or irrelevant buzzword? A capacity building and research agenda for Southern Africa. *Physics and Chemistry of the Earth, Parts A/B/C, 30*(11), 867-871.

Vorosmarty, C. J., Green, P., Salisbury, J., and Lammers, R. B. (2000). Global water resources: vulnerability from climate change and population growth. *Science (New York, N.Y.), 289*(5477), 284-288.

Water Technology. (2017). Carlsbad Desalination Project, San Diego, California, United States of America. Retrieved from http://www.water-technology.net/projects/carlsbaddesalination

Wentz, E. A., and Gober, P. (2007). Determinants of small-area water consumption for the city of Phoenix, Arizona. *Water Resources Management, 21*(11), 1849-1863.

Whitmire, J. (2013). *The case of the Yavapai County, Arizona water conflict: A power and politics analysis.* (Doctoral Dissertation), Northern Arizona University,

Wiek, A., and Larson, K. L. (2012). Water, people, and sustainability—a systems framework for analyzing and assessing water governance regimes. *Water Resources Management, 26*(11), 3153-3171.

Wirt, L. (2005). *The Verde River Headwaters, Yavapai County, Arizona. Chapter A, Geologic Framework of Aquifer Units and Ground-Water Flowpaths, Verde River*

*Headwaters, North-Central Arizona*. Retrieved from Reston, VA: https://pubs.usgs.gov/of/2004/1411/pdf/ChapterA.pdf

Wirt, L., and DeWitt, E. (2005). *Geochemistry of Major Aquifer and Springs. Chapter E, Geologic Framework of Aquifer Units and Ground-Water Flowpaths, Verde River Headwaters, North-Central Arizona*. Retrieved from Reston, VA: https://pubs.usgs.gov/of/2004/1411/pdf/ChapterE.pdf

World Commission on Environment and Development. (1987). *Our Common Future*. Oxford: Oxford University Press.

World Health Organization. (2016). Radon and Health. Retrieved from http://www.who.int/mediacentre/factsheets/fs291/en/

Wutich, A., White, A. C., White, D. D., Larson, K. L., Brewis, A., and Roberts, C. (2014). Hard paths, soft paths or no paths? Cross-cultural perceptions of water solutions. *Hydrology and Earth System Sciences, 18*(1), 109-120.

Yin, R. K. (2013). *Case study research: Design and methods*: Sage publications.

Young, O. (2006). Vertical interplay among scale-dependent environmental and resource regimes. *Ecology and Society, 11*(1), 27.

Zelli, F., and Van Asselt, H. (2013). Introduction: The institutional fragmentation of global environmental governance: Causes, consequences, and responses. *Global Environmental Politics, 13*(3), 1-13.

Zimmerer, K. S., and Bassett, T. J. (2003). *Political ecology: an integrative approach to geography and environment-development studies*: Guilford Press.

# APPENDIX A

# INTERVIEW GUIDE FOR WATER RESOURCE GOVERNANCE ACTORS

A.1 Interview Guide for Water Resource Managers/Government Actors

Topic 1: Background/Water Management

1. What is your job title (or duties) and how do they relate to water management in this town/city?
2. What would you say are the main water management goals in this area?
3. What are the major water resource challenges facing your town/city?
4. Do you have adequate water supplies? What are you doing about demand management?
5. What AMA rules influence water governance in your city or town?
6. What impact does the AMA designation have on water management activities?
    a. Probe: What benefits does your community's water system enjoy from being part of the AMA?
    b. Probe: What are the downsides of being part of the AMA?
7. How does the goal of safe yield translate into the planning and day-to-day functions of the community's water system?
8. Beyond safe yield, what other water management goals are central to your town/city?

