

DESERT HYDROLOGIES: EXPLORING WATER DIALOGUES IN THE ARID WEST  
THROUGH PARTICIPATORY PHOTOGRAPHY

BY

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## ABSTRACT

### DESERT HYDROLOGIES: EXPLORING WATER DIALOGUES IN THE ARID WEST THROUGH PARTICIPATORY PHOTOGRAPHY

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As concern mounts over issues related to global environmental change, research that brings to light people's perceptions and experiences of those issues will be critical in the effort to avert anthropogenic environmental disaster. Studies have shown that not only do public dialogues around environmental issues influence environmental policy (M. Ingram, H. Ingram, and Lejano 2015; Kelly et al. 2014), personal stories related to environmental issues also motivate environmental action (Gustafson et al. 2020; Morris et al. 2019).

This thesis explores one means by which researchers, activists, and communities may be able to go about both examining and creating dialogue about environmental issues: participatory photography. Also known as "photovoice," participatory photography involves having members of a community take and submit photos that offer their perspective on the research topic. The

methodology has a fairly extensive history in social science research, but it has been used only sparingly in studies of human-environment relationships.

This thesis explores the use of participatory photography in human-environment research by detailing the results of a participatory photography project I conducted on water and water issues in Las Cruces, New Mexico. Between late October 2021, and the end of February 2022, I curated fifty-three photos taken by thirty-two Las Cruces community members depicting their relationships with and understandings of water in an arid landscape. The project, named “Desert Hydrologies,” culminated in a virtual exhibit (<https://hardtb.wixsite.com/deserthydrologies>) featuring participants’ photos and excerpts from surveys they sent in along with them. The project was an attempt to better understand local water dialogues and highlight the ways people experience water in the arid West at a time when the region faces myriad environmental threats related to water scarcity.

This thesis consists of four chapters. The first two provide context on water issues and water discourse in the arid West (Chapter One) and in Las Cruces (Chapter Two). The third chapter discusses the history and past uses of participatory photography as a methodology within the social sciences and human-environment research. Chapter Four details the methods and results of the Desert Hydrologies project and analyzes the various perspectives and understandings of water participants expressed through their photos. I then conclude with some reflection on the Desert Hydrologies project and future directions human-environment researchers might take participatory photography.

Overall, the Desert Hydrologies project proved successful in both engaging participants in meaningful conversation around water and providing insight into how they relate to water. Participants’ photos revealed that aspects of broader dialogues around water in the arid West are

circulating at local levels in nuanced forms, and participants reported that the photography process either influenced or strengthened their thinking about water issues. As we look for ways to better understand the “human” component of human-environment relationships, participatory photography stands out as a means for achieving this goal that is both practical for researchers and rewarding for communities who hold stake in key research topics.

*Keywords: Geohumanities, Participatory Photography, Water Narratives, Water Dialogues, Water in the West*

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## INTRODUCTION

As a Minnesotan who moved to southern New Mexico a little over a year ago, I arrived in the desert with a keen curiosity about what water means to people in a place with so little of it. I wondered if my ways of seeing, understanding, and relating to water might have been different had I grown up in a place like the arid West instead of the "Land of 10,000 Lakes" I called home for most of my life. As I have worked to create this thesis and settled into life as a "desert rat," I have come to find that water signifies many different things in this parched landscape. It is both life and death, joy and dread. It is both the sanguine dream of abundance and the harsh reality of scarcity; a trophy of human dominion over nature and a symbol of the folly inherent in trying to subjugate the natural landscape. Today especially, it is both hope and apprehension as water supplies dwindle across the region and threaten to bring unprecedented changes to local lifeways and landscapes.

The need to better understand the varying and often conflicting ways in which people see water in the arid West is becoming increasingly apparent. Between climate-change-induced drought and a regional history largely defined by widespread human modification of the natural environment (often for the purposes of obtaining water), residents of the arid West are among the first to come up against the far-reaching environmental changes we humans are imposing on this planet. While we have come to know much about these types of changes from a scientific perspective, might there also be value in understanding how these changes are lived and experienced? In a region like the arid West that seems to be staring down the barrel of what some have called a "new normal," how are people's relationships with the natural world changing? Is water as an economic, cultural, and natural resource being seen and understood in different



ways? More specifically, what types of dialogues are appearing around water and the various roles it plays in life and society in the arid West?

I believe questions like these to be crucial for a couple of reasons. For one, public discourse plays a key role in environmental action. Studies have shown that people's perceptions of place, the environment, and environmental issues drive both informal environmental action and environmental policy decisions (M. Ingram, H. Ingram, and Lejano 2015; Kelly et al. 2014). Furthermore, localized experiences of place and environmental issues have the capacity to raise awareness for environmental issues and inspire environmental action in other places. Personal stories depicting people confronting climate change, for instance, have been shown to promote belief in the issue and motivate environmentally friendly behavior (Gustafson et al 2020; Morris et al. 2019). Bearing this in mind, exploring new and innovative ways to examine local environmental discourse and share people's experiences of environmental change will be increasingly valuable in the coming decades as we look to improve humanity's relationship with the planet.

This thesis will explore one such method of analyzing and cultivating environmental dialogue—one that does so by engaging communities in the creative and affective practice of photography. Participatory photography, sometimes known as “photovoice,” has been used by geographers, anthropologists, and other social science researchers to both investigate perceptions of place and generate meaningful conversation around social, economic, and environmental issues affecting communities at a local scale. Desert Hydrologies, the project that forms the basis for this thesis, uses participatory photography to examine the ways residents of Las Cruces, southern New Mexico's largest city, relate to water and understand water issues in this current period of looming environmental upheaval. In doing this, the project also assesses participatory

photography's usefulness as a human-environment research tool and as a means for fostering engagement in environmental issues.

The theoretical roots of the Desert Hydrologies project can be traced to a few different areas of geographic thought. Broadly, it falls within what Pattison (1964) calls the “Man-Land Tradition” of geography, more accurately and inclusively known today as the Human-Environment Tradition. It also draws inspiration from the work of cultural geographers like Yi Fu Tuan, whose exploration of the concepts of place and space sought to illuminate “how the human person, who is animal, fantasist, and computer combined, experiences and understands the world” (Tuan 1997, 5). More particularly, Desert Hydrologies draws heavily from previous participatory work in both geography and the geohumanities, a growing subdiscipline within geography that explores the role of the arts and the humanities in geographic inquiry (Hawkins 2015; Magrane 2019). In fact, one of my aims in conducting the Desert Hydrologies project was to begin bridging the somewhat surprising gap that exists between the participatory geohumanities and participatory photography—something that will be discussed in more detail in Chapter Three. My hope is that this endeavor will contribute to geography theoretically and methodologically by further developing participatory and visual methods within the discipline.

Over the following pages, I will seek to answer three main questions: 1) What are some of the key perspectives and outlooks that define modern discourse around water in the arid West, and where does Las Cruces fit into this discourse? 2) Where do Las Cruces community members' perspectives on and relationships to water fall on the spectrum of thought and discourse on water in the arid West? and 3) In what ways can participatory photography be useful in both analyzing and elucidating people's experiences of place and environmental issues? Chapter One will mostly tackle the first question, focusing on the various framings and

narratives of water and water issues that have circulated through environmental conversation in the arid West. Chapter Two zooms in on the Las Cruces area, providing context on some of the water issues it faces and analyzing perspectives on those issues from local water professionals and leaders. Chapter Three takes a closer look at participatory photography as a methodology, discussing its theoretical underpinnings and past uses in social science and human-environment research. Finally, Chapter Four details the methods and results of the Desert Hydrologies project and examines the various ideas, attitudes, and perspectives about water and water issues participants expressed through the photos they sent in. I then wrap things up by reflecting on Desert Hydrologies and some of the future directions in which human-environment researchers might take participatory photography.

Overall, the Desert Hydrologies project proved effective in illuminating how recent shifts in broader dialogues around water in the arid West are being expressed at a local level. It was also successful in engaging participants in conversation around water and water issues. As we continue looking for ways to understand the “human” component of human-environment relationships, participatory photography stands out as a means for achieving this goal that is both practical for researchers and rewarding for communities.

## CHAPTER ONE: WATER FRAMES AND NARRATIVES IN THE ARID WEST

Water has long dwelled at the center of environmental conversation in the arid American West. It has permeated popular myth, sparked bitter conflict, created complex political and legal conundrums, and posed dire threats to the wellbeing of the region's residents (both human and more-than-human) as it has disappeared with increasing rapidity over the decades. To develop a deeper understanding of the ideas and perspectives that have appeared around water in the arid West as the region faces what many believe to be a water crisis, this chapter will examine framings and narratives of water that have precipitated out of recent conversations on water history and water issues in the region. After defining frame and narrative, I will examine several distinct water frames, along with their respective supporting narratives, that commonly appear in various types of literature (both academic and otherwise) on water in the West.

There has been a marked shift in how water in the arid West has been understood and discussed over the last three to four decades. As the region has been forced to confront a multitude of social, political, economic, and environmental issues related to water, many of which stem directly from its past mishandling of water resources, the dialogue surrounding water in the region has taken on a noticeably more reflective, gloomy, and at times frustrated tone. Many scholars, authors, journalists, activists, and other concerned parties have begun chewing over the missteps that riddle the history of water use and management in the region, pondering the tensions water and water issues have raised over the years, and worrying about what the water future in the arid West might look like, if there is one at all. Though not fully over, the days of envisioning a West where deserts bloom and human ingenuity intrepidly leads the region into a rosy, utopian future increasingly appear to be in the rearview. By better understanding the discourse that has both produced and been produced by this shift, we might achieve a clearer

sense of what the coming decades will hold for the region as westerners reimagine what water means to them.

### **Defining frame and narrative**

Environmental thought and discourse loom large when it comes to water in the West. Not only have people and their various ways of understanding the natural world played an integral role in creating water issues in the region, these issues have also been examined from myriad angles and produced a vast array of different ideas (and actions) both related to water issues themselves and broader issues of global change and human-environment relationships. While this has made water in the West a subject of keen interest for human-environment researchers, it also has made the topic rather difficult to analyze. Where do the various perspectives on water in the West come from? How did they come to be? What is the relationship between how water in the West is seen, understood, and discussed and what is actually done about the issue? By breaking down recent shifts in discourse about water in the West into frames and narratives, we can begin to organize and better understand the ideas that have been part of that shift as well as their implications.

However, before “diving into” water frames and narratives, we must assess how frame and narrative have been defined in the social sciences and particularly in social science research on human-environment relationships. This is a tricky task, as literature that deals with frames and narratives often provides vague and sometimes contradictory definitions of what they are and how they function (Aukes, Bontje, and Slinger 2020). That said, attempts to identify key characteristics of frames and narratives have been made, and unifying definitions of both concepts have been proposed.

I will begin by discussing narrative, as it is the more commonly seen of the two concepts in social science literature. Narrative as an analytical device was introduced to the social sciences by policy analysts who sought to understand how policy issues are circulated within public discourse (Roe 1994). Roe (1994) defines narratives as stories or scenarios with distinct beginnings, middles, and ends that establish and perpetuate policy arguments. Social scientists have used this concept in a variety of ways. Policy analysts, for example, tend to define narratives as stories or story-like entities with distinct plots, settings, characters, morals, and persuasive strategies designed to incite a certain type of action or policy decision (Kelly, Cooley, and Klinger 2014; Leong 2021; Shanahan, Jones, and McBeth 2019). Narrative network analysis, introduced by Ingram, Ingram, and Lejano (2015), also highlights story as a key component of narrative but approaches the concept from a more humanistic angle. This type of analysis treats narratives as the means by which groups of people formulate and understand their relationship to place and identifies narratives as components of networks that link groups of actors together and drive informal environmental action (H. Ingram, M. Ingram, and Lejano 2015; Leong 2021). Other social science disciplines define narrative more broadly. Political ecologists, for instance, associate story with narrative but also use the term to describe prevailing schools of thought or perspectives surrounding certain issues (Beymer-Farris and Bassett 2012; Bixler 2013; Gislason et al. 2013). Often, political ecologists will differentiate between narratives produced by dominant discourses and “counternarratives” that challenge dominant discourses (Beymer-Farris and Bassett 2012; Gislason et al. 2013).

The definitions outlined above, while useful, differ slightly in how they identify what makes a narrative a narrative (a story dealing with a given subject versus a broader viewpoint on said subject). Noting this discrepancy, some have made efforts to distinguish narratives from the

wider conversations through which they circulate (Aukes, Bontje, and Slinger 2020; Wilder et al. 2015). This is where the concept of frame enters the picture. Aukes, Bontje, and Slinger, working with definitions put forth by others, define frames as bodies of knowledge, or “schemas of interpretation” (n.p.), built around certain worldviews and perceived realities of which narratives are a component. Put more simply: “...frames are actors' perspectives, whereas narratives are the expressed products of those perspectives” (n.p.). This is essentially the definition of frame and narrative that I will use in this thesis. Water frames (or framings, as I will sometimes refer to them) are shared perspectives or modes of discussion that cast water and water issues in a certain light and have their own sets of salient conclusions. Within each frame are individual narratives—stories or story-like cases-in-point—that support the broader frame. While I do not propose this treatment of frame and narrative as a be-all-end-all for defining the two concepts, I do feel it is useful when it comes to examining the shifts in water discourse in the West that have occurred in recent decades.

In total, I will discuss six distinct water frames that I have teased out of various literature on water in the West, including academic books and journal articles, books and articles written for both academic and wider audiences (e.g., Reisner 1993; Sevigny 2016), fictional works, and news articles. A simplified summary of each frame, its key ideas, and component narratives can be found in the typology table below (Table 1).

**Table 1:** Typology of water frames and narratives in the arid West.

Water frame	Key arguments from water literature	Supporting narratives
Water as myth	<ul style="list-style-type: none"> <li>Myths of water abundance during early colonial exploration and settlement and the erroneous idea that human presence would cause the arid West to become less arid portended the region's troubled relationship with water.</li> </ul>	<ul style="list-style-type: none"> <li><b>The legend of the Rio Biuenaventura</b> (Sevigny 2016)</li> <li><b>Water and Manifest Destiny</b> (Courtwright 2015; Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016; Stegner 1982) <ul style="list-style-type: none"> <li>“Rain follows the plow”</li> <li>Rainmaking</li> </ul> </li> </ul>
Water as delusion	<ul style="list-style-type: none"> <li>The belief that human ingenuity could make the arid West “bloom” into a new cradle of human civilization was in many ways just as foolish as the water myths of the previous</li> </ul>	<ul style="list-style-type: none"> <li><b>Environmental impacts of dams</b> (Jenkins 2009; Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016) <ul style="list-style-type: none"> <li>Fragmentation of aquatic habitat</li> <li>Disruption of flood cycles</li> </ul> </li> </ul>

	<p>century.</p> <ul style="list-style-type: none"> <li>Dams and other large water engineering projects have done more harm than good in many respects.</li> </ul>	<ul style="list-style-type: none"> <li>Threats to biodiversity</li> <li><b>Water supply impacts of dams</b> (Kohli and Frenken 2015; Phillips, Hall, and Black 2015; Reisner 1993) <ul style="list-style-type: none"> <li>Evaporation and sedimentation</li> </ul> </li> <li><b>The social cost of dams</b> (Capossela 2015; Reisner 1993) <ul style="list-style-type: none"> <li>Working conditions during the dam-building era</li> <li>Environmental justice issues (particularly with Pick-Sloan dams)</li> </ul> </li> <li><b>Rampant and reckless water engineering in the twentieth century</b> (Jenkins 2009; Sevigny 2016; Reisner 1993; Sheridan 1995) <ul style="list-style-type: none"> <li>Slapdash and haphazard dam building</li> <li>Competition between the Bureau of Reclamation and Army Corps of Engineers</li> <li>Safety concerns—the Teton Dam</li> <li>Water engineering aberrations—the Central Arizona Project</li> </ul> </li> <li><b>Attempts to find “new water”</b> (Reisner 1993, Sevigny 2016) <ul style="list-style-type: none"> <li>Cloud seeding</li> <li>Proposals to import water from distant riverways (NAWAPA)</li> </ul> </li> </ul>
Water as a cultural battleground	<ul style="list-style-type: none"> <li>Differing cultural understandings of nature and the environment clash around water.</li> <li>Water law and policy in the arid West have codified imperialistic understandings of water at the expense of non-colonial understandings.</li> </ul>	<ul style="list-style-type: none"> <li><b>The law of prior appropriation</b> (Hundley 1996; Hundley 2004; Lane 2011; Mott 2017; Perramond 2018; Perramond and Lane 2014; Phillips, Hall, and Black 2015; Redman and Kinzig 2008; Reisner 1993) <ul style="list-style-type: none"> <li>Impacts of water adjudication on <i>acequia</i> communities</li> </ul> </li> <li><b>Native American water rights issues</b> (Espeland 1998; Hundley 1996; Hundley 2004; Perramond 2018; Reisner 1993) <ul style="list-style-type: none"> <li>Shortcomings of the Winters Doctrine</li> <li>The Orme Dam conflict</li> </ul> </li> </ul>
Water as an instigator	<ul style="list-style-type: none"> <li>Water’s importance and scarcity in the arid West makes it a flashpoint for political and judicial conflict.</li> <li>Struggles over water have become violent (or nearly become violent) in the past, raising concerns over the possibility of water violence in the future.</li> </ul>	<ul style="list-style-type: none"> <li><b>Battles between states and government agencies over water</b> (Crossland 1998; Espeland 1998; Hundley 1996; Hundley 2004; Jenkins 2009; Nott 2020; Reisner 1993; Sevigny 2016; Sheridan 1995) <ul style="list-style-type: none"> <li>Competition between the Bureau of Reclamation and Army Corps of Engineers</li> <li>Arizona v. California</li> <li>Texas v. New Mexico</li> </ul> </li> <li><b>Instances of water violence (or near-violence)</b> (Hundley 1996; Reisner 1993, Sevigny 2016) <ul style="list-style-type: none"> <li>The Owens Valley “water wars”</li> <li>The Parker Dam conflict</li> </ul> </li> <li><b>Concern about water violence expressed in fiction</b> <ul style="list-style-type: none"> <li><i>The Water Knife</i> (Bacigalupi 2015)</li> <li><i>Chinatown</i> (1974)</li> </ul> </li> </ul>
Water as catastrophe	<ul style="list-style-type: none"> <li>Water overconsumption and mismanagement could eventually lead to environmental and economic collapse in the arid West, especially as the threat of anthropogenic climate change looms.</li> <li>Water management in the arid West has violated the region’s natural order.</li> </ul>	<ul style="list-style-type: none"> <li><b>Threats to the arid West’s major water sources</b> (Buono and Eckstein 2014; Hundley 1996; Jenkins 2009; Mott 2017; Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016; Williams, cook, and Smerdon 2022) <ul style="list-style-type: none"> <li>Ecological degradation along the Colorado River due to overconsumption, over-engineering, and drought</li> <li>The destruction of the Colorado Delta</li> <li>Concerns over the Rio Grande’s water supply</li> <li>The depletion of the Ogallala Aquifer</li> <li>The megadrought</li> </ul> </li> <li><b>Apprehension over the future of water in the arid West</b> (Bacigalupi 2015; Hundley 1996; Jenkins 2009; Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016; Stegner 1982) <ul style="list-style-type: none"> <li>Collapse of the Hohokam and Chaco civilizations</li> <li>Ominous imagery of humans’ impact on the West’s water systems</li> <li>Reverence of John Wesley Powell as a prescient figure</li> </ul> </li> </ul>
Water as opportunity	<ul style="list-style-type: none"> <li>Water issues in the arid West could make it a breeding ground for water innovation.</li> <li>The arid West could lead by example when it comes to combatting issues related to global environmental change if it can adjust its approach to water to be more eco-centric.</li> </ul>	<ul style="list-style-type: none"> <li><b>Cultural and technological innovations around water</b> (Buono and Eckstein 2014; Gerlak, Zamora-Arroyo, and Kahler 2013; Gunn 2016; Jenkins 2009; Magrane, Buenemann, and Aguirre 2021; Rivera and Martínez 2009; Mott 2017; Perramond 2018; Redman and Kinzig 2008; Sevigny 2016; Sheridan 1995) <ul style="list-style-type: none"> <li><i>Acequias</i> as a glimpse of what a better water-society relationship might look like in the arid West</li> <li>Minute 319—international cooperation and water for nature’s sake</li> <li>Strides in urban water conservation</li> </ul> </li> </ul>



### **Frame one: water as myth**

For many, the tumultuous history of water in the arid West traces back to the first arrivals of Europeans in the region and the attitudes toward nature and natural resources they brought with them. As the Spanish and later white Americans colonized the West, they carried a belief that water in the region was more plentiful than it truly was or that it would become more plentiful due either to divine intervention or the mere presence of (white) people. Due to its patent naivety, this belief has been singled out in contemporary literature to frame Europeans' relationship with water in the arid West as troubled from the beginning. In her 2016 book, *Mythical River: Chasing the Mirage of New Water in the American Southwest*, science journalist Melissa Sevigny spotlights the legend of the Rio Buenaventura, a river that early Spanish colonists once believed flowed through the upper Great Basin and through California's Sierra Nevada to the Pacific Ocean. The Buenaventura was thought to hold a vast trove of water riches—riches that would be key to sustaining life and society in the arid West for decades or even centuries to come (Sevigny 2016). Sevigny weaves the narrative of Spanish explorers' futile search for the Buenaventura throughout a broad critique of the relentless effort to exploit new water sources in the arid West over the past two centuries. In doing so, she frames the Buenaventura myth as the first in a long line of problematic ideas surrounding the true abundance (or lack thereof) of water in the arid West. In a regional history marked by perpetual denial of the realities of living in a desert, Sevigny argues, the Buenaventura serves as one of the earliest examples of “the inventing of water where none belongs” in the West (xiv).