Topic 2: Vertical Governance

1. How do you and your local department (town/city) interact with the ADWR (state) office?
    a. Probe: What type of relationship exists between your office/municipality and the ADWR office?
    b. Probe: What improvements do you hope to see in the interaction between your office/municipality and ADWR?
    c. Probe: What improvements do you hope to see in the flow of information or communication between your office/municipality and ADWR?
2. What programs do you have to implement based on the Groundwater Management Act and goal of safe yield?
    a. Probe: How relevant have these programs been to (i) achieving safe yield (ii) municipal priorities?
    b. Probe: Who or what organization(s) provide oversight for these programs? How is this done?
3. What programs do you have that are not a result of the Groundwater Management Act and goal of safe yield?
    a. Probe: Where did the initiatives for these programs come from? For example, town council, water resources office, residents, environmental groups, advocacy groups, ADWR. Please explain.
    b. Probe: What was/is the purpose of these initiatives?
4. What groups are you aware of that collaborate around water beyond local groups within the AMA? How does your relationship with each work?

Topic 3: Horizontal Governance

1. Do you meet and/or coordinate with certain individuals or groups in managing water resources?
    a. Probe: How and why do you do so?
    b. Probe: What would you say are the outcomes of those interactions?
2. What sort of relationship exists between your department and local community groups around water?
    a. Probe: Please identify all the groups you are aware of.
    b. Probe: Which of the identified groups does the town/city collaborate with? Why? How does this take place?
    c. Probe: For those that the town/city does not collaborate with, why is this so?

Topic 4: Water Sustainability

1. What do you see as the major impacts of the Groundwater Management Act and goal of safe-yield on the community's water system?
    a. Probe: What benefits or positive outcomes have come from the Act?
    b. Probe: What are the challenges or negative impacts of the Act?
2. What are the chances of achieving safe yield by 2025? Please explain how or why not.

3. What could have been the situation of water resources and management in this area without the Groundwater Management Act and goal of safe-yield?
    a. Probe: Which components of your community's water system would be different if there was no AMA designation in the region?
4. What critical steps need to be taken to ensure that your community's water system is viable in the long term?

A.2 Interview Guide for Non-government Water Actors

Topic 1: Background/Water Management

1. How did you get involved with water issues?
2. What would you say are the main water management goals in this area?
3. What are the major water resource challenges facing this town/city/AMA?
4. What do you see as the role of your committee/group in interacting with water resources in your community?
    a. Probe: What are the goals/responsibilities of your committee/group?
    b. Probe: What programs do you implement in order to achieve your group's goals?
    c. Probe: What outcomes have you seen from these programs?
5. What AMA rules influence water governance in your city or town?
6. What impact does the AMA designation and goal of safe yield have on your committee/group's activities?
    a. Probe: What benefits does your community's water system enjoy from being part of the AMA?
    b. Probe: What are the downsides of being part of the AMA?
7. Beyond safe yield, what other water management goals are central to your committee/group's functions?

Topic 2: Vertical Governance

1. How do you and your committee/group interact with the ADWR (state) office?
    a. Probe: What type of relationship exists between your committee/group and the ADWR office?
    b. Probe: What improvements do you hope to see in the interaction between your committee/group and ADWR?
    c. Probe: What improvements do you hope to see in the flow of information or communication between your committee/group and ADWR?
2. What groups are you aware of that collaborate around water beyond local groups within the AMA? How does your relationship with each work?

Topic 3: Horizontal Governance

1. Do you meet and/or coordinate with certain individuals or groups in managing water resources?
    c. Probe: How and why do you do so?
    d. Probe: What would you say are the outcomes of those interactions?
2. What sort of relationship exists between your committee/group and other community groups around water?
    d. Probe: Please identify all the groups you are aware of.
    e. Probe: Which of the identified groups does your committee/group collaborate with? Why? How does this take place?
    f. Probe: For those that your committee/group does not collaborate with, why is this so?
3. What sort of relationship exists between your committee/group and the local government?

Topic 4: Water Sustainability

1. What do you see as the major impacts of the Groundwater Management Act and goal of safe-yield in this area?
    c. Probe: What benefits or positive outcomes have come from the Act? What benefits does your community's water system enjoy from being part of the AMA? What are the upsides of being part of the AMA?
    d. Probe: What are the challenges or negative impacts of the Act? What are the downsides of being part of the AMA?
2. What are the chances of achieving safe yield by 2025? Please explain how or why not.

3. What could have been the situation of water resources and management in this area without the Groundwater Management Act and goal of safe-yield?
    a. Probe: Which components of your community's water system would be different if there was no AMA designation in the region?
4. What critical steps need to be taken to ensure that your community's water system is viable in the long term?

### A.3 Additional Questions for State Level Governance Actors

1. What are the responsibilities of your office in ensuring the Prescott AMA region achieves safe yield?
2. What particular programs is your office currently overseeing in each of the municipalities? How about in the past? Any plans for the future?
3. What type of relationship exists between your office and the municipal water departments in Prescott AMA? Is your correspondence the same with all of them? Does size play a role in your expectations of those offices or their expectations of yours?
4. Does your office mandate programs, recommend them or do you coordinate those suggested by the municipalities? Please explain.
5. What is the response of each of the municipalities to current programs?

# APPENDIX B

## ARIZONA STATE UNIVERSITY'S INSTITUTIONAL REVIEW BOARD

EXEMPTION GRANTED

Kelli Larson
Geographical Sciences and Urban Planning, School of
480/727-3603
Kelli.Larson@asu.edu

Dear Kelli Larson:

On 5/26/2015 the ASU IRB reviewed the following protocol:

| | |
|---|---|
| Type of Review: | Initial Study |
| Title: | Water Governance, Scale, and Power: Governing the Transition to Sustainability in Arizona's Central Highlands |
| Investigator: | Kelli Larson |
| IRB ID: | STUDY00002689 |
| Funding: | None |
| Grant Title: | None |
| Grant ID: | None |
| Documents Reviewed: | • Interview Questions.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);<br>• Water Governance in the Prescott Area 3.0.doc, Category: IRB Protocol;<br>• Short Consent Form 3.pdf, Category: Consent Form; |

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 5/22/2015.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Deborah Ayodele

# APPENDIX C

## CONSENT AND RECRUITMENT LETTER

**GOVERNING THE TRANSITION TO WATER SUSTAINABILITY IN ARIZONA'S CENTRAL HIGHLANDS**

I am a graduate student under the direction of Professor Kelli L. Larson in the Department of Geography at Arizona State University. I am conducting a research study to understand current water governing activities in the Prescott Area with the goal of identifying pathways to long-term water sustainability not just in this area but in the broader region.

Please consider this letter as your invitation to voluntarily participate in an interview of about 45-60 minutes. The interview questions are related to how different stakeholders in this area coordinate and collaborate around water issues. There are no foreseeable risks or discomforts to your participation and you have the right not to answer any question or to stop participation at any time. There might be need for a follow-up interview but your continued participation is entirely voluntary. You must be 18 or older to participate.

I would like to audio record this interview, but the interview will not be recorded without your permission. Please let me know if you do not want the interview to be recorded; you can also change your mind after the interview starts, just let me know.

Your responses will be confidential. The research team will be the only ones to have access to the interview. Audio recordings will be securely stored on ASU's server and the field research computer. These storage devices are password protected for added data security. Meanwhile, the recorded interviews will be transcribed and analyzed with qualitative data analysis software to understand water governance in this area and identify pathways to long-term water sustainability. The results of this study may be used in reports, presentations, or publications but your name will not be used. Quotes may be used from this interview but your name will not be attached to any.

If you have any questions concerning the research study, you can email me at doayodel@asu.edu or my research advisor at Kelli.Larson@asu.edu. If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Your participation in the interview will be considered your consent to take part in this study.

Thank you.