Others writing about water in the arid West have zeroed in on white American myths of water's abundance in the region during the era of westward expansion. Reisner (1993) opens his landmark publication, *Cadillac Desert: The American West and its Disappearing Water*, with a

rather exasperated discussion of the many explorers, politicians, and scientists who, during the early years of western expansion, predicted that the region would see more rain as it became more populated. This notion was largely rooted in Manifest Destiny ideology, which claimed settlement of the West to be God's will, but it was also adopted by climatologists who incorrectly attributed a short-lived period of above average rainfall in the region to increased human traffic during early settlement (Phillips, Hall, and Black 2015; Reisner 1993; Stegner 1982). There was a widespread belief that agriculture specifically was behind the increase in precipitation, giving rise to the oft-repeated rallying cry of westward expansion: "Rain follows the plow" (Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016; Stegner 1982).

Explanations for the dubious phenomenon of rain "following the plow" varied. Some said that plowing western soils exposed buried moisture to the air, increasing evaporation and thus precipitation (Courtwright 2015; Reisner 1993). Others theorized that the widespread planting of trees and crops would create a moister atmosphere (Courtwright 2015; Reisner 1993). Some also believed that non-agricultural human activity would bring more rain to the West, postulating that things such as smoke from trains, vibrations from foot and vehicle traffic, and the conductive properties of metal train tracks and telegraph wires would encourage cloud and storm formation (Courtwright 2015; Reisner 1993). Believing these theories, some western "rainmakers" attempted to induce precipitation using such tactics as releasing chemicals into the atmosphere and detonating airborne explosives (Courtwright 2015; Reisner 1993).

### **Frame two: water as delusion**

As the nineteenth-century wet period waned and the reality of cyclical drought in the arid West set in, it started to become clear to many that the region would not magically become less

arid, nor would westerners be able to transform its climate in any impactful way. However, this did not put an end to the starry-eyed belief that western deserts could be made to “bloom” into a new cradle of American civilization. The vision persisted, but the means by which it was to be achieved changed. Rather than an act of God or a human-induced shift in climate, water was to be brought to the West through human ingenuity—namely the widespread construction of dams, reservoirs, and aqueducts. These types of endeavors appeared, especially at the time, to be of superior practicality and scientific soundness. However, many in the modern day have argued that the water engineering era of the twentieth century was driven by the same type of imperialist sentiment and problematic environmental thinking that lied beneath water myths and pseudoscience of previous decades.

Perhaps nowhere is the above idea more evident than in the recent re-framings of the great American dam. Though the dams of the American West have long been revered as modern marvels—wonders of the world comparable to the pyramids of Egypt (Espeland 1998, 65)—they have come under increased scrutiny over the last several decades as some of their less desirable side effects have made their presence felt (Espeland 1998; Reisner 1993; Sevigny 2016). One of these side effects is the havoc dams have wrought on aquatic and riparian ecosystems in the arid West. Modern writers and scholars have drawn attention to a number of high-profile environmental issues linked to western dams, including the widespread fragmentation of fish habitat (particularly in the Pacific Northwest), the disruption of ecologically crucial flood cycles, and the destruction of biodiversity hotspots like the Colorado Delta (Jenkins 2009; Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016). A second side effect of dams frequently mentioned in recent literature is that, while dams increase water supplies in specific places, they may threaten long-term water security by exacerbating the depletion of river systems at larger

scales. This occurs not only because of the increased rate of water consumption dams and reservoirs enable (Phillips, Hall, and Black 2015; Reisner 1993), but also due to the ways they alter rivers' water cycles and geomorphological dynamics. Examples include river evaporation rates increasing as reservoirs expose greater amounts of water surface area to the sun (Kohli and Frenken 2015; Reisner 1993) and reservoirs losing capacity as they become choked with sediment that ordinarily would flow downstream (Phillips, Hall, and Black 2015; Reisner 1993).

To add to these long-term sustainability concerns, a third side effect of dams modern writers and scholars have called attention to is their social cost. Narratives of American dam workers facing long hours, paltry wages, labor rights violations, and risk of death and injury due to heat, dynamite explosions, and falling rock frequently appear in literature on water in the West. (Espeland 1998; Reisner 1993). This literature also often highlights the impact of dams on Native American communities. For instance, the Garrison Dam on the Missouri River, which impounds the rather perversely named Lake Sakakwea, flooded thousands of acres of the Fort Berthold Indian Reservation (Capossela 2015; Reisner 1993). Afterward, displaced tribespeople were forbidden from fishing, drinking from, or grazing cattle near the reservoir (Reisner 1993). The Garrison Dam, as well as the several other Pick-Sloan Missouri Basin Program dams that inundated Native American lands, have been used to narrativize the link between water engineering and environmental injustice in the West (Capossela 2015; Reisner 1993). Other instances in which dams have flooded non-Native-American communities, such as those in the valley now occupied by Elephant Butte Reservoir in New Mexico, have been employed similarly (Phillips, Hall, and Black 2015).

That such a vast number of dams were built so quickly and with so little regard for their consequences seems to both bewilder and frustrate modern water writers and scholars, especially

Reisner, who is particularly critical of the dam-building era. In a chapter of *Cadillac Desert* aptly titled “The Go-Go Years,” he writes:

The astonishing thing about Grand Coulee [Dam]—and the whole era—was that the people just went out and built it, built anything, without knowing exactly how to do it or whether it could even be done. There were no task forces, no special commissions, no proposed possible preliminary outlines of conceivable tentative recommendations. Tremendous environmental impacts, but no environmental impact statements (160).

Reisner eschews the idea of dams as unmitigated triumphs of human ingenuity, instead casting them as manmade “monstrosities”—aberrations brought about by relentless human greed and ambition. In support of this idea, he spends much of the “Go-Go Years” chapter discussing the corrupt politics and haphazard decision making that went into the construction of the West’s largest dams, such as Hoover, Shasta, Boneville, and Grand Coulee. Within this, he highlights a number of startling instances in which unforeseen technical challenges forced dam builders to improvise some rather wacky solutions. Examples include construction teams plugging leaks in coffer dams with old mattresses, frantically importing large refrigeration units to freeze mudslides, running hundreds of miles of cooling pipes beneath dams to counteract superheating, and in the case of Hoover Dam, hastily building spillways when its newly created reservoir filled up quicker than expected (Reisner 1993).

Reisner further challenges the legacy of dams in the following chapter, titled “Rivals in Crime.” He details the decades-long competition between two of the United States’ most powerful dam-building agencies, the Bureau of Reclamation and the Army Corps of Engineers, which in the mid-twentieth century led to the construction of hundreds of dams with minimal economic or utilitarian upside. In many cases, these dams were also built despite what Reisner argues were foreseeable safety concerns. Making a case for this point, he spends part of a later chapter discussing the deadly collapse of the Teton Dam in Idaho, which was built despite

warnings that the permeable bedrock underlying its construction site could not support a large dam structure. Using narratives like these, Reisner characterizes the dam building era as a crazed and reckless rush for control over western water resources rather than the triumphant march toward progress it was once made out to be.

This sentiment that has been echoed in other literature on dams and similar large water projects that were products of the West's dam building era (Espeland 1998; Phillips, Hall and Black 2015; Sevigny 2016). One project that has garnered a great deal of criticism from water writers and scholars is the Central Arizona Project (CAP), a massive aqueduct that pumps a portion of the Colorado River from Lake Havasu southeast toward Phoenix and Tucson. The CAP is often framed as illustrative of the seemingly bizarre and illogical lengths to which the arid West has gone to harness water resources.

In addition to the CAP's environmental externalities, such as its contribution to depleting the Colorado River and the energy expended pumping water from low-lying Lake Havasu to higher elevations around central Arizona, the sheer scale and complexity of the CAP also draws the same abject bewilderment from modern writers and scholars that dams tend to provoke. Sevigny (2016) forces readers to wonder if the CAP was a sensible endeavor in the first place, noting that early proposals for the project were dismissed by scientists as absurd and unrealistic. Others have noted the irony with which the CAP makes water "flow uphill" as a way to illustrate the seemingly strange and unnatural ecology water engineering has created in the West (Jenkins 2009; Redman and Kinzig 2008; Sevigny 2016; Sheridan 1995). The idea of water "flowing uphill" appears to trace back to Reisner, who calls the CAP "...as incongruous a spectacle as any on earth: a man-made river flowing uphill in a place of almost no rain" (293).

Another fascinating aspect of the CAP often used in modern water literature to highlight the project's absurdity is that water pumped to its terminal end in Tucson does not go directly to consumers (Jenkins 2009; Sevigny 2016). When the CAP was first built, the water it delivered was so laden with salt, chloride, and sulfate that it corroded residential pipes (Sevigny 2016). As a result, the city was forced to spend \$85 million on a groundwater recharge facility where to this day CAP water is left to percolate down to the aquifers below (Jenkins 2009; Sevigny 2016).

Within narratives like those around the CAP and other audacious western water projects lies an implicit central question: Why, despite the immense costs and myriad environmental and social externalities, has the arid West been so incredibly gung-ho about water engineering? For much of the twentieth century, dams and water projects became an almost rote response to any water-related issue in the West. Whether it had to do with municipal water supply, irrigation, hydropower generation, flood control, or waterway navigation, there always seemed to be a government agency and/or contingent of citizens chomping at the bit to solve the problem with yet another dam, diversion, or aqueduct—sometimes all three (Espeland 1998; Reisner 1993; Sevigny 2016). What was behind this “dams for dams’ sake” attitude (Espeland 1998, 73) that seemed to grip the nation for so many decades? Was it the rivalry between the Bureau and the Army Corps? Was it historical characters like Floyd Dominy, the bull-headed former Bureau commissioner widely considered one of the dam building era’s main driving forces (Reisner 1993)?

While these things contributed, many have argued that the underlying cause of dam overpopulation in the West is the longstanding relationship between water engineering and American exceptionalism. Reisner highlights the symbolic value of dams to the American public and its governing bodies as he details the early years of the dam building era, pointing out that

“dams announced that America could still do remarkable things” and acknowledging their meaning as “symbolic achievements” (159). Others have examined the “engineering ethos” (Espeland 1998, 69) that became institutionalized within agencies like the Bureau of Reclamation and the ways water engineering landscapes reflect ideals of American patriotism, economic progress, and dominion over nature (Espeland 1998; Phillips, Hall, and Black 2015; Rogers and Schutten 2004; Sevigny 2016). Analyses like these cast aside surface-level explanations for the West’s water issues, instead focusing criticism on a regional history marked by foolhardy water imperialism. The argument seems to be not that water engineering in the West was carried out poorly or that it could have been done better, but rather that we were unwise to even believe in water engineering in the first place.

Contemporary discussions of the values and beliefs that fueled the West’s water engineering craze often characterize them as riddled with the same ignorance and naivety that defined the water myths of centuries prior. As alluded to previously, Sevigny draws a metaphorical connection between the myth of the Buenaventura and the short-sighted (in her view) technocratic notion of finding “new water” in the West. She and others point to instances in which water engineering efforts have drawn upon blatantly flawed logic in ways reminiscent of the “rain follows the plow” era. Examples include failures to properly consider construction costs in dam revenue calculations, widespread over-forecasting of stream flows, ambitions to bring water to the West from rivers as far away as the Mississippi, Yukon, and Mackenzie<sup>1</sup>, and the practice of cloud seeding—attempting to create rain by releasing silver iodide into the atmosphere (Reisner 1993; Sevigny 2016). Within these types of discussions, terms like “folly,”

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<sup>1</sup> The North American Water and Power Alliance (NAWAPA) is a proposed continental-scale engineering project that would involve creating a series of dams, reservoirs, and aqueducts to supply water to the West from the American Midwest as well as western and northern Canada (Reisner 1993). The project has been repeatedly dismissed since the mid-twentieth century for its grandiosity, cost, and potential environmental impacts, but proposals for the project still resurface periodically (deBuys 2011)



“hubris,” and “illusion” are frequently thrown around to emphasize the imprudence with which western water resources have been handled (Espeland 1998; Jenkins 2009; Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016; Sheridan 1995).

Water writers and scholars have also questioned the notion held by some that water engineering has succeeded in “taming” the arid West. Reisner spends most of the introduction to *Cadillac Desert* arguing that, despite predictions that water engineering could make the arid West “bloom,” the region remains lightly populated and still contains vast stretches of empty, dry land. While population and economic growth in the West over the decades since *Cadillac Desert*’s publication might detract from this argument somewhat, recent news about regional drought and water shortages (Borunda 2022; Coan 2021; Elam 2022; Kann, Ringdon, and Wold 2021; Marsh and Ramirez 2022) force one to wonder if the arid West’s “blooming” (if one can even call it that) might be short-lived.

Through reframing water engineering as part of a long history of naïve ignorance of the arid West’s natural limits, modern writers and scholars seem to be pushing dialogue on water in the region in new directions. The idea that more water can be “made” in the West if it runs out seems to be losing credibility, especially as harnessing untapped water resources through things like desalination continue to prove logistically and economically difficult (Sevigny 2016). While continued water engineering and urban expansion efforts across the West signal that the notion of “new water” still exists for some, others (especially water journalists, writers, and scholars) seem to be advocating for a more introspective water dialogue in the West—one in which the region takes a hard look at its relationship with water and acknowledges that innovations of mindset might do more to solve water issues than innovations in technology.

### **Frame three: water as a cultural battleground**

Clashes between different cultural understandings of water have also been highlighted by water writers and scholars as they interrogate the problematic mentalities and beliefs that have plagued western water policy and management. Both western water law, which many argue has codified imperialistic attitudes toward water, and the marginalization of non-colonial ways of seeing water have become frequent topics of discussion in recent literature.

Much of the criticism around water law in the West has focused on the law of prior appropriation, which has become a poster child of sorts for the mishandling of water resources in the region. The law, which allocates water rights based on who first put water to “beneficial use” on a given piece of land, has been denounced on several bases. In addition to the often painstaking and time-consuming process involved in proving first use, water writers and scholars have argued that prior appropriation fails to properly account for the ways water moves through natural systems, disincentivizes sustainable use and conservation of water (one must “use it or lose it”), and runs into dead ends when applied to water not owned by a single individual (Hundley 1996; Hundley 2004; Mott 2017; Perramond 2018; Phillips, Hall, and Black 2015; Redman and Kinzig 2008; Reisner 1993).

Perramond (2018) explores the latter issue in more detail in his study of the ongoing New Mexico stream adjudication process, in which the state is relying heavily on laws like prior appropriation to quantify and allocate water rights to various individual stakeholders. Perramond focuses heavily on situations where policymakers have struggled to adjudicate water in communally managed *acequia* systems that date back to early Spanish settlement. Not only has adjudication pitted some *acequia* communities against one another as they lobby to claim water rights that were previously treated as a part of a commons, the very notion of individualized

water rights threatens to extinguish the communal values on which *acequia* culture is built (Lane 2011; Perramond 2018; Perramond and Lane 2014).

There are also parallels between the ways Perramond discusses the adjudication process and the ways others have discussed water engineering. Adjudication, like water engineering, appears to be supremely thoughtful, rational, and scientific—a noble attempt to account for and harness every precious drop of water in an arid region. However, as Perramond argues, the reality of adjudication is much more complex and challenging. He points out that adjudication is incredibly expensive and laborious, noting that New Mexico’s adjudication process has already lasted over a century with no end in sight. He also contends that adjudication involves flawed assumptions about year-to-year water supply stability in an arid landscape and operates on imperialistic values related to individual ownership of nature and natural resources.

Water policy in the West has run into similar practical issues and cultural pitfalls when it comes to Native American water rights. Many have noted the irony with which Native American communities have struggled to claim adequate supplies of water despite being granted vastly superior water rights (under the standards of prior appropriation) by the 1908 Winters Doctrine (Hundley 1996; Hundley 2004; Perramond 2018; Reisner 1993). According to water writers and scholars, the political will to enforce the Winters Doctrine has been lacking from the start; it provided no method or mechanism by which to identify and quantify Native American water rights, making it easy for future courts to leave those rights unacknowledged (Hundley 1996; Hundley 2004; Perramond 2018).

Even in situations where Native Americans win back their water rights, conflict abounds. Espeland (1998) explores tensions that arose between three groups party to the now defunct Orme Dam project, which was proposed in 1968 as part of the CAP and was to be built at the

confluence of the Salt and Gila rivers in Arizona. The parties were the Bureau of Reclamation's "Old Guard"—older engineers who shared an enthusiasm for large water projects, the "New Guard"—younger Bureau professionals who were brought in to ensure water projects complied with National Environmental Policy Act (NEPA) regulations, and the Fort McDowell Yavapai tribe, whose lands the Orme Dam would have inundated. Similar to Perramond's critique of the way adjudication has marginalized the traditional values of *acequia* communities, Espeland's Orme Dam narrative frames water as an arena in which different values surrounding nature and natural resources collide. In addition to detailing the differences between the technocratic ideologies of the Old Guard and the conservationist ethos of the New Guard, Espeland also examines the cultural conflicts that underpinned the New Guard's attempts to compensate the Yavapai for the land the Orme Dam would have flooded. The Bureau, repeatedly perplexed as the Yavapai turned down multiple lucrative offers, failed to understand that the Yavapai did not see their land as something that could be commensurate with monetary value. The Bureau was never able to overcome this cultural obstacle, and the Orme Dam was never built (Espeland 1998).

These narratives that problematize water policy in the West and highlight cultural conflicts over water seem to be part of a modern attempt to think about water more pluralistically—to confront the shortcomings of white American water philosophy and policymaking and begin thinking about ways the West's relationship with water might be changed for the better. Espeland (252), concluding her narrative of the Orme Dam conflict, captures this sentiment quite eloquently: "This is the story of a dam that was not built. But it is also a story of the complicated, dynamic interplay between identities, interests, and rationalities. One moral of this story is that we should investigate this complexity rather than assume it away." In a similar way, Sevigny, in

challenging the notion of “new water,” and Perramond, in interrogating what he calls the “adjudication industrial complex,” call for serious reflection on the ideologies and philosophies that have been brought to water policymaking in the West. The key point here is that the thinking that underlies policy rather than the policy itself now seems to be the chief area of concern. Some of the new ideas that have come out of this reframing will be explored in a later section of this chapter.

#### **Frame four: water as an instigator**

Conflict over water in the West does not only occur in the cultural arena. Instances in which conflict over water has spilled into the political and judicial arenas, or in some cases even devolved into violence (or near-violence), have gained quite a bit of attention in recent literature. This largely seems to be linked with modern concerns over water scarcity in the West and what that might mean for the region’s social, political, and economic future.