# APPENDIX D

# INDUCTIVE CODEBOOKS

D.1. *Inductive Codebook for Research Question One: Avenues of Water Governance Interactions Across State, Regional, and Local Level Actors*

| Code | Definition | Exemplar from data |
|---|---|---|
| Management Plans | These are references to the statutory periodic plans to be developed by ADWR to support the region's safe yield management goal | "The management plan we are in the fourth management plan now and those plans are developed by ADWR and our staff" (Prescott; March 2016) |
| Technical resource | These are references to the supply of technical assistance. | "We have a modeling section with excellent modeling staff, hydrologists. They've been involved with the modeling of both the Prescott AMA and the Big Chino. The formal study, itself, I don't believe that involves the Big Chino but we're certainly involved in that, and the groundwater modeling work that we've done for the Prescott AMA certainly interacts with the modeling in the Big Chino." (Phoenix; October 2015) |
| Funding | These refer to instances about financing for the group in question, how those funds are used, and what they can (and cannot) be used for. | "Well, it came from the legislation. The funds came from the charge to mainly the municipalities" (Prescott; March 2016) |
| Meeting | These are reference to in-person meetings, their frequency, attendance, and composition of attendees. | "I think we try to meet quarterly. Sometimes even more often, but we try to meet quarterly." (Dewey-Humboldt; June 2015) |
| Conservation | These are references to water saving or reduction measures whether for municipal, agricultural, or industrial purposes. | "I don't think people here even realize how much water conservation we actually do. Cause they don't see it cause we've been doing so steadily along the way." (Prescott; June 2015) |
| Growth | These are references to increase in population and economic growth. | "New houses. Subdivisions, that sort of thing. It is not something that you just stop. Nobody has authority over it. If … said 'Stop growth', then it just goes over there. It just goes next-door" (Prescott Valley; June 2015) |

| | | |
|---|---|---|
| Permitting | These refer to all processes of receiving or assigning permits for different aspects of water use, and governance. | "everything flows through the Phoenix office and that has to do with well permits and a lot of things" (Prescott; March 2016) |
| Reporting | These include references to statutory record keeping and document filing that different water users in the region have to perform. | "Essentially once we drill wells and create a pipeline there, the AMA rules apply to our parcel of land on items such as well spacing, water report withdrawals, reporting the withdrawals, that sort of thing." (Prescott Valley; June 2015) |
| Communication | These include references to the dissemination of information, whether as an exchange or one-sided. | "We do have interaction with irrigation right holders, both with filing annual reports and with dealing with their flexibility account balances. We notify them each year if they are in compliance or not." (Phoenix; October 2015) |

D.2. *Inductive Codebook for Research Question Two: Avenues of Interaction among Local Level Water Governance Actors*

| Code | Definition | Exemplar from data |
|---|---|---|
| Big Chino Water Ranch (BCWR) project | These are references to the proposed water import from the Big Chino basin. | "There are lots of fighting happening over water between Prescott and the Verde side as Chino Valley and Prescott Valley and Prescott start looking at, as they start looking at the Upper Big Chino" (Chino Valley; June 2015) |
| Intra-basin water transfer | These are references to the movement of water from one point within a sub-basin to another where municipal boundaries are crossed. | "It's just standard operating procedure in Arizona to go through this when you have an issue over other persons' or parties' water use. Talks initially fail. They always do. You go into litigation, and then everybody kind of figures out their positions and strengths little bit better, and then you go back and you negotiate. That's standard operating procedure. There hasn't been a water right settlement in Arizona without at least one iteration of litigation. Typically, there's two iterations of litigation for these things." (Prescott Valley; June 2015) |
| Groundwater recharge | These are references to groundwater storage either through recharge stations, or recharge beds. | "our recharge facility is in the Little Chino sub-basin and our pumping is in Little Chino." (Prescott; June 2015) |
| Growth | These are references to increase in population and economic growth. | "They have to do something to guide their growth, how they want to grow and then have these programs to be put in place to encourage growth or one or the other. But we don't..." (Dewey-Humboldt; June 2015) |
| Exempt wells | These are references to private wells that can pump up to 35 gallons per minute. They are exempt from conservation, and reporting requirements that other water providers are bound by. | "There are a lot of well owners that have been reporting reduced water levels, some of them have had their wells going dry" (Phoenix; October 2015) |