A majority of the battles over water in the West have been fought either between governmental agencies or in court. As discussed previously, water writers and scholars often bring up the rivalry between the Bureau of Reclamation and the Army Corps of Engineers, which led to a slew of massive water engineering projects that are now seen to have been more about prestige than rationality and practical utility (Hundley 1996; Reisner 1993). Similar power struggles over water engineering projects have occurred between other entities. The CAP is rarely mentioned in literature on water in the West without discussion of the numerous Supreme Court bouts between Arizona and California that preceded the project and continued after its implementation (Espeland 1998; Hundley 1996; Hundley 2004; Jenkins 2009; Reisner 1993; Sevigny 2016; Sheridan 1995). Similarly, Texas has now twice taken New Mexico to the

Supreme Court over water, first because New Mexico was failing to deliver to Texas its full allotment of the Pecos River (Crossland 1988), and currently because Texas is not receiving its full allotment of the Rio Grande (Nott 2020).

Perhaps due in part to these political and judicial struggles over water, scholars have noted instances in which the ferocity of water conflict in the West has escalated to violence, or at least the threat of violence. A historical narrative that often pops up in this area of the conversation is that of the Owens Valley “Water Wars” of 1902-1907, during which the City of Los Angeles essentially swindled Owens Valley farmers out of their water in order to sustain its rapidly growing population. Reisner dedicates nearly an entire chapter of *Cadillac Desert* to the Owens Valley conflict, laying out the many compelling characters involved (William Mulholland, Joseph Lippincott, Fredrick Eaton, and others) and the ways they spied, lied, and bribed their way into securing water rights previously owned by Owens Valley farmers for pennies on the dollar. Owens Valley residents resisted, first by threatening violence against city officials, then by vandalizing Los Angeles city property, and eventually by dynamiting parts of the Owens River diversion system (Reisner 1993). In the end, a massive aqueduct moving water from the Owens Valley to Los Angeles was constructed, and the valley was thrust into a long period of economic decline (Hundley 1996; Reisner 1993). The events of the Owens Valley conflict later became the inspiration behind Roman Polanski’s 1974 neo-noir thriller, *Chinatown*, a film whose gritty violence has been read as reflective of water’s capacity to fuel greed and corruption in an arid landscape (Scott 2007).

Interestingly, the Owens Valley conflict is the only major example of a water dispute in the West that has involved physical violence. And as some have pointed out, no major violent conflicts have occurred (as of yet) over arid-land water resources (Wolf 1998). However, this has

not stopped the term “water war” from being used to describe the Owens Valley conflict and other water disputes in the West. Sevigny, for example, details a 1934 incident in which the Arizona National Guard was deployed to the test site of the Parker Dam, which was to divert Colorado River water to California. It was perhaps the closest the West has come to a true water war, and it was branded as such by the media both at the time and afterward (Sevigny 2016).

The prospect of violent water conflict in the West has also been represented in fiction, most notably in Paolo Bacigalupi’s (2015) bestselling novel, *The Water Knife*, which depicts a dystopian near future in which corrupt southwestern state governments employ militant mercenaries to acquire water rights from one another through extortion, intimidation, bribery, and murder. Evidently, recent reconsideration of water issues and water history in the West has made a future resembling what is depicted in *The Water Knife* seem imaginable, at least to some. *The Water Knife* deals heavily with issues discussed previously in this chapter, such as the legacy of dams and the law of prior appropriation. Tellingly, it is revealed at the end of the novel that the ancient water rights document around which most of the story’s violence has revolved is hidden in a copy of *Cadillac Desert*, which the characters refer to as the “bible” of water in the West.

#### **Frame five: water as catastrophe**

Another contemporary issue of growing concern in the arid West is the threat water scarcity poses to the environment and, by extension, human life and civilization in the region. As dams and water engineering have fallen under a critical eye, water supplies have dried up at an increasing rate, and climate-change-driven drought has descended upon the region, there has been increasing apprehension that the arid West could be in store for some form of

environmental, economic, and/or social collapse should it fail to drastically change its approach to water management and sustainability.

Rivers often serve as poster children for the mistakes humans have made and continue to make when it comes to water in the arid West. The Colorado River in particular receives a great deal of attention in conversations around this subject. As Reisner (1993) puts it: “To some conservationists, the Colorado River is the preeminent symbol of everything mankind has done wrong—a harbinger of a squalid and deserved fate.” Reisner and others argue that the Colorado River is one of the most over-engineered and over-consumed rivers in the world, noting the widespread impacts this has wrought on its natural systems. These impacts include riparian forests being drowned by reservoirs and choked out by diminished stream flows, the destruction and fragmentation of aquatic and riparian habitat due to dams, diversions, and altered sediment dynamics, and encroachment of invasive riparian species like saltcedar, just to name a few (Buono and Eckstein 2014; Jenkins 2009; Reisner 1993; Sevigny 2016).

The Colorado River Delta has also been a focal point for environmental anxiety, as upstream dams and diversions have reduced its once verdant maze of sloughs, canals, and backwaters to a nearly barren wasteland (Buono and Eckstein 2014; Jenkins 2009; Mott 2017; Reisner 1993; Sevigny 2016). Recent efforts to restore the delta have begun to return some of it to its previous state, but concerns over the startling loss of biodiversity that accompanied the delta’s deterioration linger (Mott 2017; Sevigny 2016). The fact that one of the country’s preeminent rivers now only intermittently reaches its final destination has often been used as a sobering reminder of the destructive power humans have exercised over water in the arid West (Jenkins 2009; Mott 2017; Reisner 1993; Sevigny 2016).



Concerns for the wellbeing of nature and concerns for the wellbeing of human society are closely tied to one another, and this is especially true when it comes to water in the arid West. Reisner compares residents of the Colorado River basin to those of the Nile River valley, contending that they both “helplessly depend” on their respective rivers for survival (121). He writes: “If the Colorado River suddenly stopped flowing, you would have four years of carryover capacity in the reservoirs before you had to evacuate most of southern California and Arizona and a good portion of Colorado, New Mexico, Utah, and Wyoming” (120). While one could argue that this assertion is somewhat hyperbolic, it is indicative of a growing notion that the fate of society in the arid West is inexorably tied to its rivers. Mott (2017, 522) describes the Colorado River as the “lifeblood” of the American West and northern Mexico, and Sevigny notes that the Colorado River sustains around 40 million people plus those who eat the food its waters irrigate. Other major western waterways have been approached in similar ways. In discussing the Rio Grande, for example, Phillips, Hall, and Black point out that only a few very dry years would drastically change the calculus of water deliveries laid out by the Rio Grande Compact.

Additional narratives highlighting the potential human impact of water scarcity extend beyond rivers. The ongoing depletion of the Ogallala Aquifer, the western Great Plains’ vast groundwater system once thought to contain at least a century’s worth of water supplies, is commonly used to put into perspective the rate at which western water resources are vanishing and ground fears of water-related enviro-economic catastrophe in observable reality (Hundley 1996; Jenkins 2009; Reisner 1993). Similarly, worsening drought across the arid West has stoked fears around how climate change might impact the region moving forward. A recent study found that the megadrought that has been afflicting the American Southwest for the last two decades is

the worst the region has seen in 1,200 years (Williams Cook, and Smerdon 2022). Notably, the study also found that anthropogenic climate change is likely to blame for turning what would have been an ordinary drought into the historic megadrought seen today (Williams Cook, and Smerdon 2022). Events like these have led to a widespread sense that the arid West and its residents sit at the edge of immense environmental upheaval, much of which will likely be directly related to water (Mott 2017; Paskus 2020; Phillips, Hall, and Black 2015; Sevigny 2016)

Increasing awareness of the link between water and potential catastrophe in the arid West has cast a noticeable shadow over the regional water conversation. Not only are apprehensions over the region's future palpable in fictional works like *The Water Knife* and the seemingly endless slew of news headlines signaling an impending water crisis in the West (e.g., Borunda 2022; Coan 2021; Elam 2022; Kann, Ringdon, and Wolfe 2021; Marsh and Ramirez 2022; Pskowski 2022), they have also produced increasingly ominous narrativizations of water in the West. Reading through recent water scholarship, one will often encounter narratives of ancient Native American civilizations, such as the Hohokam and the Chaco, that are thought to have collapsed due to water scarcity. These discussions often imply that current civilization in the West could be in store for a similar fate should the region continue business as usual (Phillips, Hall, and Black 2015; Reisner 1993; Sevigny 2016). There also seems to be a growing reverence for figures like the eminent explorer and scientist John Wesley Powell, who in the late nineteenth century warned that the arid West could never sustain a large population long term (Jenkins 2009; Reisner 1993; Stegner 1982). Water writers and scholars often wistfully imagine how the modern West might look had Powell's prescient warnings been heeded.

Also found in literature on water in the West is apocalyptic imagery that feels deliberately designed to be hair-raising. The aforementioned concept of water in West "flowing uphill" is

frequently accompanied by similarly eerie depictions of human impact on the western water landscape: “salt-encrusted” crop fields and streambeds abandoned by farmers and left behind by dammed waterways (Hundley 1996; Sevigny 2016; Reisner 1993), streams “disappearing” into the earth as the bulk of their water is siphoned away for municipal and agricultural use (Jenkins 2009; Sevigny 2016), and characterizations of major waterways as nothing more than “sumps” or “plumbing systems” for modern cities and farms (Jenkins 2009; Reisner 1993; Sevigny 2016). This imagery paints a picture of a region whose natural order has been violated—one whose geography humans have upended and replaced, both intentionally and unintentionally, with a new artificial geography that is absurd, backward, and potentially hazardous.

#### **Frame six: water as opportunity**

Though sometimes lost beneath the doom and gloom that tends to dominate the conversation on water in the arid West, some framings of water and water issues offer a glimmer of positivity and a potential way forward. These framings hint at the possibility that the region could be a breeding ground of sorts for more progressive ways of thinking about water and new innovations related to water use, management, and conservation.

The idea of combatting water issues in the West through cultural innovation has gained steam among modern writers and scholars. For example, *acequias*, discussed briefly in the “water as a cultural battleground” section, have been pointed to as something the West might learn from as it searches for more equitable and ecologically sound water management strategies (Gunn 2016; Magrane, Buenemann, and Aguirre 2021; Rivera and Martínez 2009; Perramond 2018). The commons ethos *acequias* employ in managing water resources been framed as a better alternative to the individualistic mindset that governs state and federal water policy in the

West (Gunn 2016; Rivera and Martínez). Acequias also tend to harness water in ways that are less detrimental to riverine and riparian ecosystems. By delivering water through networks of earthen canals that mimic rivers' natural sloughs and backchannels, *acequias* promote riparian health and return water to riverways through groundwater seepage (Rivera and Martínez 2009; Perramond 2018). Additionally, some writers and scholars have noted that the long history of *acequias* as arid-land livelihood systems have made them more adaptable to the natural fluctuations in water supply that are typical of arid regions (Perramond 2018). *Acequias* are not a panacea, and their water management strategies may not be scalable in the current sociopolitical and economic climate. However, many seem to feel that they offer a glimpse of what an improved water mindset in the West might look like—one that is governed by a heightened sense of community between water stakeholders and greater sense of connection to the natural environment.

Other writers and scholars have reflected on broader ways water scarcity in the arid West might force less consumptive and more eco-centric behavior toward water across the region. Advocating on behalf of this prospect, Sevigny comments on the generative potential of arid landscapes when it comes to sustainability solutions:

In some ways... a desert makes an ideal testing ground for a twenty-first-century vision of humanity's relationship to Earth. Dryland ecosystems cover 41 percent of the planet's surface. They contain just 8 percent of the global freshwater supply, yet hold a third of the world's population and are growing faster than any other bioregion.... People must learn how to live in arid regions—and if we can, surely we can learn to live anywhere (Sevigny 2018, 235-236).

Sevigny may be onto something here. For all its water issues, the West has made some encouraging strides toward giving water back to the environment. For instance, efforts to restore the Colorado Delta seem to have inspired some hope that the Colorado River is not a lost cause. In 2014, a pulse of water was allowed to flow past the Morelos Dam near Mexicali, allowing the

Colorado River to reach its delta for the first time in sixteen years as part of a broad effort to explore restoration strategies along the beleaguered waterway (Buono and Eckstein 2014; Sevigny 2016). The endeavor, widely known as Minute 319 after the eponymous update to the Colorado River Compact<sup>2</sup>, has been heralded as a potential harbinger for a better water future in the arid West and a testament to the power of international cooperation (Buono and Eckstein 2014; Gerlak, Zamora-Arroyo, and Kahler 2013; Mott 2017; Sevigny 2016).

Also notable are the improvements western cities have made when it comes to water conservation. In addition to advances in water-saving technology such as low-flow faucets, toilets, and showerheads and the advent of water-smart practices like xeriscaping, large cities like Los Angeles and Las Vegas have developed better methods of capturing stormwater and recycling wastewater for non-potable uses and groundwater recharge (Mott 2017). Water rationing has also proved successful in some parts of the West; in a period of ten months spanning 2015 and 2016, the state of California was able to reduce its total water consumption by a whopping 25 percent through implementing mandatory rationing orders (Mott 2017).

Should the West build on successes like these, a future where the region is looked to as a trailblazer for sustainable innovation rather than one of the first casualties of global change seems attainable. However, many writers and scholars feel that accomplishing this will require further departure from the avaricious and anthropocentric mindset that has historically underlain water use and management in the West. Sevigny (234) makes some compelling arguments to this effect:

Science has begun to show us ways to heal the underlying processes that have fostered invasive species, destroyed habitat, eroded riverbanks, threatened plants and animals, and aggravated floods and fires across the Southwest. This healing

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<sup>2</sup> In the context of the Mexican Water Treaty of 1944, which is part of the broader Colorado River Compact, the International Boundary and Water Commission (IBWC) defines “Minutes” as implementing agreements aimed at carrying out the terms agreed upon in the treaty (IBWC, n.d.)

requires humans to give back to an environment from which we've grown accustomed to taking. The illusionary policies of new water fundamentally contradict the idea of building a society guided by environmental ethics. The crux of arguments about water scarcity is the question: do you reduce demand or increase supply? The promise of the mythical river has imprinted itself so strongly in the western psyche that we mostly chase the mirage of supply without considering demand.

For Sevigny, future water innovation in the arid West should aim to sustain the natural systems of which humans are a part rather than exploit natural systems as things that are separate from humanity, an appeal that has been made in various ways by other water writers and scholars (Gunn 2016; Jenkins 2009; Redman and Kinzig 2008; Sheridan 1995). Only by turning away from the idea that the West must constantly fight nature to expand its water supply, these authors argue, can the region overcome the cultural and intellectual barriers it has erected around water sustainability.

## **Final thoughts**

The arid West still has quite a few obstacles to conquer before its water outlook can begin to brighten. As many have noted, the region is still struggling to let go of the seductive prospect of water abundance. Newly built dams and diversions, though smaller and less grandiose than those of the past, continue to enable irresponsible water consumption and burden natural ecosystems in places across the West (Perramond 2018), not to mention that much of the water westerners use still comes from the large dams and reservoirs built in the twentieth century (Mott 2017; Perramond 2018; Sevigny 2016). Additionally, such elaborate ideas as importing water to the West from other parts of the North American continent, some as far away as northern Canada, continue to surface and resurface to this day (deBuys 2011; Reisner 1993; Sevigny 2016). Even the seemingly arcane practice of rainmaking lives on; cloud seeding is still fairly widely

practiced across the West today despite there being essentially no evidence that it works (Sevigny 2016). Desalination as well, though heralded by some as the next great frontier for water in the West, has been critiqued for its exorbitant cost and its capacity to disincentivize more cost-efficient water conservation practices (Mott 2017; Sevigny 2016). In many respects, the idea (or illusion as some would call it) of “new water” is still alive and well in the West.

Despite this, however, the West also seems to be in the midst of a rather momentous rethinking of water as it confronts the impacts of its fraught water history and stares down the barrel of water-related environmental, social, and economic change. As this rethinking occurs, it will be fascinating, and perhaps enlightening, to observe how it might influence (or not influence) water dialogue in more localized settings. Reisner and others have argued that while powerful individuals and government entities have historically been the ones directly responsible for western water policy, their actions have been both enabled and driven by the will of the western public. Therefore, it stands to reason that the ways residents of the arid West experience and participate in the changes the region is facing and the new dialogues and discourses that those changes generate will be an important part of understanding where the region is headed long term. This is precisely the subject around which the remainder of this thesis is centered.

## CHAPTER TWO: WATER IN LAS CRUCES

The Las Cruces area is an excellent place to examine the ways water issues and narratives in the arid West play out at a local scale. Like much of the arid West, it is facing a dwindling water supply due to overconsumption, climate-change-induced drought, and human alteration of natural water systems. It also sits directly along one of the United States' largest and most engineered riverways—the Rio Grande—which has been a focal point for concerns over environmental degradation and conflict over water rights.

Over the fall and winter of 2021-2022, I interviewed five Las-Cruces-area professionals and community leaders whose work intersects with water to get their perspectives on local water issues. I chose an interview-based approach for a couple of reasons. The first was simply that information on water issues at a local scale can be difficult to find. Second, places where information on local water issues can be found, such as technical reports and planning documents, often lack critical commentary. By interviewing local water professionals and leaders, I was able access perspectives on water issues similar to those provided by the written sources I analyzed in Chapter One of this thesis. Chapter Two will combine the findings of the interviews I conducted with further research on water in Las Cruces to provide context on the water dialogues that were examined in the Desert Hydrologies study.

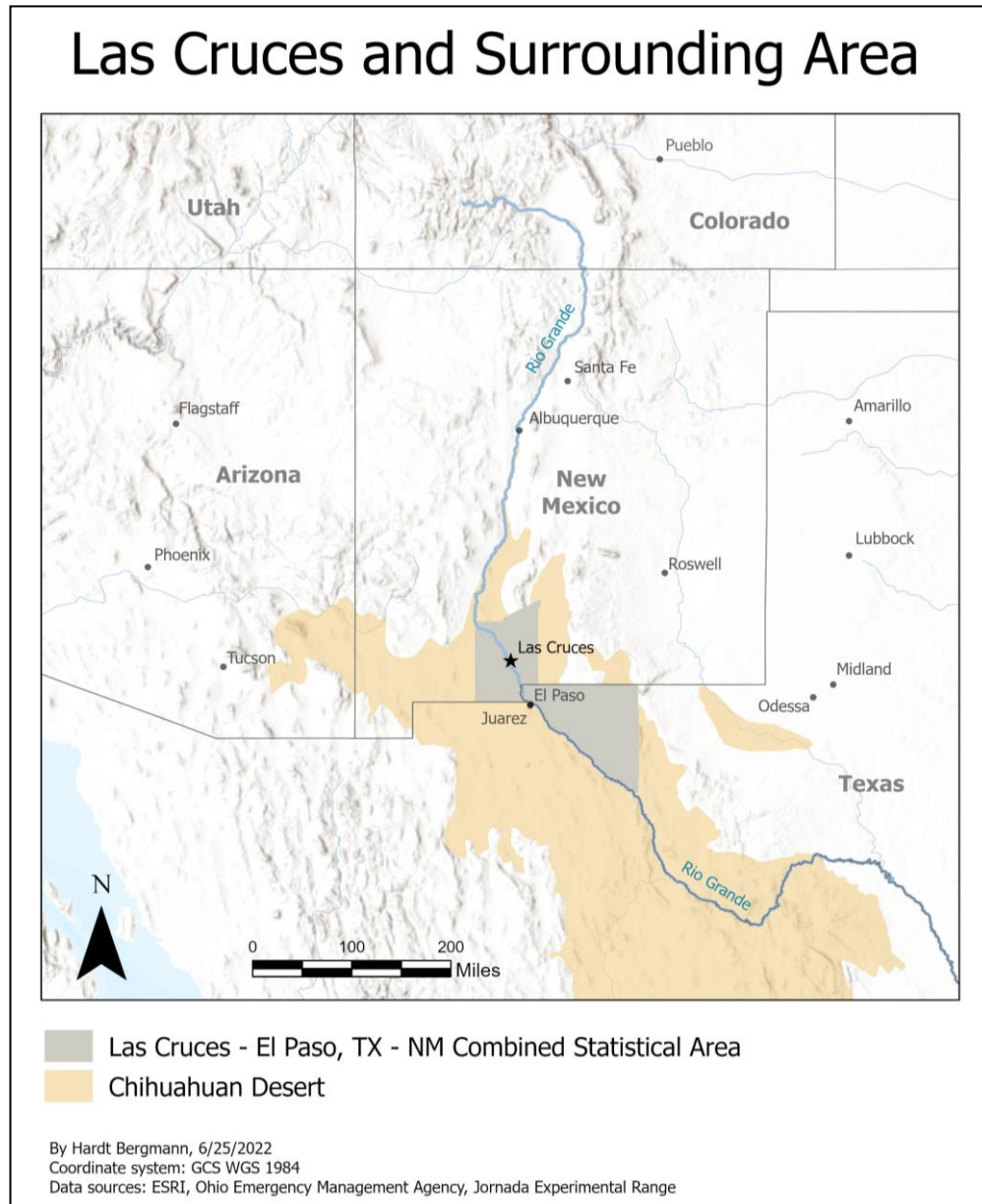
Through the interviews and my research, I identified several key water issues facing the Las Cruces area: urban water use, drought and climate change, tensions surrounding agricultural water use, the depletion of the Rio Grande, and the recent Texas v. New Mexico Supreme Court case. As a whole, these issues have posed great challenges to the Las Cruces community and have caused apprehension among local water professionals and leaders around what lies ahead for the city and its surrounding area. While recent successes in water policy and management



provide hope that Las Cruces can overcome its water challenges, interviewees emphasized that there is still much progress that must be made in order to accomplish this goal.