# APPENDIX E

# DEDUCTIVE CODEBOOKS

E.1. *Deductive Codebook for Human Resources*

| Mnemonic | Hu-R |
|---|---|
| Short Description | Human Resources |
| Inclusion Criteria | Text passage where the respondent refers to or describe the role, activities or actions of people or groups of people or organized groups involved in the region's water governance or needed in its water management, even when brought in from outside the region.<br>Only direct/specific references to the ADWR office in Phoenix, Verde watershed and Yavapai County stakeholders should be included, if the reference directly relates to Prescott AMA water issues.<br>Direct/specific references to state level stakeholders (who influence statewide water governance and management) should also be included |
| Exclusion Criteria | The mention of persons that are neither directly nor indirectly related to the region's water management and governance. For example, references to Verde watershed in broad terms or references to persons in Phoenix AMA or state level users and stakeholders should not be included |
| Typical Exemplars | Skilled workers, technicians, engineers, geologists and other persons who currently practice a particular skill area. I/We/They are involved in… (where there is a specific person/unit/organization being identified) |
| Atypical Exemplars | Exempt well owners, forest service |
| Close but no | Reference to retired engineers and other retired persons unless their area of work being described is different from the skill area they retired from. Also, broad general description of sectors or users that do not refer to specific known units/individuals within the region. For instance, text passages that refer to the statewide conservation requirement of municipal users need not be coded unless the passage contains specific reference to Prescott Area water issues |

E.2. *Deductive Codebook for Artefactual Resources*

| Mnemonic | Ar-R |
|---|---|
| Short Description | Artefactual Resources |
| Inclusion Criteria | Passage of text that refers to infrastructure or construction materials and other man-made materials that are necessary to or relate in one way or another to the region's water management and governance. It could be artifact from outside the study region and does not have to be administered in it but must be contributing to their (the study region's) water sustainability.<br>Only code references to Salt River Project, Central Arizona Project or Big Chino Ranch project that refer to the artefactual aspects of the projects. |
| Exclusion Criteria | Exclude artifact that do not relate either directly or indirectly to the study region's water management and governance<br>Do not code artefactual resources that specifically refer to city development activities and not water governance. For example, building houses, and similar.<br>Do not code generic drilling of wells. It has to refer to a specific project or instance. |
| Typical Exemplars | Pipes, desalination plant |
| Atypical Exemplars | Water pump, recharge facility, sewer system, water line/system, the act of drilling a well, specified projects[29], drill |
| Close but no | Reservoir, exempt well, lot split, build houses. |

[29] Do not code 'Salt River Project'. SRP is the name of a company not necessarily reference to a particular project. Include references to CAP, BCR project.

E.3. *Deductive Codebook for Mental Resources*

| Mnemonic | Me-R |
|---|---|
| Short Description | Mental Resources |
| Inclusion Criteria | Text passage where respondents refer to or describe the need for ideas, suggestions, or solutions both tangible and intangible that dictate how water is used or will be used in study area. These references must be about a specific product. |
| Exclusion Criteria | The mention of expertise should be excluded and coded as human resources |
| Typical Exemplars | Information, recommendations, informational videos, outreach, talks, meetings<br>Statutes, law, bills, regulations<br>Models, Master plan/blueprint, step-by-step plan/strategies |
| Atypical Exemplars | Research product, modeling activities<br>informative workshop, websites/webinars, formal negotiations<br>Conservation plans |
| Close but no | Informal discussions, other use combination of permit which do not refer to a document e.g. 'permitted', generic reference to conservation, the use of 'bill' in reference to payment for a service. Do not include generic references to meetings. Current or old websites should not be coded. |

E.4. *Deductive Codebook for Monetary Resources*

| Mnemonic | Mo-R |
|---|---|
| Short Description | Monetary Resources |
| Inclusion Criteria | Text passage where reference is made to money, finances, payment, and funding even when described as 'funding for project'. This should be an explicit mention or reference related to the region's water governance |
| Exclusion Criteria | All implicit references to, or inferences about money, finances, and funding are excluded |
| Typical Exemplars | Dollars, money, funds, financing, purchase, shop, sell |
| Atypical Exemplars | Economic turn, cost of household water |
| Close but no | The value of water, rich people |

E.5. *Deductive Codebook for Natural Resources*

| Mnemonic | Na-R |
|---|---|
| Short Description | Natural Resources |
| Inclusion Criteria | Passages of text that refer directly to water resources of the study area or water resources that are being used, will be used or is needed in the study area.<br>The references have to do with a specific source or allocations of it. That is, sources of, dimensions and types of water |
| Exclusion Criteria | References to other natural resources that are not part of the hydrosphere |
| Typical Exemplars | Rainwater, groundwater, surface water, lake, creek, stream |
| Atypical Exemplars | Reclaimed water, groundwater recharge, Water permit, harvested rainwater/rainwater harvesting, water right, paper (back) water, reservoir, well field, exempt well, wastewater, private water company[30] |
| Close but no | Safe yield |

[30] Private water companies but not municipal water providers are included because the interview transcripts contain the exact water source(s) of municipal water providers but not for private water companies.

# APPENDIX F

## COMPREHENSIVE LIST OF THE ACTOR/ACTOR GROUPS DERIVED FROM THE SECOND CYCLE CODING (RESEARCH QUESTION THREE)

F. 1. *Human resources or actors from second cycle coding (described by respondents)*

| | |
|---|---|
| Active Management Area (AMA) residents | Non-water supply stakeholders |
| ADWR Prescott AMA staff | Non-water supplying municipalities |
| Agricultural water users | Northern Arizona Municipal Water Users Association (NAMWUA) |
| Arizona Department of Environmental Quality | Other Municipal Water Users Associations (Central and Southern Arizona) |
| Arizona Department of Real Estate | Officials in the Prescott Valley area |
| Arizona Department of Water Resources (ADWR) staff | Paulden residents |
| Arizona governor | Prescott AMA communities |
| Brokers of Groundwater Management Act | Prescott AMA elected officials |
| Camp Verde | Prescott AMA Homeowners Association |
| Camp Verde council | Prescott AMA residents |
| Center for Biological Diversity (Tucson) | Prescott Homeowners Association |
| Charlie Arnold | Prescott Valley Homeowners Association |
| Chino Valley council | Prescott Valley Town Manager |
| Chino Valley former employee | Prescott Valley Water Manager |
| Chino Valley public works director | Prescott Yavapai Indian Tribe |
| Chino Valley resident | Press |
| Chris Hoy, CWAG | Private water companies |
| Citizens Water Advocacy Group (CWAG) | Professional agencies and organizations |
| Judiciary* | Realtors* |
| City of Prescott council | Residents being served water |
| City of Prescott Mayor | Residents surrounding Chino Valley |
| City of Prescott Mayor candidates | Retired Chino Valley City Manager |
| City of Prescott municipal staff | Salt River Project |
| City of Prescott residents | Sierra Club |