### **Urban water use**

One of the main issues surrounding water in Las Cruces revolves around the stress its large population puts on the local water supply. Las Cruces is New Mexico's second most populous city, with an estimated 112,914 residents as of July 2022 (U. S. Census Bureau 2021). It is also part of the El Paso-Las Cruces, TX-NM Combined Statistical Area (Figure 1), which houses a population of just over one million people (U. S. Census Bureau 2020). Ciudad Juárez, home to a little over 1.5 million people (DataMEXICO 2022), sits directly across the U. S.-Mexico border from El Paso. Combined, the Las Cruces-El Paso-Juárez area is one of the most populous urban corridors in the arid West, its total population of nearly 2.7 million eclipsing those of some of the region's other major metropolitan areas, including Albuquerque, Tucson, Salt Lake City, and Las Vegas (U. S. Census Bureau 2020). Expectedly, this creates a significant local demand for water. In Las Cruces, average per-capita water consumption is about 176 gallons per day (NMOSE 2020). In El Paso, residents consume an average of around 130 gallons per day (El Paso Water 2019). Multiply these numbers by each city's population, and it amounts to over 108 million gallons of water consumed each day (and this does not include Juárez and smaller communities around the Las Cruces-El Paso-Juárez area).



**Figure 1:** Map of Las Cruces and its surroundings, including the Las Cruces-El Paso, TX-NM Combined Statistical Area (created using ESRI's ArcGIS Pro 2.9.0).

Most of the urban water supply for Las Cruces, El Paso, and Juárez comes from aquifers (El Paso Water 2019; McCoy and Shoemaker 2017), which have become a focal point for concerns surrounding local water resources. Multiple water professionals and leaders I interviewed cited groundwater use and recharge as one of the main issues the Las Cruces area is currently dealing

with. A city councilor I spoke to expressed concern over the city “mining” its aquifers faster than they are being replenished and noted the possibility of groundwater supplies running out before the end of the current century. Another interviewee who works in New Mexico State University’s (NMSU) Department of Environmental Health Safety and Risk Management described being in awe of how much water was drawn out of local aquifers when he first started his position:

Once I had a little more exposure to potable water systems, I was amazed by the volume of water that was pulled out—for a city, for a college campus, for a golf course, for anything.... I was frankly amazed that the ground could recharge enough to keep that going, which it really can't. But I was surprised we didn't run out forty years ago once I saw how many million gallons a day are coming out of our aquifers.

Interviewees generally attributed the overdrawing of local aquifers to excessive water use on the part of both city residents and local institutions. “We waste water in this city,” said the city councilor when asked about his outlook on urban water supply issues. Both he and the aforementioned NMSU employee pointed to water intensive practices like maintaining golf courses, green spaces, and lawns as well as a lack of public education on water issues as drivers of overconsumption. They also discussed the shortcomings of water policy when it comes to motivating and incentivizing water conservation. The NMSU employee recalled meetings he attended several years ago in which the university brainstormed ways to *increase* its water consumption so it could make full use of (and thus not lose) its groundwater rights—an illustration of how the ever-problematic concept of beneficial use can inhibit water sustainability. He and the city councilor also discussed improvements the city could make when it comes to managing water, such as investing more in stormwater infrastructure and water-smart landscaping practices like xeriscaping. While they recognized that Las Cruces has made some

strides in recent years in terms of reducing per-capita water consumption, they seemed to feel the city still has much room to improve upon how it manages its limited water resources.

### **Drought and climate change**

Climate also plays a major role in local water issues in Las Cruces. The city sits in the northwestern corner of the Chihuahuan Desert, where precipitation averages around eight to nine inches per year (LeRoy and Garfin 2017). About half of this precipitation comes during the summer monsoon season (LeRoy and Garfin 2017). As is common in arid regions, annual precipitation in Las Cruces has varied considerably year to year and decade to decade, with several multi-year wet and dry periods having been recorded over the past two centuries (LeRoy and Garfin 2017; Phillips, Hall, and Black 2015). Since the early 2000s, however, the Las Cruces area has been experiencing a particularly pronounced dry period due to widespread drought conditions that have been affecting the southwestern United States over the past two plus decades. As mentioned in Chapter One, this “megadrought” was recently estimated to be the worst the Southwest has seen in the past 1,200 years (based on measurements of regional soil moisture deficits) and has largely been fueled by anthropogenic climate change (Williams, Cook, and Smerdon 2022).

Each interviewee identified drought and/or climate change as a major area of concern in their respective lines of work. The NMSU employee, the city councilor, and another interviewee who works for the New Mexico Environment Department’s (NMED) Surface Water Quality Bureau brought up the relationship between drought and city water supply. In addition to discussing the negative effects of reduced precipitation and changing runoff dynamics on aquifer recharge, they also expressed apprehension over how climate change will impact water

availability in Las Cruces long term. The city councilor noted that while urban water consumption has been going down, a future where the city has “50 percent less water” due to climate change might render that progress worthless. Another interviewee who works with the New Mexico Water Resources Research Institute (NMWRRI) echoed these apprehensions, describing the megadrought as a “crisis” and citing a need for more local research into drought response and water budgeting. The fifth interviewee, a high-level employee at Elephant Butte Irrigation District (EBID), spoke at length about how recent dry conditions, which were preceded by a prolonged wet period, have thrown local farmers for a loop:

The wet cycle was something that we all got used to.... And then came 2003, and that’s when [Elephant Butte] lake started receding.... It started receding in ’99, and by 2003 we realized we wouldn’t have a full allotment for our farmers.... I think we started with about an eight-inch allotment, maybe twelve. So from three feet down to twelve [inches] was a huge change in the way we operated.

The “receding” of Elephant Butte Reservoir alluded to by this interviewee has been a particularly pressing concern for the Las Cruces area, whose agricultural industry relies on the reservoir for most of its irrigation supply. Partially due to drought and climate change, Elephant Butte Reservoir has shrunk drastically in recent years. As recently as 2018, it fell to 3 percent of its total capacity (Paskus 2020). Currently, it sits at just 13.2 percent of its total capacity (TWDB 2022). As a result of this, EBID farmers will receive just five inches of water per acre of land this coming summer compared to the full allotment of thirty-six inches (Pskowski 2022).

Another climate issue commonly referenced by interviewees was reduced snowpack in the southern Rocky Mountains. The southern Rockies, which are home to the headwaters of the Rio Grande and many of its main tributaries, have been hit hard by drought and climate change in recent years, reducing the amount of water supplied to the Rio Grande from spring snowmelt (Blythe and Schmidt 2018; Phillips, Hall, and Black 2015). Interviewees attributed much of the local concern over water scarcity to this issue. The city councilor framed declining snowpack as

one of the main climate-change-related issues impacting Las Cruces, pointing out that the city gets “most of [its] water from snow in the mountains.” The NMWRRRI researcher identified reduced snowpack as a focal point for water supply concerns, characterizing it as one of the reasons that “water scarcity is on everybody’s mind.” The interviewee from EBID also talked about snowpack, noting its importance in determining how much water will be allotted to farmers during the irrigation season. In many respects, it almost seems as though the weather in the distant southern Rockies is as important (if not more important) to the water situation in Las Cruces as local weather patterns.

## **Agriculture**

Agriculture itself, not just how it has been impacted by water supply issues, is a third major topic area when it comes to water in Las Cruces. As mentioned previously, the Las Cruces area houses a fairly robust agricultural industry despite its arid environment. Its location in the fertile Mesilla Valley, which straddles the Rio Grande between Radium Springs and western El Paso, has enabled the production of cash crops such as pecans, cotton, alfalfa, corn, onions, and chilis as well as a sizeable cattle industry (NMED 2011; Phillips, Hall, and Black 2015). All this requires a great deal of water. In the state of New Mexico, irrigated agriculture accounts for about 76.3 percent of all water usage (Magnuson et al. 2015), and interviewees confirmed that this number is about the same for the Las Cruces area.

Statistics like this have often made agriculture a scapegoat for water scarcity concerns in the arid West. Writers and scholars often characterize agriculture as an “inefficient” use of water in the region, noting discrepancies between the amount of water it consumes (70 to 90 percent of local water resources in most places across the West) and the amount of revenue it generates for

local economies (usually less than 30 percent) (Mott 2017; Reisner 1993; Sevigny 2016). Especially in places like California’s San Joaquin Valley, the practice of growing thirsty crops like almonds in an arid environment has been decried as a reckless use of water (Mott 2017). Similarly, criticisms of water engineering and the notion of making the desert “bloom” are also often implicitly (and sometimes explicitly) directed at agriculture. Reisner, for example, frequently casts government-subsidized water engineering projects as “socialism” in service of water-needy elites, those elites often being rich hobby farmers or corporate farming giants.

While interviewees generally stopped short of blaming agriculture for water issues in Las Cruces, those who did not work in agriculture struggled to see how the industry would fit into the local water picture going forward. The NMED employee described the current level of agricultural production in the Las Cruces area as “not sustainable.” The NMSU employee voiced concern about the water-intensive nature of growing crops like pecans, noting the irony of practicing flood irrigation (which is commonly used for pecans) in a desert. He also said he would like to see more innovation in the agricultural sector around conserving water and criticized the industry’s growth-oriented mindset, which he argued gets in the way of finding water-saving solutions. For many interviewees, the sheer amount of water required for agriculture seemed to cast doubt on whether the industry will survive in the Las Cruces area long term. When asked about what Las Cruces might look like in the future, all interviewees except the EBID employee said they expect some level of decline in local agriculture over the coming decades if the industry does not adapt.

Despite its disproportional share of the local water budget and the questions surrounding its future viability, however, agriculture in Las Cruces does not seem to be seen as a villain when it comes to local water issues, at least not to the extent it sometimes is in other parts of the arid

West. Interviewees who discussed the possibility of agricultural decline did so rather somberly, characterizing it as a process that would likely entail “a lot of sad moments” and “really hard decisions.” The city councilor indicated he does not feel that the city and farmers are adversaries when it comes to water, noting that the two groups have historically relied on different water sources (surface water for farmers versus groundwater for the city) and that he “[does] not see agriculture as taking water away from the city.” Even the NMSU employee, who was the most critical of all the interviewees when it came to agriculture, prefaced his criticisms by saying that he does not like to “pick on agriculture.”

Some interviewees went as far as to defend agriculture. The researcher at NMWRRI noted that she works closely with farmers and thinks of them as valuable partners when it comes to local watershed protection efforts:

If the land management goes, the environment goes. I think some environmentalists would be happy to see ranchers fail, but I can tell you that [the Bureau of Land Management] is not gonna be able to fix all that land on their own, so we’re much better off finding ways to help the last few remaining ranchers on the land take care of it.

The EBID interviewee, expectedly, also defended agriculture. He pushed back on criticisms surrounding the industry’s water usage, arguing that flood irrigation aids groundwater recharge (a claim that may hold merit according to recent research [Pool et al. 2021]), and touted new technologies EBID has been using to monitor and conserve surface water and groundwater. He also pushed back on the dichotomy often drawn between urban and agricultural water use, noting that much of the food that farmers in places like Las Cruces grow feeds people in cities—an argument sometimes seen in broader dialogues about agricultural versus urban water consumption in the arid West (Mott 2017). When these types of arguments were brought up with other interviewees, they often acknowledged that they carried some validity. The NMSU employee, for instance, conceded that flood irrigation might indeed provide some groundwater



recharge. The impression all this gave is that water professionals and leaders in Las Cruces, or at least the ones I spoke to, generally prefer to steer clear of pointing fingers at agriculture despite their recognition of the tensions that surround the industry when it comes to water. Perhaps for this reason, it appears those tensions have not yet reached a boiling point at a local scale.

## **The Rio Grande**

Another key component of the water story in Las Cruces, and one in which agriculture is also heavily involved, revolves around declining flow levels in the Rio Grande. A recent study found that the Rio Grande upstream from the Rio Conchos confluence, located about 200 miles southeast (downstream) of El Paso, is currently only flowing at about 5 percent of its estimated natural capacity (Blythe and Schmidt 2018). In Las Cruces, where the Rio Grande once flowed perennially even during dry periods, the river is often completely dry (NMED 2011).

As alluded to earlier, drought, climate change, and related issues like reduced snowpack near the Rio Grande's headwaters are one of the main contributors to the river's declining flow levels (Blythe and Schmidt 2018). However, human activity along the Rio Grande has also been a contributor, particularly in the stretch of the Rio Grande that runs through the Las Cruces area. The Rio Grande between Elephant Butte and El Paso has been heavily dammed and channelized since the completion of Elephant Butte Dam in 1916, mainly to supply water for irrigation but also for purposes such as flood control (Phillips, Hall, and Black 2015). While this helped the Mesilla Valley to develop into an agricultural powerhouse, it has also created a situation today in which Rio Grande water is stored in reservoirs for agricultural use for most of the year instead of being allowed to flow down the river channel (NMED 2011; Phillips, Hall, and Black 2015).

This leaves the Las Cruces area with a dry riverbed for most of the year except during the irrigation season.

Interestingly, interviewees did not comment specifically on agriculture's role in depleting the Rio Grande, perhaps a further indication of the desire to maintain cooperation between the agricultural industry and the environmental sector. Instead, they more often chose to focus on efforts to combat the degradation of the Rio Grande. The NMWRRI researcher and the NMED employee highlighted recent efforts aimed at "reconnecting" and revitalizing floodplains in the Rio Grande watershed. The NMWRRI researcher talked about the ways water engineering has disrupted the riverway's natural flood regimes, which are critical to local ecological functioning, but concentrated more on the ways that issue has (increasingly successfully) been combatted. The city councilor also talked about riverway restoration, expressing excitement over plans to rejuvenate parts of the Rio Grande in Las Cruces using treated wastewater. The employee from EBID spent a great deal of time talking about how the district has been a partner to riverway restoration efforts. He discussed a recent initiative in which EBID collaborated with Audubon New Mexico and the U. S. International Boundary and Water Commission (IBWC) to set up a riparian bird habitat restoration project on land along the Rio Grande that held agricultural water rights. He framed the project as a way irrigators and environmentalists might find common ground when it comes to the Rio Grande:

They call for an irrigation just like a farmer does—they place an order, we deliver to a cottonwood patch. And now they're growing trees—cottonwoods—thirty foot tall, because we're irrigating them.

While the Las Cruces portion of the Rio Grande continues to face serious challenges, narratives such as these demonstrate a strong local recognition of the issue and would seem to support the idea discussed in Chapter One that the arid West could serve as a pilot site for innovation and cooperation around water.

## **Texas v. New Mexico**

A final water issue that surfaced during interviews has to do with recent legal conflicts surrounding dwindling water supplies in the Las Cruces area. As mentioned in Chapter One, the recent Supreme Court case between Texas and New Mexico over Rio Grande water allotments is among the latest in a long line of judicial battles over water that have been fought between southwestern states. Curiously, the Las Cruces area seems to be caught in between the two opposing sides of the dispute.

It began in the early 2000s, when the El Paso County Water Improvement District (EPCWID) accused EBID of not delivering the full allotment of Rio Grande surface water across the Texas border (Tory 2018). According to EPCWID, increasing groundwater withdrawals by Mesilla Valley farmers were adversely impacting the Rio Grande's flow (Prokop 2021; Tory 2018). The two sides met to resolve their differences in 2008, with EBID agreeing to increase the amount of surface water it would deliver to EPCWID as long as Mesilla Valley farmers could continue pumping groundwater (Prokop 2021; Tory 2018). Three years later, the New Mexico attorney general sued EBID, EPCWID, and the Bureau of Reclamation, who presided over the 2008 EBID-EPCWID agreement, alleging that it promised too much water to Texas (Prokop 2021; Tory 2018). Texas then countersued New Mexico in 2014 under the same allegations related to groundwater pumping that had been at the center of the initial EBID-EPCWID dispute (Prokop 2021; Tory 2018). The two sides are currently negotiating to avoid a trial resumption and are reportedly getting close to reaching a settlement (Bryan 2022).

Two interviewees discussed the Texas v. New Mexico case. The city councilor discussed the uncertainty it has created when it comes to making water management decisions:

The bottom line on that is that we don't know what to do about water because we're being sued by Texas.... It's coming to a head pretty soon, but it's taking

forever.... We know there's going to be a shortage, it's just that we don't know who gets the water. Will Texas get more? Will we do something different?

The EBID employee spoke similarly about how Texas v. New Mexico has seemed to paralyze the local water management system, noting that it has put the brakes on the already lengthy and litigious process of stream adjudication in the Las Cruces area. As part of this discussion, he also reflected on the case's relationship to shortcomings in western water law that treat groundwater and surface water as separate entities even though they are very much connected. Toward the end of the interview, he expressed apprehension at the prospect of leaving important water allocation decisions to the courts, arguing that the question of who gets what amount of water is best left to local stakeholders. He expressed optimism that these stakeholders could cooperate with one another if given the chance, contending that their mutual understanding of how much water they need and how much they can afford to give up would allow them to reach a more just and mutually beneficial final ruling on the issue than a judge could provide.

The impact of Texas v. New Mexico case on the Las Cruces area demonstrates both the inefficiencies of water law in the arid West and the ways water can act as an instigator of conflict in the region. What had been an agreement between two parties (EBID and EPCWID) over water has turned into a dispute as more powerful stakeholders (the states of New Mexico and Texas) have inserted themselves into the negotiation. The resulting situation is one in which an irrigation district (EBID) has been sued by its own state government and water management decisions have been put on hold at a time when water-related innovation and adaptation are desperately needed.

## **Looking toward the future**

Many of the water issues affecting the Las Cruces area mirror those seen across the arid West. The city and its surrounding agricultural landscape are largely products of the twentieth-century water engineering era, but they are now facing dwindling water supplies despite the water security engineering efforts were expected to create. Climate change poses further threats to water security as the environmental issues produced by engineering make themselves increasingly apparent. On top of all this, shortcomings in water law and policy have been laid bare as different groups of stakeholders clash over local water resources.

Despite these challenges, however, we also see some more positive water narratives playing out in Las Cruces. Interviewees recognized that tensions exist between different local water stakeholders, yet their general attitude seemed to be one of courtesy and cooperation rather than criticism and blame. Additionally, partnerships between local groups that have often found themselves in opposition with one another, such as the agricultural industry and the environmental sector, hint at the possibility that water scarcity could breed cooperation and innovation.

The mixture of negativity and positivity surrounding water in Las Cruces leaves us with a somewhat unclear picture of the local water outlook. Interviewees' responses when asked about the future of Las Cruces ranged from rosy to rather bleak. The EBID employee was optimistic that current efforts to monitor and conserve water resources will see Las Cruces through either until the end of the megadrought or until ways to harness untapped water resources, such as desalination, become viable. The NMSU employee's outlook, on the other hand, leaned much more toward the pessimistic side of the spectrum. He talked about how his concerns over water

scarcity have reached a point where he has begun encouraging family members to move away from the arid West:

I said, “Go somewhere where there's water and there's gonna be water.” I think human nature is we don't worry about it... until it's critical—until the city wells run dry or the campus wells run dry. We just don't seem to care about it. Humans are incredibly short-sighted. So I'm definitely pessimistic when it comes to this.

The other interviewees landed somewhere in between optimism and pessimism. They recognized that immense hardship may be ahead for the Las Cruces area but maintained faith that it can weather coming crises successfully if the right policies and strategies are implemented. The NMWRI researcher summed up this sentiment astutely, characterizing the current situation in Las Cruces as both a “really exciting time” and a “really scary time”—exciting in that impactful water solutions may lie just around the corner, and scary in that water-related social, economic, and environmental upheaval may also be near at hand. Las Cruces, like much of the arid West, is at a crossroads between two very different futures—one where it becomes part of a cautionary tale about overburdening natural resources, and one where it becomes a case study in innovation and sustainability. While it is still difficult at this point to predict which direction Las Cruces will go, one thing that interviewees identified as important to putting the city on a brighter path is fostering greater public engagement around water issues. Multiple interviewees asserted that getting people to think about, appreciate, and understand water issues to a greater degree will be essential components of water conservation, water cooperation, watershed restoration, and other efforts to address contemporary water concerns. Said the NMSU employee:

If everybody had a high level of awareness and understanding of our water system—the hydrologic cycle, our day-to-day interaction with it.... And that means you and me and our houses. It means the pecan farmers. It means cities who have twenty wells to manage. If everybody had a very strong awareness and desire... I think opportunities abound.

This subject of public awareness and outreach is precisely what the following two chapters of this thesis will focus on. As we reach a critical point in the long and tumultuous history of water in the arid West, new and innovative ways of fostering discourse around water and elucidating the experiences of communities confronting water issues have a key role to play in pushing the region toward a better water future. The following pages will explore one new way this goal might be approached—one that utilizes collaboration and creativity to present water issues in a way that is both relatable and engaging for broader audiences.

### CHAPTER THREE: PARTICIPATORY PHOTOGRAPHY

The following chapter will trace the origins and past uses of participatory photography as a methodology and discuss its potential as a geo-humanistic approach to studying human-environment relationships. Though participatory photography has been applied extensively within the social sciences and geography, its use in the areas of human-environment geography and the geohumanities has been rather scant. This is surprising, considering it espouses ethics that are largely foundational to both fields, including community engagement, community empowerment, and the generative power of creativity. I will argue here that participatory photography, due to its ability to shed light on people's experiences of place and the environment, is a tool well-suited for examining human-environment relationships and fostering productive public dialogue about environmental issues. I will also argue that approaching participatory photography from a geo-humanistic angle can boost its methodological richness and analytical potential.

#### **What is participatory photography?**

Broadly, participatory photography involves asking members of a community to take and submit photographs depicting aspects of their everyday lives that relate to the research topic (Hergenrather et al. 2009; Liebenberg 2018; Wang and Burris 1994). The photos are thought of as a participant-led visual conversation of sorts—a way for participants to provide insight into the research topic on their own terms in a way that cuts across social, economic, political, and linguistic barriers (Hergenrather et al. 2009; Liebenberg 2018; Wang and Burris 1994, 1997). Though no two participatory photography studies are carried out exactly the same way, they generally follow several key steps:



- Recruiting participants from the community to take photographs. Often, this involves supplying cameras and training participants in basic photography (Belcher and Roberts 2012; Berbés-Blázquez 2012; Bignante 2010; Maclean and Woodward 2012; Margulies 2019; Wang and Burris 1994).
- Allowing participants to interpret the photos they take, usually via an interview (Berbés-Blázquez 2012; Bignante 2010; Kuehne and Bjornlund 2010; Maclean and Woodward 2012; Margulies 2019; Wang and Burris 1994).
- Having participants' share and discuss their photos with other participants and/or with their community, usually through some type of focus group or community forum (Baldwin and Chandler 2010; Berbés-Blázquez 2012; Bignante 2010; Kuehne and Bjornlund 2010; Maclean and Woodward 2012; Margulies 2019; Wang and Burris 1994).
- Often (but not always), sharing participants' photos with people outside of the community, usually policymakers or the broader public. This may be done via a presentation by the researchers (Wang and Burris 1994; Wang et al. 2004) or via a publication of some kind featuring participants' photos (Baldwin and Chandler 2010; Margulies 2019).

The theoretical and methodological roots of participatory photography lie within participatory action research (PAR) (Kindon 2016; Wang and Burris 1994, 1997). PAR seeks to empower communities holding stake in the research topic by involving them in the production, collection, and analysis of data (Cameron and Gibson 2005; Hall 2005; Kindon 2016). It emphasizes the importance of the researcher's positionality and relationship with participants; the goal is for the research process to be collaborative rather than extractive. As Kindon (2016, 351) puts it: "...a PAR researcher does not conduct research on a group but works with them to

achieve change that they desire.” Rather than simply consulting with the communities being researched, PAR allows community members to become “co-researchers” in a sense (Kindon 2016, 350), highlighting their perspectives, ideas, and needs in an effort to challenge power structures and spur social change (Cameron and Gibson 2005; Hall 2005; Kindon 2016).

Participatory photography operates off these principles, approaching members of communities being researched as “authorities on their own lives” (Wang and Burris 1994, 174) and seeking to interrogate and make more equitable the researcher-subject power dynamic (Wang and Burris 1994, 1997). Photography is used as a means for achieving these goals due to its accessibility and its capacity to engage and empower participants through affective and creative expression (Margulies 2019; Wang and Burris 1994, 1997).

Wang and Burris (1994) are often credited with conducting the first major participatory photography study and establishing the methodology’s practices and aims. Working with women in rural Chinese communities, Wang and Burris used participatory photography to allow participants to identify and comment on economic development and reproductive health challenges. Wang and Burris (1994, 1997) cite participatory photography as a form of PAR whose ease and accessibility makes it capable of fostering increased inclusion of marginalized voices in sociopolitical discourse and policy. Following Wang and Burris’s study, participatory photography has been picked up by other PAR and social science scholars, especially in fields concerned with social justice, community development, and public health (Belcher and Roberts 2012; Hergenrather et al. 2009; Liebenberg 2018; Maclean and Woodward 2012). Geography in particular is one of the fields in which participatory photography has become increasingly popular. Participatory photography studies are fairly abundant in geographic journals (e.g., Alam, McGregor and Houston 2017; Bignante 2010; Maclean and Woodward 2012; Margulies

2019; Mitchell, Kearns, and Collins 2007; Volpe 2019), and the methodology has also begun to make appearances in geographic methods textbooks (Kearns 2016; Pyyry, Hilander, and Tani 2021). It seems that as geographers and other social scientists have grown more conscious of the problematic power relationships embedded in community-based research, methods like participatory photography have become increasingly relied upon to ensure the voices of communities are heard.

### **Participatory photography in human-environment research**

Despite its growing popularity in geography and other social science fields that engage with environmental subjects, participatory photography has only sparingly been used in the broader environmental research arena. The small handful of participatory photography studies that have dealt with environmental subjects are largely geared toward testing and evaluating the methodology (Baldwin and Chandler 2010; Belcher and Roberts 2012; Berbés-Blázquez 2012; Bignante 2010; Maclean and Woodward 2012), and many are components of larger research projects (Belcher and Roberts 2012; Berbés-Blázquez 2012; Bignante 2010). Some human-environment researchers have noted the lack of previous participatory photography work in their fields and advocated for wider adoption of the methodology (Belcher and Roberts 2012; Berbés-Blázquez 2012). Despite this, however, human-environment researchers still seem to be in the exploratory phase of integrating participatory photography into their methodological arsenal, as evidenced by the small handful of participatory photography studies on human-environment relationships published in the past ten years (Alam, McGregor, and Houston 2018; Bell 2015; Berbés-Blázquez 2012; Maclean and Woodward 2013; Margulies 2019).

In areas like sustainability, natural resource management, environmental advocacy, and environmental justice, just to name a few, there is growing focus on addressing issues of power, combatting marginality, and engaging communities in brainstorming bottom-up environmental solutions that meet their needs. This has been noted both by scholars like Julian Agyeman (2013), who has written broadly about the idea of “just sustainabilities,” and researchers who have done community-based work in those fields (Baldwin and Chandler 2010; Belcher and Roberts 2012; Maclean and Woodward 2012; Margulies 2019). The work of these scholars gets at a number of crucial questions for the broader field of human-environment studies: How do communities interact with and relate to the natural environment? How are changes and disturbances to the natural environment seen, understood, and experienced by different communities? How might we identify community needs related to the natural environment and make sustainability efforts more just and equitable?

Participatory photography, as a community-engaged approach to understanding diverse perspectives and getting people talking about key issues, is well suited to handle these questions and the wide array of subject matter with which they engage. Human-environment research that has used participatory photography, though scarce, has dealt with a variety of themes, including “more-than-human” geographies<sup>3</sup> (Alam, McGregor, and Houston 2017; Margulies 2019), local and indigenous perceptions of nature (Bignante 2012; Maclean and Woodward 2012), natural resource management and ecosystem services (Belcher and Roberts 2012; Berbés-Blázquez 2012), and human experiences of environmental issues (Baldwin and Chandler 2010; Bell 2015; Kuehne and Bjornlund 2010). Studies that have sought to assess participatory photography’s utility and applicability have found the methodology to be successful not only in accomplishing

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<sup>3</sup> More-than-human geography is an area of inquiry within the broader discipline of geography aimed at understanding “the contribution of non-human agencies in shaping places and practices” (Alam, McGregor, and Houston 2018, 256).

the investigative goals of the research, but also in fostering researcher-participant trust and collaboration, facilitating cross-cultural communication, and cultivating dialogue and knowledge exchange around environmental issues (Belcher and Roberts 2012; Berbés-Blázquez 2012; Maclean and Woodward 2012). Considering these early results, it is exciting to think about the types of insights participatory photography might produce should it be put to further use in human-environment research.

### **Participatory photography from a geohumanities perspective**

The geohumanities, a burgeoning subdiscipline in geography that engages heavily with environmental topics and creative, participatory research methods, is another field within which participatory photography should increasingly find a home in the coming years. In fact, there is already a good deal of existing work within the geohumanities that resembles participatory photography. Peralta (2011), for instance, worked with schoolchildren in San Diego and Tijuana to create short animations depicting their perceptions of space and place along the US-Mexico border. Kanarinka (2011) investigated local perceptions of place in Cambridge, Massachusetts by crowdsourcing and mapping alternative place names. Magrane (2019) explored the capacity of poetry to strengthen human-environment relationships in southern Arizona by gathering and presenting eco-poems written by the local literary community. These projects not only share participatory photography's focus on collaborative community art, but also its goals of including communities in the knowledge creation process, analyzing relationships between people and place, and exploring ways to foster public dialogue, challenge conventional wisdom, and destabilize entrenched power structures.

Participatory photography theory and practice also resembles geohumanities theory and practice in many ways. Though geohumanities projects tend to intersect more heavily with the arts than participatory photography projects do, often engaging directly with professional and/or amateur artists and fine art theory (Hawkins 2015; Magrane 2019), participatory photography at its core has a distinctly artistic bent to it. The methodology was initially developed as an alternative form of documentary photography (Wang and Burris 1994, 1997), which though not always considered a “fine art” is certainly a robust and rigorous art form in its own right. Participatory photography researchers also often read into the artistry behind the works participants produce much the same way participatory geohumanities researchers do. Wang and Burris’s (1994) interpretation of a participant’s photo of a woman standing in a rice field serves as a good example:

...one woman took many photos that showed a tiny, distant speck of a person engulfed in a field of rice. When encouraged to take some pictures from a closer range next time, she said she had wanted to show that one woman must grow this huge piece of land.... Her imaginative photo accomplished exactly what she wanted. She made the woman in the field look like an ant to show that relative to her herculean task she *is*.

However, there are also many instances in which participatory photography researchers seem to shy away from reading participants’ photos as works of art, treating photos more like simple documentations of participants’ lives rather than artistic interpretations of their worlds as Wang and Burris do in the quoted passage above. Bearing this in mind, the geohumanities might boost participatory photography’s methodological richness and analytical potential by helping it re-engage with participants’ artistry and creativity.

The Desert Hydrologies Project, which will be detailed in the next chapter of this thesis, sought to accomplish the above goal in several ways. For one, it explored what a participatory photography project looks like in a community containing experienced photographers and other

artists well-versed in communicating through visual language and aesthetics. A number of the participants in the project were amateur and even (semi)professional photographers, and quite a few were experienced with other forms of visual art. As will be discussed later on, the “artist perspective” lent by these participants led to some insightful and powerful representations of water and water issues. Encouraging participants to take additional artistic license with their photos, such as editing them and/or strategically utilizing composition, lighting, and color during the photography process, also gave participants more ways to communicate ideas through their photos.

Other participatory photography studies have employed similar tactics to allow participants to speak more forcefully through their photos. In Baldwin and Chandler’s (2010) study examining attitudes toward climate change and sea level rise in coastal Australia, for example, the researchers highlight one participant’s photo depicting a man sitting in a half-submerged beach chair holding a sign reading: “What CO<sub>2</sub>?” This staged photo was a bit of a departure from the documentary style of photography that participatory photography studies traditionally encourage, but it enabled the participant to communicate their message in a more clear and impactful way. Desert Hydrologies participants were similarly able to more freely express their thoughts around what they photographed through editing and other artistic choices they were encouraged to consider during the photography process.

### **What’s in a label? Participatory photography versus photovoice**

Readers already familiar with participatory photography might be wondering why I have not yet used the term “photovoice” or why I have not chosen to refer to this research as such. Many (if not most) participatory photography studies adopt the “photovoice” label, which was

originally coined by Wang and Burris (1997) as part of an effort to establish a clear identity for the methodology. This was done after the conclusion of their initial participatory photography study with women in rural China, the methodology of which they described using the term “photo novella” (Wang and Burris 1994). While participatory photography and similar labels are often used interchangeably with photovoice, there are some factors that I feel warrant consideration when deciding whether or not the photovoice label is useful for a given study.

Most significantly, studies that adopt the photovoice label tend to focus on marginalized and/or non-western communities whose members have little to no photography experience (e.g., Berbés-Blázquez 2012; Margulies 2019; Wang and Burris 1994; Wang et al. 2004). Though Wang and Burris (1997) argue that the photovoice approach is flexible and can be applied in varying types of communities and geographic contexts, it seems that most photovoice studies have been conducted in settings where the methodology’s tenets of cross-cultural communication and community empowerment can make the most difference. As a result of this, photovoice studies, even those that deal with different issues in different parts of the world, are largely unified by a focus on experiences of marginality. This is something that, intentionally or not, has come to define photovoice in some respects. While the practices and procedures of photovoice can be applied to many different subjects, it has largely geared itself toward providing a glimpse of the world through the eyes of people whose voices and perspectives are not usually given due attention. While studies carrying the photovoice label that break with this convention have been done (e.g., Baldwin and Chandler 2010), they seem to be fewer and further between.

Another complicating factor is that some studies that largely follow photovoice conventions use other labels to describe their methodology. Some of the more common ones are “photo elicitation” (Bignante 2010; Kuehne and Bjornlund 2010), “photo response” (Alam, McGregor,



and Houston 2017) and simply “participatory photography” (Alam, McGregor, and Houston 2017; Belcher and Roberts 2012). These studies often cite photovoice as the inspiration or foundation behind their methodology, but rarely do they provide an explanation for why they opted for an alternative label.

This begs the question: When should a study be labeled photovoice, and when does a different label make sense? Nobody likes to get hung up on semantics, and I do not think that certain types of participatory photography studies that break with convention should be disqualified from using the photovoice label. However, I do feel it is important, at least in the context of this research, to make a distinction between photovoice and the broader label of participatory photography so as not to obscure or misrepresent the aims of the project around which this thesis is centered. The Desert Hydrologies project draws from the photovoice methodology and shares aims similar to those of photovoice, such as reading perceptions of place, fostering community inclusion in research, and cultivating public dialogue on current issues. However, it does not deal with the subject of marginality, and it also employs some procedures and practices that are not traditional to photovoice, such as working with experienced photographers and encouraging forms of photography other than the traditional documentary style. Because of these differences, which I will discuss in more detail in Chapter Four, I have chosen to refer this research using the more all-encompassing term participatory photography rather than photovoice.

## CHAPTER FOUR: THE DESERT HYDROLOGIES PROJECT

In October of 2021, I put out a simple (if somewhat nebulous) request to members of the Las Cruces community: Send in photos that you feel encapsulate, or at least begin to encapsulate, how you see, understand, and interact with water in the context of our local arid environment. The following pages will detail what has occurred over the several months since that request was dispatched. The project, named “Desert Hydrologies” in an attempt to articulate the varying ways participants depicted their perspectives on and roles within the desert water cycle, was an exercise in both reading and communicating people’s experiences of place in a time and location where environmental upheaval appears to be at the doorstep.

As discussed in the first two chapters of this thesis, the numerous water issues Las Cruces and the rest of the arid West are facing have changed the way many people understand the region’s history and its population’s relationship with the natural world. The Desert Hydrologies project set out to gain insight into how this shift in understanding is operating at a local level and to evaluate participatory photography as a means for studying and cultivating dialogue around environmental issues. The project was ultimately successful on both of these fronts. Not only did it bring to light different ways in which broader framings of water and water issues can be understood through lived experiences at a local scale, it also created conversation about water among both participants and those who viewed the project exhibit. As places around the world like Las Cruces confront the consequences of global environmental change and human alteration of the environment, endeavors like Desert Hydrologies that use critical and creative methodologies to understand the social dynamics of environmental issues will be increasingly important. Hopefully, what follows below can provide useful material for future participatory projects in human-environment research (photography or otherwise) to draw upon.

## **Participant recruiting, forms, and surveys**

The Desert Hydrologies project consisted of four stages. The first was participant recruiting and the gathering of photo submissions and survey data, which took place between mid-October 2021 and the end of February 2022. The second stage was participant interviews, which took place between mid-February and mid-April 2022. The third stage was building the online project exhibit, which was launched in late April 2022. The final stage was data analysis, which took place after the exhibit was released.

I began distributing the recruiting call for Desert Hydrologies on October 18, 2021. I initially set January 9, 2022 as the photo submission deadline, but I later extended the deadline to February 28, 2022 to allow time to recruit more participants. The recruiting call was a one-page flyer (Appendix A) that briefly described the Desert Hydrologies project, its goals, and what participating in the project would entail. It also briefly went over photo eligibility requirements and instructed people interested in participating to contact me via email. Methods for distributing the flyer included:

- Emails to local groups and organizations with whom I and/or my colleagues at NMSU were familiar. This included the New Mexico Water Resources Research Institute (NMWRRI), The Mesilla Valley Audubon Society (MVAS), the Doña Ana Photography Club (DAPC), and participants in the Literary Inventory of the Organ Mountains – Desert Peaks project.
- Announcements in local publications and news outlets, including the Las Cruces Bulletin, Luminosity (the DAPC’s monthly magazine/newsletter), the DAPC website, and NMSU Hotline (NMSU’s daily news dispatch). For some of these, the wording of the recruiting

call was altered slightly to accommodate the publications' communication conventions and word count constraints.

- Sharing on social media platforms, including Facebook, Instagram, and Reddit (via the r/LasCruces subreddit).
- Posting in physical locations around Las Cruces, including breweries, coffee shops, art galleries, museums, parks and recreation areas, outdoors stores, and locations around the NMSU campus.

After receiving an inquiry email from a prospective participant, I would send a reply containing a photography “prompt” (Appendix B). This one-page document provided additional information about the project and step-by-step instructions for participating. The prompt directed participants to first take one or two photos (two being the limit) depicting how they “perceive or relate to water in the context of our arid local environment.” Next, the prompt instructed participants to submit their photo(s) digitally via an online photo submission form (Appendix C), which also contained a short survey. Participants who chose to submit two photos were required to fill out the submission form and the accompanying survey twice. The remaining steps of the participation process were optional. Participants who wanted to take part in the virtual exhibit were directed to fill out an “exhibit entry form,” and those who wanted to provide additional information about themselves were given the option of filling out a supplemental demographic survey. All forms and surveys were created with and hosted on Survey123, an online data collection platform by ESRI.