*possibly the same actor described elsewhere by respondents in a different way

| | |
|---|---|
| City of Prescott water committee | State judiciary |
| City of Prescott water manager | State legislators |
| City of Sedona | The Nature Conservancy |
| City of Sedona council | Town of Clarkdale |
| Commerce industry | Town of Clarkdale council |
| Comprehensive Agreement Number One parties | Town of Prescott Valley council |
| Cottonwood residents | Town of Prescott Valley graduates |
| Cottonwood council | Town of Prescott Valley municipal staff |
| County residents within City of Prescott's service area | Tribal President |
| CWAG supporters | United States Fish and Wildlife Service |
| Developer | United States Forest Service |
| Dewey-Humboldt | United States Geological Survey (USGS) |
| Dewey-Humboldt council members | Unnamed downstream rights holder |
| Drillers* | Unnamed water rights holder (willow lake) |
| Environmental Protection Agency (EPA) | Upper Verde River Watershed Protection Coalition (UVRWPC) |
| Exempt well owners | Utilities |
| Federal government | Verde River Basin Partnership (1st formation) |
| Federal judiciary | Verde River Basin Partnership (2nd formation) |
| Federal legislators | Verde River Institute |
| Former owners of Chino Valley Irrigation District | Verde Valley communities |
| Geologists and other scientists | Verde Watershed Association |
| Groundwater Users Advisory Council | Walton Family Foundation |
| Homebuilders Association | Water Infrastructure Finance Authority |
| Hydrologist | Water Resources Development Commission |
| John Munderloh, Prescott Valley | Well drillers |
| Kyl Center for Water Policy | Western Resources Advocate |
| Landowner along BCWR line | Williamson Valley |
| Lawyers and other legal professionals | Yavapai County |
| Mark Holmes | Yavapai County communities |
| Municipal water suppliers | Yavapai County government |
| Ned Warren | Yavapai County Water Advisory Committee |

# APPENDIX G

## CLASSES OF GOVERNANCE ACTORS

Within the power framework adopted, governance actors are human resources. For clarity in analysis, I separated the 110 coded human resources (governance actors/actor groups) into classes. The classes were developed based on who 'creates' the particular actor group and who its 'members' are. This typology was created due to the observation that actors with similar formation-type and membership exhibited similar characteristics in what resources they could mobilize, and hence, how they exercised power. The seven classes are:

- **Government-formed government actor group** – This includes all formal government groups/associations whose members are individuals with government positions, whether elected or appointed (e.g. municipal staff)
- **Citizen-elected government actors** – This includes all elected government officials at different jurisdictional levels (e.g. city councilor)
- **Government professionals** – This includes government workers who are professionals in the water industry, including public water providers (e.g. municipal or government agency staff)
- **Government-formed non-government actor group** – This includes formal non-government actor groups whose members are individuals with government positions, whether elected or appointed irrespective of jurisdictional level (e.g. legislators or municipal staff)
- **Citizen-formed non-government actor group** – This includes formal non-government groups whose members are individuals without public office. An example from this research is the Citizens Water Advocacy Group (CWAG)
- **Market actors** – This includes for-profit water providers and investors. Examples from this research include Salt River Project (SRP), Water Asset Management, Humboldt Water Systems, among others.
- **Informal actors** – This includes residents who are neither part of government or formal non-government groups (e.g. municipal residents)

Within these classes, no actor/actor group is in more than one class. However, it is possible to have a particular actor in more than one group, and hence, more than one class. The selected governance actors in Table G.1 provide a representative coverage of water stakeholders specifically linked to the study area's water governance.

G.1. *Main Actors Linked to Prescott AMA's Water Governance*

| ***Government-formed government actor group*** |
|---|
| Northern Arizona Municipal Water Users Association (NAMWUA) |
| Upper Verde River Watershed Protection Coalition (UVRWPC) |
| City of Prescott Water Committee |
| |
| ***Citizen-elected government actors*** |
| City/town council |
| Tribal officials |
| County supervisors |
| State governor |
| State legislators |
| Secretary of the Interior |
| Federal legislature |
| |
| ***Informal actors*** |
| Individual well owners in Prescott AMA |
| |

| ***Government professionals*** |
|---|
| Arizona Department of Water Resources (ADWR) |
| Arizona Department of Environmental Quality (ADEQ) |
| US Environmental Protection Agency (EPA) |
| United States Geological Survey (USGS) |
| Municipal Staff Professionals |
| US Bureau of Reclamation |
| |
| ***Government-formed non-government actor group*** |
| Prescott AMA Groundwater Users Advisory Council (GUAC) |
| |
| ***Citizen-formed non-government actor group*** |
| Citizens Water Advocacy Group (CWAG) |
| Verde River Basin Partnership (VRBP) |
| |
| ***Market actors*** |
| Salt River Project (SRP) |

# APPENDIX H

## DEDUCTIVE ANALYSIS OF POWER IN WATER GOVERNANCE

H.1. *Definitions of Innovative Power by Resource Mobilization*

| *"Innovative Power* is the capacity of actors to create or discover new resources" (Avelino and Rotmans, 2009, p. 552). It is the ability to introduce into the AMA's water governance regime, forms of a resource that used to be absent or outside it. | |
|---|---|
| Artefactual | Bringing in artefactual resources that are new either from the outside or newly created by the actor. Depending on the specific case, the actor wielding power could be the one that authorizes the project or the one who provides money to fund the project. |
| Mental | Bringing in mental resources from the outside or creating from the inside new mental resources. Any of the agencies whose jurisdiction extend beyond the boundaries of the AMA have an ability to wield this power. |
| Monetary | The giver of the funds is the one that possesses innovative power over the monetary resource. To fit in this category the resource has to come from outside the AMA but can be brought in by someone within. Only that the actor within would have to be the giver, for power to be attributed to him/her OR the resources must be something that is not currently existent in the study area. The giver is the one that wields innovative power. |
| Natural | Bringing in natural resources that did not exist before in the study area, into it. For example, the one who awards a new water right (not re-awarding an existing one) exercises innovative power over the natural resource. |

Adapted from Avelino and Rotmans, 2009:552, 2011:798-799; Avelino 2012:72

H.2. *Definitions of Reinforcive Power by Resource Mobilization*

| | |
|---|---|
| *"Reinforcive Power* is the capacity of actors to reinforce and reproduce existing structures and institutions, thereby constituting the way resources are distributed and valued" (Avelino, 2011, p. 72). Actor groups that can sustain current institutions so that the distribution of resources remain the way it is exercise reinforcive power. | |
| Artefactual | The one who exercises power is the one who ensures the plans for specified projects (artefactual resources) are implemented. For example, Big Chino Ranch project, desalination etc. |
| Mental | The one who exercises power is the one who ensures that report writing, modeling studies, and production of other mental resources continue. |
| Monetary | The one who exercises power is the one who keeps funding allocation the way it is right now. |
| Natural | The one who exercises power is the one who maintains the current network of water rights. |

Adapted from Avelino and Rotmans, 2009:552, 2011:798-799; Avelino 2012:72

H.3.*Definitions of Transformative Power by Resource Mobilization*

| | |
|---|---|
| *Transformative Power* is "the ability to transform the distribution of resources, either by redistributing resources and/or by replacing old resources with new resources" (Avelino and Rotmans, 2009, p. 553). This involves the ability to redistribute/replace the artefactual, mental, monetary, and natural resources that frame water governance activities. | |
| Artefactual | The one who exercises power is the one with authority to change location of project construction. For example, desalination plants, recharge, recovery plants among others. |
| Mental | The one who exercises power is the one who makes water-related bulletins or study results available to a different or wider audience. |
| Monetary | The one who exercises power is the one who diverts money from one place to another. There is an origin and a destination. In this study, the destination is Prescott AMA. |
| Natural | The one who exercises power is the one who changes the current network of water rights. |

Adapted from Avelino and Rotmans, 2009:552, 2011:798-799; Avelino 2012:72

H.4. *Definitions of Destructive Power by Resource Mobilization*

| | |
|---|---|
| *"Destructive Power* is the ability to destroy or annihilate existing resources" (Avelino and Rotmans, 2009, p. 552). Destructive power could be positive (needed) if ends unsustainable or damaging practices while destructive power could be negative if it is used to undermine or end practices that encourage water sustainability | |
| Artefactual | Destroying artefactual resources or stopping construction activities or projects involves the exercise of destructive power. |
| Mental | Keeping an issue off the agenda by getting rid of it completely or discrediting mental resources is an exercise of destructive power. |
| Monetary | Withholding and/or stopping finances or funding is an exercise of destructive power. |
| Natural | Stopping the ability to bring natural resources in is an exercise of destructive power. |

Adapted from Avelino and Rotmans, 2009:552, 2011:798-799; Avelino 2012:72