The prompt encouraged participants to think freely and creatively with their photo submissions. The final section of the prompt, titled “What kind of photo(s) should I take,” explained that photos could depict any subject that participants felt to be related to the water

theme. This included (but was not limited to) natural water features (e.g., lakes and rivers), anthropogenic water features (e.g., reservoirs, canals, and irrigation ditches), weather (e.g., rain and snow), or things more abstractly related to water, such as plants, animals, arroyos, gardens, lawns, golf courses, bathtubs, faucets, toilets, etc. This section of the prompt was designed to get participants thinking about the multiple ways they might approach their photography and to make it clear to them that a variety of ways of capturing water were acceptable for the project.

There were only a few restrictions on photo eligibility. Photos were required to have been taken by the participant and not anyone else, not include any sexual, obscene, or violent content, and not have involved putting the photographer or anyone else in danger. Photos were also required to have been taken within forty miles of the Las Cruces area (to keep the focus of the project local) and after the participant inquired about the project (so that the influence of the project theme on the photography process could be assessed). When I extended the photo submission deadline, I expanded the photo location radius to eighty-five miles outside of Las Cruces and allowed participants to submit photos they already had on hand if they preferred not to take new ones. I made these changes for a couple of reasons. For one, I realized that there were potential photo locations outside the initial forty-mile radius that were relevant to the local water situation (e.g., Elephant Butte Dam and Reservoir). It also became apparent after the first photo submission deadline that requiring people to take brand new photos for the project was inhibiting participation. Only seven people submitted photos before the first deadline, and many who inquired about participating before the first deadline asked if they could submit photos they had already taken. Though the participants who did take new photos provided some valuable commentary on the photography process, I received far more photo submissions after the requirement of taking new photos was lifted.

The survey questions in the photo submission form invited participants to provide more information about their photos and their connection to water. Participants were first asked to provide their names and think of titles for their photos. Next, they were asked where and when (approximately) their photos were taken and what type of camera they used. The remaining questions were more open ended, asking participants to describe the subjects they chose to capture, what kinds of artistic decisions and edits they made (if any), how their photos related to the water theme, and if the process of taking (or selecting) their photos influenced the way they think about water. After answering these questions, participants were asked if they would like to take part in the project exhibit and if they would be interested in being contacted for an interview. To see the questions asked on the photo submission form, see Appendix C.

The exhibit entry form (Appendix D) was required for all who wanted to participate in the exhibit. In addition to having participants formally consent to have their photos featured, this form also gave participants the opportunity to specify how they would like to be credited in the exhibit and have their social media handles and websites included with their exhibit entries. Participants were also given the option to submit a brief artist statement to include in the exhibit via the photo submission form.

I designed the supplementary survey (Appendix E) to collect basic demographic data, measure participants' level of engagement with environmental issues, and assess their experience with photography. I had initially planned to gather this information using the photo submission form, but I decided to use a separate, optional survey to avoid discouraging participation by making the photo submission form too long. I felt information about participants' photos and how they engage with the water theme was more important, and I anticipated that even just a sample of the participant pool's demographic makeup would be informative. The supplementary

survey collected demographic using basic census questions—preferred gender pronouns, age range, ethnicity, race, and annual income. The survey also asked participants how long they have been living in Las Cruces and what they do for a living. For measuring environmental engagement, the survey asked participants to rate how concerned they are about environmental issues on a Likert-type scale and select how they typically engage with environmental issues from a predetermined list of options. The final question of the survey asked participants to rate their experience level with photography on a six-tiered scale ranging from neophyte to professional. The full supplementary survey can be found in Appendix E.

### **Participant interviews**

Participant interviews began in late February, about a week before the final photo submission deadline. There was much more interest in interviews than I initially expected, so decisions had to be made regarding which participants to contact. Some participants, upon being informed of this, noted that they would be okay with not being interviewed. Out of the remaining participants, I selected interviewees primarily based on the themes their photos depicted. The goal was for each interview to provide insight into a different theme. For participants whose photos engaged with similar themes, I gave priority to the participant who submitted their photo(s) first. For instance, if there were multiple interview candidates who took photos of weather events, I would reach out to the participant whose photos came in earliest. I also gave some consideration to gender diversity when selecting interviewees, taking care to ensure the percentage of interviewees who identified as men versus women was about equal to that of the overall participant pool.

I conducted interviews both in person and via Zoom. Interviews were semi-structured and aimed at gaining additional insight into interviewees' backgrounds, the ways they think about water and water issues, and how those ways of thinking were encapsulated in their photos. Interviews started with questions that invited interviewees to share information about their lives and how they interact with water on a daily basis before moving into conversations about how their photos engaged with water issues and their personal values surrounding water. I brought copies of participants' photos to each interview (or put them on display via screen share) as a visual aid for participants. I recorded interviews using either Zoom's recording function or the recording app on my smartphone. I later transcribed them manually using Microsoft Word.

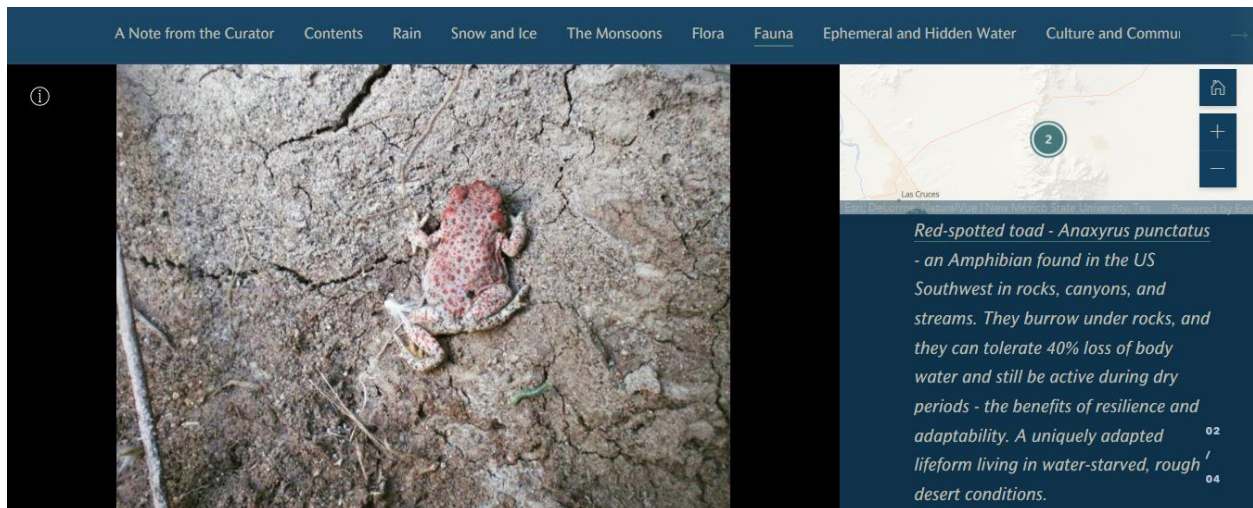
### **The Desert Hydrologies virtual exhibit**

The Desert Hydrologies exhibit went live on Earth Day, 2022 (April 22). I built the exhibit using ESRI StoryMaps, an online platform designed for creating immersive and interactive web apps that integrate multiple forms of media, including text, images, video, sound, web page embeds, and maps. I chose to host the exhibit online ([hardtb.wixsite.com/deserthydrologies](https://hardtb.wixsite.com/deserthydrologies)) rather than a physical location because it was easier from a logistical standpoint, especially due to ongoing public safety concerns related to the COVID-19 pandemic. I also had prior experience with StoryMaps that I was able to draw on while creating the exhibit.

The "Map Tour" module, which allows the user to create a series of mixed-media slides based on different point locations on a map, was the exhibit's primary building block. I sorted photos into different themed "chapters," each contained within separate Map Tours. Each Map Tour slide consisted of the participant's photo on the left side, its (approximate) location relative to other photos in the chapter on the top right, and an excerpt from the participant's survey discussing the photo beneath the map (Figure 2). If a participant chose to include their social



media handle(s), website(s), and/or an artist statement in the exhibit, I posted those items beneath the survey excerpt. Viewers were able to navigate the exhibit either by scrolling straight through or by jumping to individual chapters using navigation tabs at the top of the screen.



**Figure 2:** Desert Hydrologies virtual exhibit slide layout. Participants' photos were placed on the left with the photo's (approximate) location and an excerpt from the participant's survey on the right.

While many photos engaged with multiple themes, placing them into distinct chapters gave structure to the exhibit and acted as a preliminary step in the photo and survey analysis process. In cases where photos engaged with more than one chapter theme, I used the survey responses attached to them to determine which chapter to put them in. For example, one participant submitted two photos of raindrops dripping off a cactus. I could have placed these in either the "Rain" chapter or the "Flora" chapter, but I placed them in the "Rain" chapter because rain was the primary subject of focus in the participant's survey responses.

Though participants' photos and captions were the main features of the exhibit, I also added some supplemental text and media where I felt it appropriate. The opening sections of the exhibit consisted of a "note from the curator" introducing the water theme and the motivation behind the exhibit, an animated map of drought conditions in the West over the past two decades to

demonstrate current regional water concerns, and a “contents” section with clickable buttons that displayed each chapter’s featured photo titles and photographers on a map. Additionally, I bookended each chapter with an embed or link to some type of informational resource related to the chapter’s theme. I did this to break the monotony of an endless scroll and to allow viewers to further engage with the topics covered in each chapter if they chose. Among the resources I linked to were news, journal, and blog articles, data visualizations, and websites for environmental agencies and non-profits. I also attached similar types of resources to key words and phrases as hyperlinks in several photo slides.

Once the exhibit was built, the next step was to prepare it for launch and distribution. To do this, I used Wix to create a single-page landing website with an excerpt from the curator’s note and a button viewers could click to “enter” the exhibit ([hardtb.wixsite.com/deserthydrologies](http://hardtb.wixsite.com/deserthydrologies)). Beneath these items, I added a comment box and a link to a short, anonymous survey (Appendix F) in which viewers could provide feedback on the exhibit. After making final preparations to the Wix website the morning of the launch date, I sent participants an email containing the URL and encouraged them to share it with friends, family, and/or anyone else they felt might take an interest in the project. I also distributed the URL via many of the same avenues I used to distribute the project recruiting call. I emailed it to the same local groups and organizations, promoted it via NMSU hotline, shared it on social media, and posted QR codes linking to the exhibit in physical locations around Las Cruces. Additionally, the DAPC was also kind enough to post it on its website and include an article about the exhibit in its newsletter. The Las Cruces Bulletin also published a short article promoting the exhibit a few weeks after it launched.

## **Photo, survey, and interview analysis**

I began analyzing photos, survey responses, and interviews immediately after launching the exhibit. First, I extracted rudimentary quantitative information from participants' photo submission forms and supplementary surveys to get a sense of the participant pool's overall demographic breakdown. Survey123's "Analysis" module was the primary tool used here, but I also ran some calculations of my own where I felt it necessary. Next, I categorized and coded photos and survey responses. The categories used for the exhibit "chapters" acted as the scaffolding for this stage of the analysis. After creating a separate survey analysis document with sections for each chapter, I copied excerpts from each survey to the section of the analysis document corresponding to the chapter featuring the attached photo. For example, if a photo was featured in the "Rain" chapter, relevant excerpts from that photo's survey were copied to the "Rain" section of the survey analysis document. For photos that were not featured in the exhibit, I grouped them based on the chapter that I would have placed them in. Some parts of survey responses were either tangential to the photos and the water theme or were only useful for quantitative analysis. For this reason, only excerpts I felt were informative of participants' perspectives and attitudes surrounding the water theme, the photography process, and/or photography in general were copied to the survey analysis document.

After a list of survey response excerpts corresponding to each chapter theme had been generated, I coded them using Microsoft Word's comment tool. The coding process was carried out in typical fashion. I gave excerpts (or portions of excerpts) that pertained to certain themes or ideas their own descriptive code words or phrases (primary codes). Later, I added secondary code words and phrases beneath each primary code to further categorize and organize the ideas expressed in each survey response. After I finished coding survey responses, I applied the same

analysis to the interview transcripts using many of the same primary and secondary codes used for the survey responses. In some places, I added new code words and phrases where interviewees discussed new ideas and themes that were not captured in survey responses.

## **Project ethics**

Though the Desert Hydrologies project generally posed little risk to participants and did not involve collecting any sensitive data, I took a number of measures throughout the course of the project to ensure it maintained the ethical standards that participatory research typically espouses. In addition to obtaining approval for the project from the NMSU's Institutional Review Board (IRB) (Appendix G), I also took steps to keep participants' voices central to the project and provide them a high degree of control and agency throughout the research process. Because these subjects are often key concerns in participatory research, I feel they are worthy of some discussion here.

As discussed in Chapter Three, collaboration is a central tenet of participatory research. Conductors of participatory research projects aim to elevate participants' ideas and perspectives and allow participants to speak for themselves rather than speaking for them. While the researcher's voice will inevitably take on a prominent role in the end products of any research endeavor, participatory or not, there were a few points throughout the course of the Desert Hydrologies project in which I felt extra care had to be taken to respect and maintain the project's collaborative spirit. One of these was data analysis. Interpreting photos is tricky enough, but it is especially difficult when the intent behind those photos is a primary focus of the research. To avoid a situation in which my interpretation of participants' photos would paper over the stories they were trying to tell, I designed the surveys and interviews to give participants

ample space to interpret their photos themselves. There were five questions on the photo submission form that prompted participants to analyze their photos:

- What does your photo depict?
- Did you make any artistic decisions while you were taking your photo (e.g., lighting, angle/composition, etc.)? If so, why?
- Did you edit your photo? If yes, what kinds of edits did you make and why?
- Why did you choose to take this photo? How do you think it relates to the photo prompt?
- Did the process of taking your photo influence or change the way you think about water or water issues at all? If yes, please describe your thoughts here.

The responses these questions elicited, which I explored in more detail during interviews, were the primary means by which I “read” participants’ photos during the analysis process.

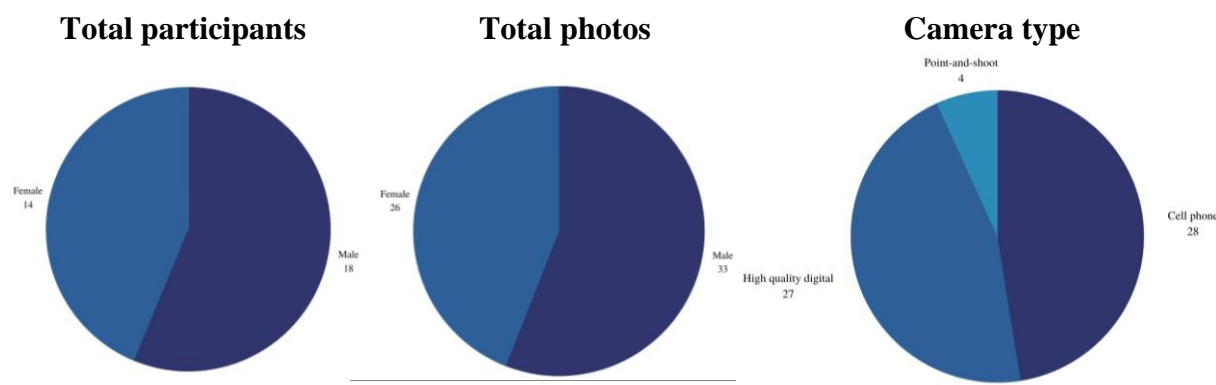
The exhibit was another point in the project during which I took extra measures to make sure I was not speaking for participants. As noted previously, the exhibit utilized excerpts from participants’ survey responses as photo captions. This often required me to make small technical edits to what participants wrote as well as decisions around which survey responses (or parts of responses) to sample. In some cases, for the sake of brevity and cogency, I formulated photo captions by melding different parts of survey responses together. Obviously, all this required a fair amount of interpretation on my part regarding the central ideas and messages participants were trying to get across in their photos and surveys. Because of this, I emailed each participant before launching the exhibit to give them a chance to approve or make changes to the photo caption(s) I had formulated for them. Though this step required extra time and effort, I felt it was critical to treat participants like the artists they are and give them the final say over how their photos would be represented in the public eye.

In addition to the above, I also took several other steps to give participants a greater degree of control over the project and agency as research subjects. As mentioned earlier, participants were able to choose how they would like to be credited for their photos in the exhibit and include things like artist statements, websites, and social media handles along with their exhibit entries. This was done not only to give participants a chance to promote their work (artistic or otherwise) through the exhibit, but also so that they could control the content and appearance of their exhibit entries to the greatest extent possible. I also gave participants the option to be credited anonymously in the exhibit and opt out of having their photos mentioned explicitly in this thesis if they wished to keep their survey and interview responses fully confidential. Additionally, to ensure participants understood the risks of having their photos displayed freely on the internet and that they knew what steps they could take should their photos be used without their permission, the exhibit entry form included information and resources on photo copyright law.

Some of these ethical concerns and the measures taken to address them may seem rather miniscule, especially considering that no participants expressed any concerns over the ethics of the Desert Hydrologies project. However, for fields like participatory research that emphasize social consciousness and equity between researchers and the communities they research, even small steps toward achieving ethical goals can be impactful. While I do not claim the Desert Hydrologies project to be a perfect example of how to conduct a participatory study, I hope this brief discussion of its finer procedural details might be informative for similar projects in the future.

## Participation and engagement in Desert Hydrologies

In total, thirty-two people submitted photos for the Desert Hydrologies project out of forty-four who inquired about participating. Eighteen (56.25 percent) of the participants identified as male, and fourteen (43.75 percent) identified as female. A total of fifty-nine photos were submitted for the project, thirty-three (55.93 percent) of which came from male participants and twenty-six (44.07 percent) of which came from female participants. Twenty-eight (47.46 percent) of the photos submitted were taken with a cell phone, twenty-seven (45.76 percent) were taken with a high-quality digital camera (such as a DSLR or mirrorless camera), and four (6.78 percent) were taken with a point-and-shoot style of digital camera. Seven participants submitted their photos prior to the first submission deadline. The remaining twenty-five submitted their photos after I extended the deadline and eased time and location restrictions on photo submissions.



**Figure 3:** Desert Hydrologies participation statistics (pie charts created with Canva).

Twenty-two participants (68.75 percent) indicated interest in an interview, fifteen (68.18 percent) of which were male and seven (31.82 percent) of which were female. Due to time constraints, I was only able to interview eight total participants. As mentioned earlier, I selected

participants for interviews with the intent of covering a wide variety of photo themes and keeping the ratio of male to female interviewees relatively close to that of the overall participant pool. In total, I interviewed five male participants and three female participants. I conducted three of these interviews via Zoom and five face-to-face.

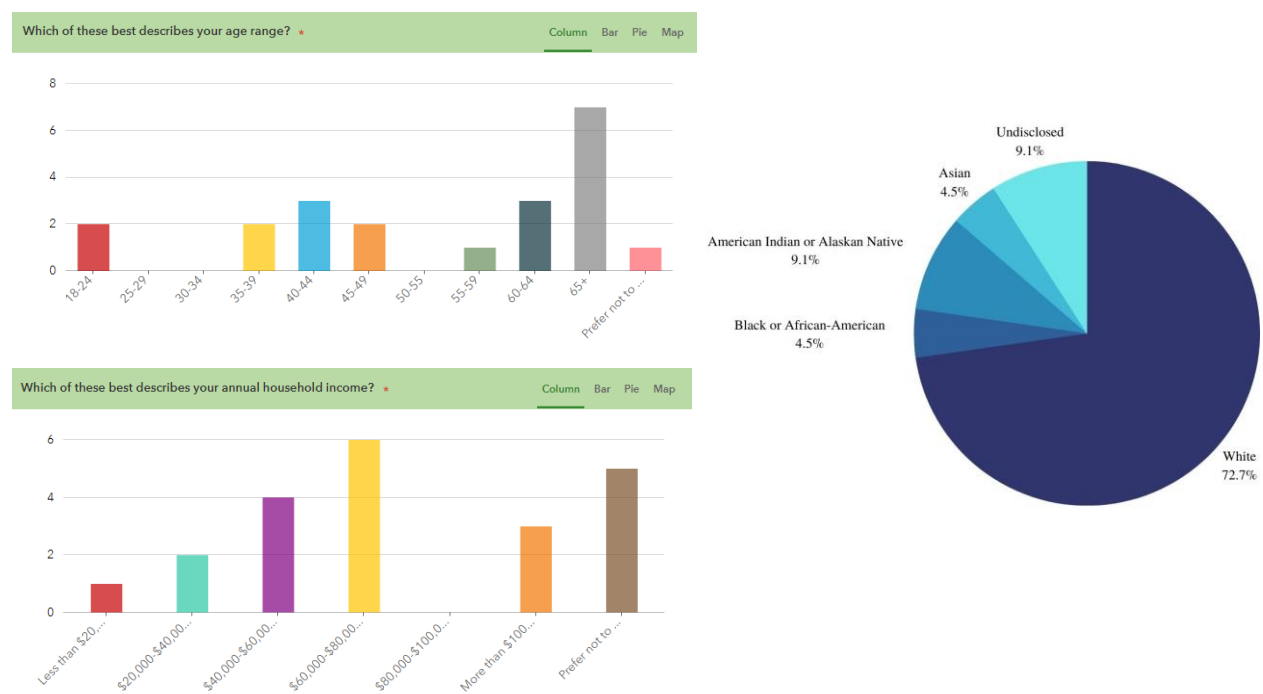
All participants chose to take part in the project exhibit, which ended up featuring a total of fifty-three photos. A few participants mistakenly submitted more than the limit of two photos per person, in which case I instructed them to choose up to two to enter into the exhibit. I did this keep things fair for other participants and avoid over-featuring any one participant. The remaining photos and their accompanying surveys were not featured in the exhibit but were kept for analysis purposes.

Since the exhibit was released, it has received a small but seemingly robust response. In the two months after its initial launch, the exhibit was viewed just over 650 times. Most of these views came during the week or so immediately after the launch date, with small spikes occurring in the following weeks when announcements about the exhibit were published in NMSU Hotline and the Las Cruces Bulletin. Despite its fairly modest view totals, the exhibit has been successful in engaging those who take the time to explore it. It seemed to be well-received among participants, many of whom have emailed me with positive feedback and further comments on water and water issues. A number of participants also shared the exhibit URL on their social media pages. In addition to this, nine comments have been left on the exhibit landing page (some of which are quite lengthy and detailed), and fourteen viewers have taken the exhibit viewer survey. This amount of engagement, though not eye-popping, is more than I expected the exhibit to receive when I first launched it.



## Participant demographics

Twenty-one participants (65.63 percent) completed the optional supplementary survey, a representative sample size large enough to provide a fairly accurate demographic breakdown of the participant pool (Figure 3). Participants tended to skew older, with 33.33 percent identifying as sixty-five years of age or older and 52.38 percent identifying as fifty-five years of age or older. 33.33 percent of participants were between the ages of thirty-five and forty-nine, and just 9.52 percent were between eighteen and twenty-four. Participants were mostly white, with only four (19.05 percent) identifying as a race other than Caucasian and two choosing not to disclose their race. Additionally, only 19.05 percent identified as being from Hispanic, Latino, or Spanish Origin. When it came to socioeconomic status, 42.76 percent of participants reported having annual incomes of \$60,000 or higher. 19.05 percent reported an annual income between \$40,000 and \$60,000, and just 14.28% reported an annual income of less than \$40,000.



**Figure 4:** Rudimentary demographic breakdown of Desert Hydrologies participants (graphics created using ESRI Survey123 and Canva).

The supplementary survey also asked participants for some rudimentary biographical information (Table 2; Table 3; Figure 5), including what they do for a living, how long they have been living in Las Cruces, how they engage with environmental issues, and how experienced they are with photography. When it came to occupation, “retired” was the most common response (33.33 percent). However, other occupations listed (including pre-retirement occupations) varied considerably. Participants reported having backgrounds in areas including education, health care, STEM, law, business, archaeology, writing, art, and, as one might expect for a project like Desert Hydrologies, photography. As far as time spent in Las Cruces, the overwhelming majority (71.43 percent) of participants reported that they have been local to the area for at least ten years. The total percentage of participants who have been living in Las Cruces for at least five years was 80.95 percent. Just 19.05 percent reported that they have been living Las Cruces for less than five years.

Questions that assessed environmental engagement revealed that, by and large, participants were highly engaged with environmental issues prior to taking part in the project. 85.72 percent reported that they felt environmental issues were of “great” or “utmost” concern. The remaining participants reported “moderate” concern over environmental issues, with no participants selecting the options for “little” or “no” concern. Participants reported engaging with the environment and environmental issues in a number of ways. By far, the most popular options selected were trying to live a sustainable lifestyle (twenty participants) and spending time outdoors (seventeen participants). After that came donating to environmental organizations and causes (nine participants) and studying or working in a field that intersects with environmental topics/issues (seven participants). Two participants reported that they do not engage frequently with the environment and environmental issues but would like to engage with them more.

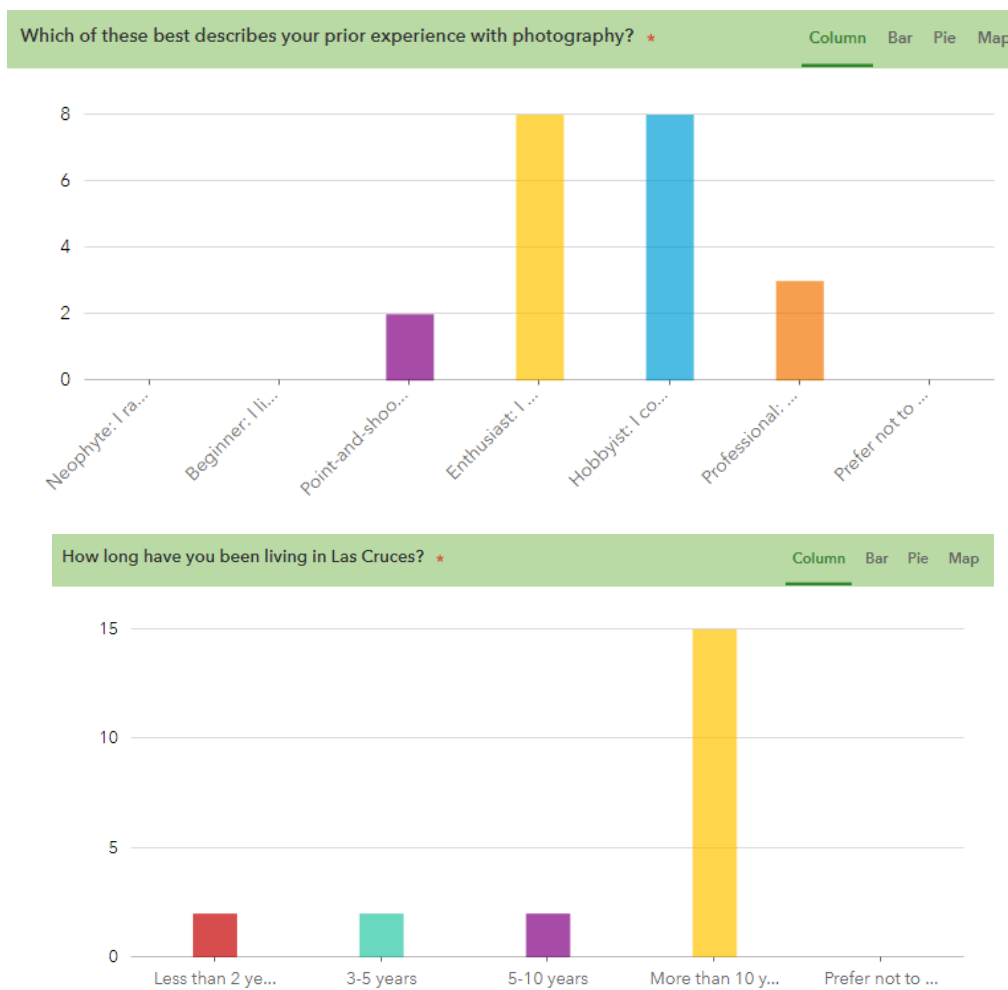
Participants' photography experience was a little more evenly distributed than their degree of environmental engagement. "Hobbyist" (photographers who practice advanced photography as a hobby) and "enthusiast" (photographers who practice photography as a hobby but do not consider their skills to be advanced) were the two photography experience categories participants identified with most (38.1 percent for each category). 14.29 percent of participants reported having done advanced photography professionally in some capacity. 9.52 percent of participants identified as "point-and-shoot" photographers—photographers who frequently practice casual photography. No participants identified as "neophyte" or "beginner" photographers.

How concerned are you about environmental issues?	Count	Percentage
They are of utmost importance/concern (should be at the very top of the political agenda)	9	42.86
They are of great importance/concern	9	42.86
They are of moderate importance/concern	3	14.29
They are of little importance/concern	0	0
They are of no importance/concern (should not even be on the political agenda)	0	0
Prefer not to say	0	0

**Table 2:** Concern with environmental issues among Deesert Hydrologies participants. Participants who filled out the supplementary survey were asked to rate their level of concern regarding environmental issues from the options listed here.

How do you normally engage with the environment and environmental issues?	Count	Percentage
I pay close attention to environmental news (newspapers, magazines, TV news, etc.)	13	61.9
I frequently post on social media and share news about environmental issues	2	9.52
I volunteer with environmental groups/organizations	3	14.29
I donate to environmental organizations/causes	9	42.86
I try to live a sustainable lifestyle (e.g. buying local, reducing carbon footprint, reducing water use, etc.)	20	95.24
I study or work in a field that intersects with environmental topics/issues	7	33.33
I spend a lot of time outdoors (hiking, running, biking, gardening, etc.)	17	90.95
I do not frequently engage with the environment/environmental issues, and I am fine with that	0	0
I do not frequently engage with the environment/environmental issues, but I would like to engage more than I do	2	9.52
Prefer not to say	0	0
I engage with the environment/environmental issues in a way not listed here (enter below)	1	4.76

**Table 3:** Modes of engagement with environmental issues among Desert Hydrologies participants. Participants who filled out the supplementary survey were asked to select how they engage with the environment and environmental issues from the options listed here.



**Figure 5:** Desert Hydrologies participant biographical information.

In general, the results of the supplementary survey indicated that Desert Hydrologies participants were mostly middle to upper-middle class, middle aged and older white people who place a high degree of importance on environmental issues and have at least some experience with photography. This is not all that surprising given the way recruiting for the project was carried out. As mentioned earlier, the recruiting call was initially distributed through groups organizations I and/or my colleagues at NMSU were affiliated with in some way. Two of these organizations—MVAS and DAPC—have many members who are retirees. The fact that the recruiting call was circulated multiple times through multiple points of connection with these organizations helps explain why participants skewed older. The affiliation-based recruiting process also helps explain the generally high degree of environmental engagement among

participants. Many of the groups and organizations who received the recruiting call, particularly MVAS and NMWRRI, are environmentally oriented. Because of this, the call likely reached more people who had prior interest in environmental issues. Self-selection bias almost certainly played a role here as well. A project like Desert Hydrologies is naturally likely to draw participants who are interested in environmental issues. It is also likely to draw people who are interested in photography, which along with the aforementioned recruiting from DAPC is probably the reason most participants reported having photography experience.

### **Exhibit viewership**

Though not participants in the same sense as those who submitted photos, exhibit viewers are still an important part of the overall scope of the Desert Hydrologies project. The fourteen exhibit viewer surveys sent in are likely not enough to be a representative sample size for all exhibit viewers, even when subtracting photography participants and accounting for people who may have viewed the exhibit more than once. However, they can still provide a glimpse of who the exhibit may be reaching.

Based on surveys sent in through June 22, 2022, the demographic breakdown of exhibit viewers seems to be similar to that of photography participants. The male/female split of exhibit viewer survey respondents is slightly more even than that of the photography participant pool (50 percent and 50 percent, to be exact). However, like photography participants, they are mostly white (just under 80 percent), middle to upper-middle class (just under 80 percent with an annual income over \$60,000), and over the age of fifty-five (just over 70 percent). They also appear to be highly engaged with environmental issues; all respondents said that environmental issues are of “great” or “utmost” concern to them, and only two said they do not frequently engage with the

environment and environmental issues. The only notable difference between exhibit viewer survey respondents and photography participants is that they reported a lower degree of interest in photography. Whereas most photography participants indicated a strong interest in photography, more than half of exhibit viewer survey respondents described their interest in photography as low or moderate.

The factors contributing to the demographic breakdown of exhibit viewers are likely the same as those underlying the demographics of photography participants. Word of the exhibit was spread through many of the same organizations who helped distribute the recruiting call, and those inclined to take the exhibit viewer survey were likely motivated, at least partially, by an interest in environmental issues. The fact that exhibit viewers reported less interest in photography would seem to indicate that the exhibit's reach is extending beyond the photography enthusiast crowd, which is somewhat encouraging. However, without a more robust sampling of exhibit viewers, I am limited only to superficial conclusions about who is engaging with it.

### **Discussion: engaging with water and water issues through photography**

Participants' photos captured water in an immense variety of ways, depicting subjects including weather events, plants, animals, puddles, springs, seeps, washes, The Rio Grande (both flowing and empty), water infrastructure, urban water use, individual water use, agriculture, and water stewardship. The Desert Hydrologies exhibit, subtitled "The many faces of water in an arid landscape," ended up containing eleven themed chapters, each of which feature anywhere from three to seven photos. The chapters, in order of appearance in the exhibit, are titled "Rain," "Snow and Ice," "Flora," "Fauna," "Ephemeral and Hidden Water," "Culture and Community," "Using

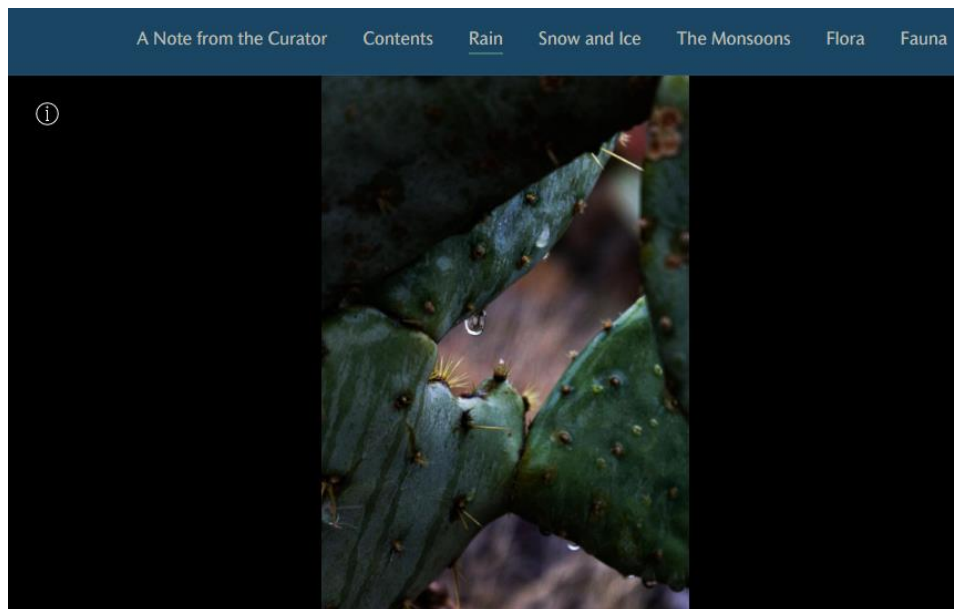
Water,” “A Beleaguered River,” Giving Back,” and “The Rio Lives.” The following sections will go over the ideas expressed in each chapter’s photos and the surveys and interviews attached to them. In many cases, photos that fell into different chapters of the exhibit were discussed by participants in similar ways. For this reason, some chapter themes that were unified by what participants said in their surveys and interviews have been grouped together in the sections below.

### *Precipitation*

Sixteen of the photos submitted focused on weather events of some kind. Five of them were featured in the “Rain” chapter of the exhibit, six were featured in the “Snow and Ice” chapter, and four were featured in the “Monsoons” chapter. One was not included in the exhibit but would have been featured in the “Monsoons” chapter.

By and large, participants associated precipitation in its various forms with positive emotions. Rain in particular was associated with a sense of hope, renewal, and joy for many participants, who often commented on how “precious” it is in light of the current drought Las Cruces is experiencing. As one participant who submitted a close-up photo of a raindrop (Figure 6) remarked: “...how fascinating that something so small is so important.” Participants had similar things to say about snow and ice, often mentioning that any form of moisture is “welcome” and “needed” in the desert. Participants also focused on the aesthetic value of snow and ice slightly more so than they did with rain. One participant, discussing why she took her photo, described being “...mesmerized by the sun glistening off of the light dust of snow on the desert scrub.” Another participant, describing a photo she took shortly after a snowstorm, said she was motivated to take the photo due to the “wondrous softening effect of the powder” on the

surrounding landscape. A potential reason that participants highlighted the aesthetic value of snow and ice is how infrequently they occur in Las Cruces. One participant described snow as an “anomaly” in the desert, and another who took a picture of ice falls in the Organ Mountains observed: “You don’t think of ice being in the desert.” Other participants focused on the fleeting nature of snow in the Las Cruces area, with one mentioning how she felt pressured to take her picture before the snow “melted away” and another observing that snow is becoming less frequent in the region due to drought.



**Figure 6:** A participant’s photo of a raindrop dripping off a prickly pear cactus. Said the participant: “...how fascinating that something so small is so important” (screenshot from the Desert Hydrologies virtual exhibit).

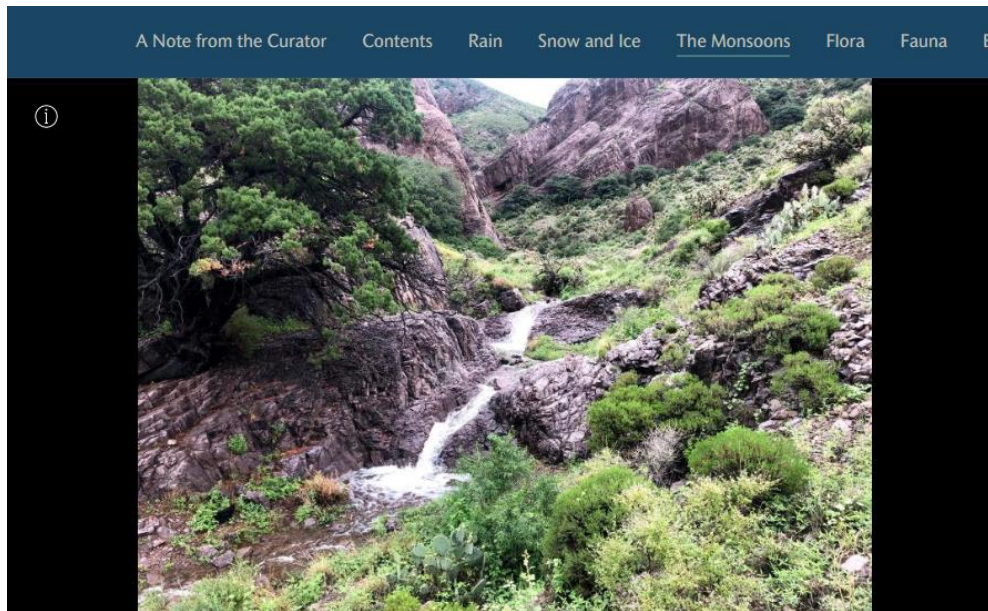
Many of the same sentiments expressed about rain, snow, and ice were also expressed about the local monsoon season, which despite only covering a few months out of the year garnered enough attention from participants to be given its own chapter in the exhibit. Several participants submitted photos not only of the late summer storms that typify the monsoon season but also the roaring waterfalls that tend to appear in the Organ Mountains after they occur. Similar to rain, participants characterized the monsoons as a rare treat—a welcome respite from the unrelenting



aridity of the desert. Words like “gift” and “blessing” were often used to describe the moisture brought by monsoon storms. One participant commented on how the monsoons make the Organ Mountains feel like a “true oasis in the desert” and described the waterfalls they create as “a welcome change to the landscape.” These comments tie into another aspect of the monsoons that garnered attention among participants: their aesthetic value. One participant described the storm clouds she photographed as “breathtaking” and remarked that she felt lucky to live in a place where such “picturesque views” can be witnessed. During an interview, another participant described the experience of being in the Organ Mountains after a monsoon storm as “magical,” recalling fondly the numerous waterfalls he saw gushing out of the cliffsides as he hiked to Dripping Springs to take the photo he submitted. A third participant commented extensively on the aesthetic features of a monsoon waterfall he photographed (Figure 7):

...I really liked how it made the old growth desert natives stick out in comparison to the bright green quick growing plants, and true riparian plants. The details of the rocks I feel are really striking, and the various levels of moisture on the different surfaces and angles of the rocks really makes them stick out.

All in all, participants’ characterizations of the monsoons were similar to their characterizations of snow and ice. They seemed to see the monsoons as something that enriches the experience of living in Las Cruces both by providing moisture and briefly transforming the local landscape in interesting and aesthetically pleasing ways.



**Figure 7:** A participant's photo of a monsoon waterfall (screenshot from the Desert Hydrologies virtual exhibit).

Beneath all these positive emotions, however, precipitation also seemed to evoke in participants a quiet but palpable feeling of anxiety. While participants generally described rain, snow, and monsoons as things that make them happy, many also said that precipitation makes them think about subjects like drought and climate change. As one participant put it:

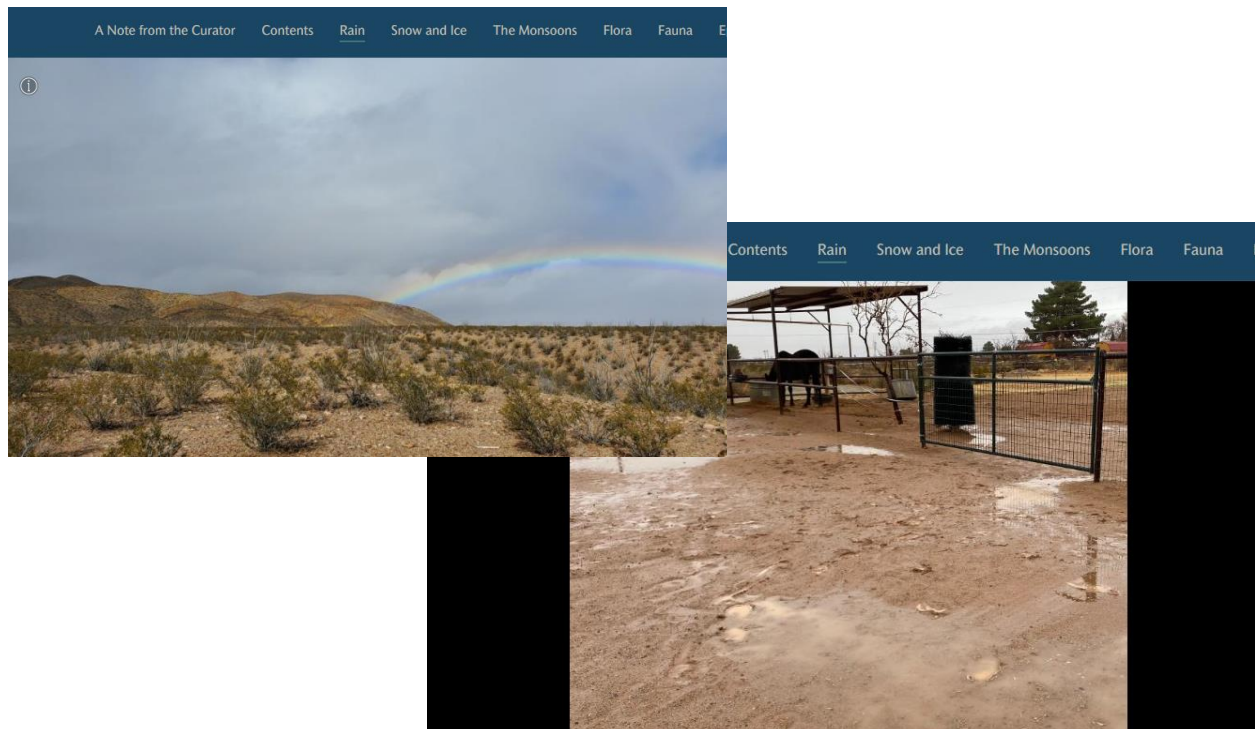
[Taking the photo] did make me realize how dependent we are on the miniscule quantities of rain we do eventually get. As predictions go, we are told to expect less and less here in the coming years, and it does make me worry about the future.

She dug deeper into this sentiment in her interview, noting that while the photo she took of her horses' muddy hoofprints (Figure 8) reminded her of the joy the animals seem to feel when it rains, it also reminded her how "tentative" a lifestyle of raising animals in the desert may be. "I love the life that we lead with our animals and the activities that we can do because of them," she said. "But when I took this photo, what I was thinking more of was it's representative of a lifestyle that I don't know will be possible in the future." Another participant I interviewed, who had associated rain with the idea of hope in his survey, also discussed how precipitation makes

him think about drought. Referencing a photo he titled “New Year, New Me?” (Figure 8), he pondered whether the hope rain elicits might ultimately cloud the bleak reality of the drought Las Cruces has been facing:

All this precipitation we had last year—the mountains were spectacular, everything was green—I think we get tunnel vision, and the tunnel vision is that we have this hope.... The reason I put a question mark at the [end of my photo title] is because.... Is this really hope, or is it a false, tunnel-vision type of hope?

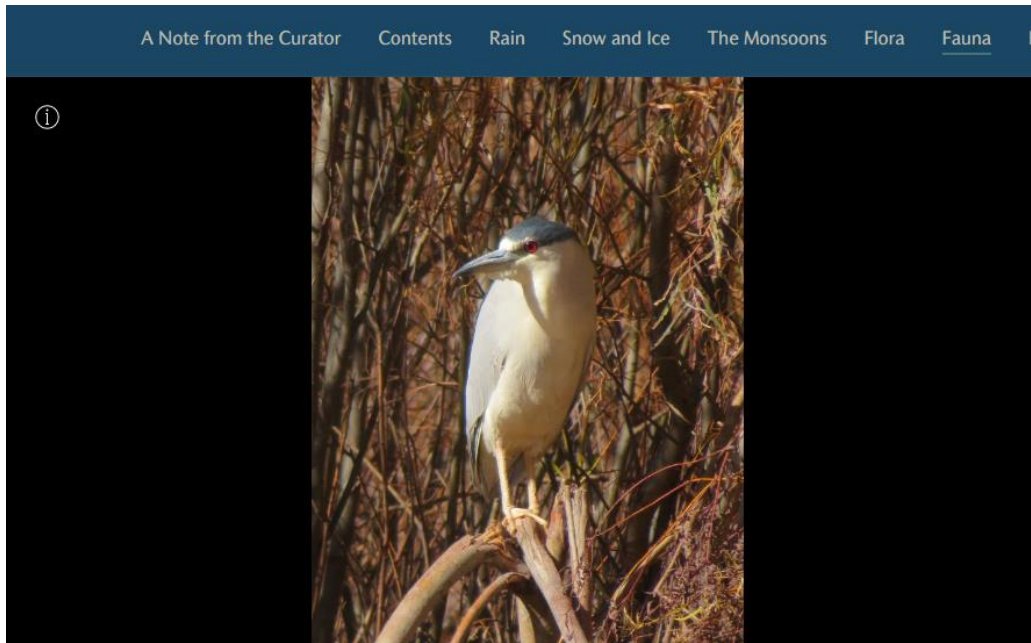
While comments from other participants stating that rain reminds them of the importance of conserving water in a drought were slightly more optimistic, it certainly seems apparent that precipitation, drought, and concerns over water scarcity are deeply intertwined for participants. Even with the sense of renewal and hope precipitation brings, the idea of “water as catastrophe” in the arid West looms large.



**Figure 8:** Two photos from the “Rain” chapter that elicited mixed feelings for the participants who submitted them (screenshots from the Desert Hydrologies virtual exhibit)

### *The more-than-human*

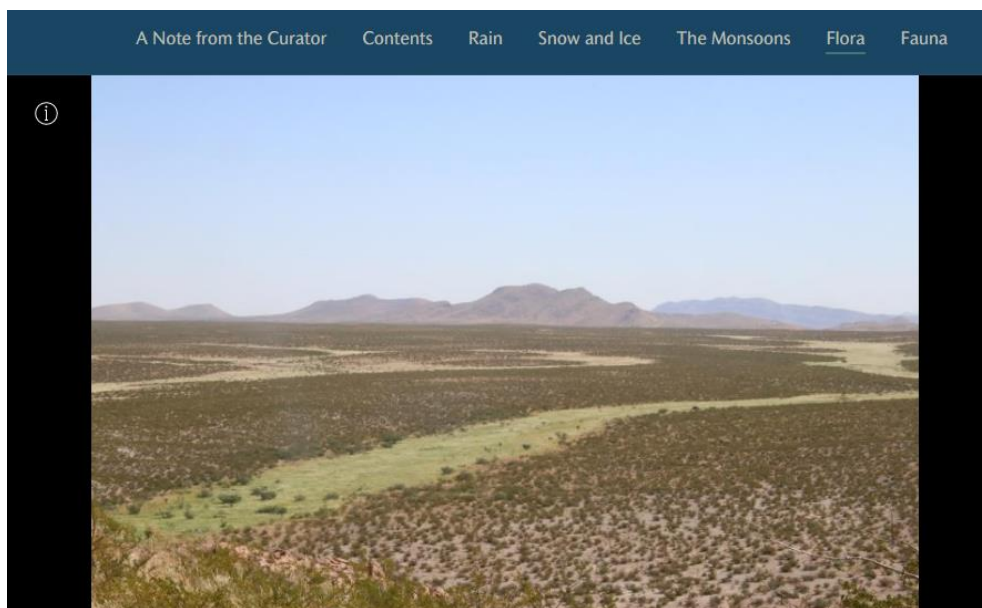
Eight of the photos submitted depicted plant or animal subjects, half of which were featured in the “Flora” chapter and half of which were featured in the “Fauna” chapter. As they did with precipitation, participants often spoke reverently about the plants and animals they photographed, frequently commenting on their aesthetic features and characterizing their presence as something that enriches the experience of living in Las Cruces. One participant who submitted photos of birds described being enraptured by their “beauty and serenity” and spoke at length in her interview about how she enjoys watching birds and other animals along the Rio Grande. Another interviewee who submitted a photo of a dying cottonwood mentioned the importance of the shade cottonwoods provide and spoke wistfully in his interview about what the bosques around the Rio Grande in Las Cruces must have looked like before engineering and drought ousted most of their native tree species. Within discussions like these, participants often animated or humanized the plant and animal subjects they captured. The participant who submitted the bird photos frequently referred to one of them (Figure 9) as a “character shot” and talked about how the bird “seemed very intelligent.” Similarly, the participant who submitted the cottonwood photo likened the trees to “old grandparents” and reflected mournfully on the cottonwood’s recent passing. A third participant who submitted a photo of a red-spotted toad framed the creature as a teacher of sorts, noting how its ability to survive after losing 40 percent of its body water “points out the benefits of resilience and adaptability.”



**Figure 9:** A participant’s photo of a black-crowned night heron, which she described as a “character shot” (screenshot from Desert Hydrologies virtual exhibit).

Many participants also used their plant and animal photos as a way into discussing how water’s importance extends beyond humans. Every participant who submitted a photo of a plant or animal commented on this subject in some way. One participant who submitted a photo of a water lily said that taking the photo made him think about how water, while important to him from an aesthetic standpoint as a photographer, “is essential to the very existence of the subject.” He also commented on how water is often taken for granted by humans, a sentiment echoed by another participant who sent in a photo of a bird drinking from a puddle left by a broken sprinkler. She noted the irony with which the bird took advantage of water wasted by humans and described feeling less angry about the wasted water knowing it was helping local wildlife. Other participants commented on the broader ecological importance of water. As mentioned previously, the participant who sent in the cottonwood photo spoke at length about the impact of water engineering on local riparian ecosystems. The participant who photographed birds along

the Rio Grande said they reminded her of the fragility of the riverway’s ecosystem and listed ecosystem protection as a primary reason to conserve water locally. Another participant, commenting on a photo she submitted of grass growing in shallow arroyos (Figure 10), discussed the impacts of drought on local biodiversity. She noted the importance of summer storms in allowing desert grasses to “keep the creosote at bay,” and described how a lack of rain in the future might “result in a less diverse Chihuahuan Desert.”



**Figure 10:** A photo of grass growing in arroyos submitted by a participant to demonstrate water’s importance for biodiversity in the desert (screenshot from Desert Hydrologies virtual exhibit).

Comments like these and others indicated that the more-than-human plays a large role in how participants understand and value water—a sentiment that mirrors those found in broader conversations around the idea of water as catastrophe and water as an opportunity to foster more eco-centric ways of thinking. As is the case in much of the arid West, fears regarding the future of water in Las Cruces coalesce not just around human wellbeing but also the wellbeing of plants, animals, and ecosystems. As one participant who sent in a photo of a butterfly pollinating

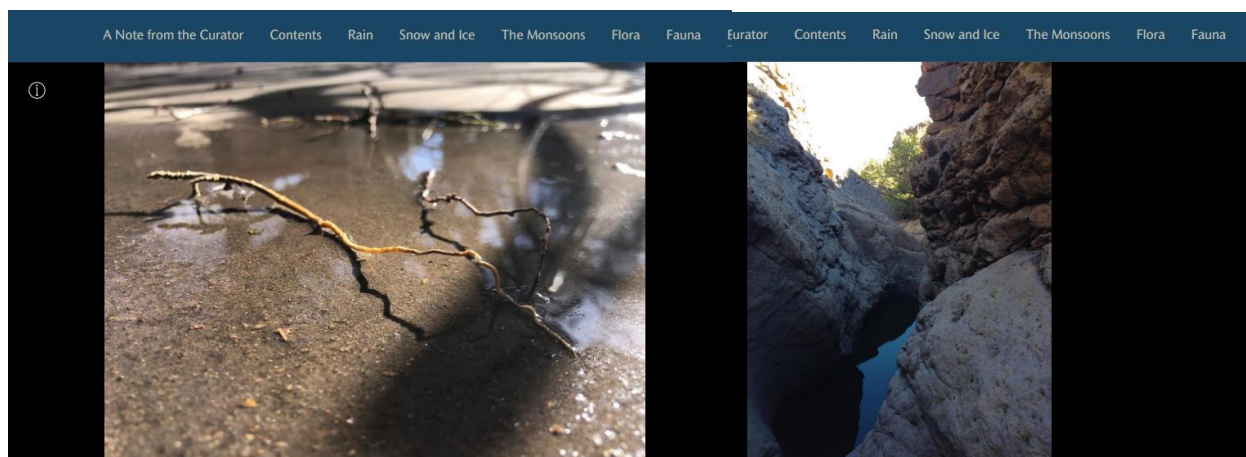
a vitex flower put it: “No water = no life.” The fact that water scarcity threatens all the desert’s inhabitants, not just people, was both a lingering concern and a motivation for combatting water issues—a motivation participants expressed powerfully by animating nature through their photos.

### *Water’s impermanence*

“Ephemeral and Hidden” water was one of the more unique chapters of the exhibit, containing a total of six photos depicting the fleeting and sometimes elusive nature of water in the desert. Subjects featured in these photos included puddles, desert seeps and springs, and arroyos. Thematically, the photos in the “Ephemeral and Hidden Water” chapter were quite distinct from those of other chapters, which is why I have chosen to analyze them on their own.

Participants whose photos engaged with the ephemeral and hidden water theme often characterized the subjects they photographed as curiosities—small, unexpected, and often temporary appearances of water that capture one’s attention and imagination. A participant who submitted photos of puddles (Figure 11) said he chose what to photograph for the project simply by “waiting for water to show up.” He went on to discuss his longstanding fascination with puddles, describing them as “dreamy” and “magical” and commenting on their unique aesthetic qualities. Another participant expressed a similar fascination with the small pockets of water he comes across while hiking around the desert. In his interview, he talked about how searching for small springs and seeps like the ones in his photos (Figure 11) is frequently the main purpose of his hikes. When he finds them, he often sends the photos he takes of them to a friend of his who shares his interest in combing the desert for hidden water.





**Figure 11:** Participants capture the fleeting and elusive nature of water in the desert (screenshots from the Desert Hydrologies virtual exhibit).

Participants also discussed how the small quantities of water they photographed made them think about water's meaning and impact over broad temporal scales. The participant who submitted a photo of a dry arroyo talked about water's role in shaping the local landscape, noting that the photo "shows the work of water over hundreds of thousands of years, recent years, and recent months and days." Another participant, the one who submitted the photos of desert springs, spoke similarly about the geological significance of water:

When I look at the smooth bedrock here, I think of all the many individual days and nights over the eons that water has flowed through this desert canyon. I think of what it would be like to be out here on any one of them, watching the water rush and rise over the bedrock and through tight passages like this one.

During his interview, this participant also described how hidden springs and seeps cause him to ponder water's role in human life throughout history. He mentioned that there is an archaeological site a short distance up the canyon from the small pool of water pictured in one of his photos and speculated that early Native Americans may have used the pool long ago. Another participant who photographed what appeared to be a small rill carved by early humans to capture runoff from a nearby spring also commented on early humans' relationship with water. He marveled at the effort that was once needed to procure even a small amount of water, remarking:



“[It] really put in perspective the three liters of ice water I carried on my back.” He also noted that the rocks around the drinking spot looked worn, possibly due to thirsty people and animals repeatedly visiting the spot over centuries.

Participants frequently connected their musings on water’s role and impact over time to the idea of water scarcity. The participant who submitted the arroyo photo talked about how arroyos “tell a tale of water scarcity and abundance” and observed that the scarcity aspect of the tale is often “not appreciated” to the extent it should be. For the participant who submitted the two desert spring photos, the springs served as a reminder of just how dry the Las Cruces area has become in recent years. In his interview, he talked about how springs are indicative of a past where water (by desert standards) may have been more abundant—a past that to him seems further and further away with each year the current drought continues:

We’re in the midst of just a super dry time where people couldn’t survive out in these areas now if they had to.... You always have some idea that a place could be different than it is, you know? And when you see something like this, you just think, “Well, people always figure out a way to manipulate their environment.” But maybe... people were able to get along in their environment in a way that we can’t possibly do anymore.

Quotes like these get at deeper questions related to the idea of water as catastrophe. Could human existence in arid places like Las Cruces prove to be just as fleeting as the puddles, springs, seeps, and washes that characterize the Chihuahuan Desert landscape? Are these things a “metaphor for the human condition,” as one participant put it? These are the types of things participants largely seemed to be wrestling with in their encounters with desert water in its ephemeral and hidden forms. In many ways, participants’ reflections on the deeper history of water in Las Cruces emulated broader dialogues that emphasize the precariousness of human presence in the arid West by looking to the past. Much as water writers and scholars contemplate narratives like those of the Hohokam and Chaco civilizations to prognosticate about the West’s

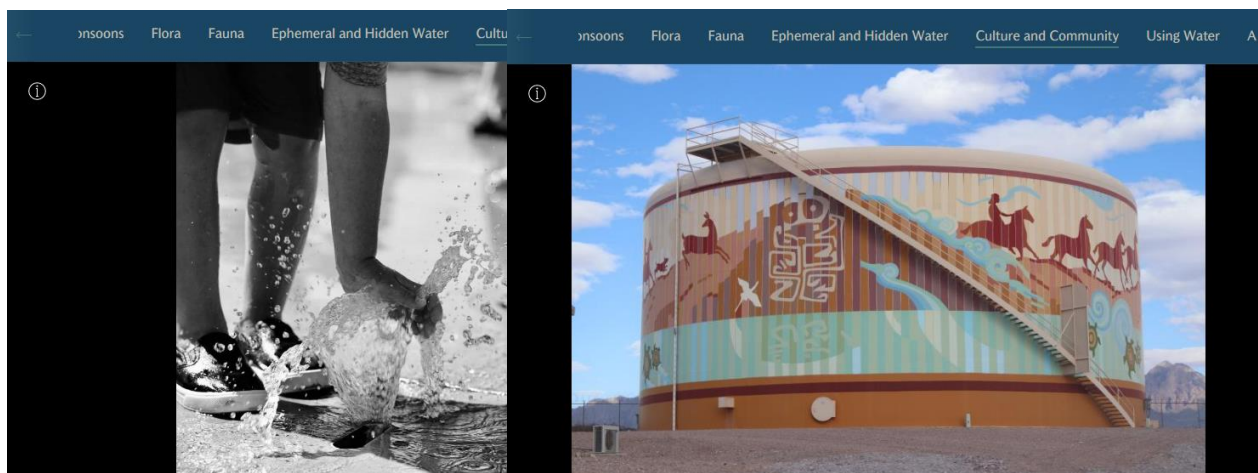
future, participants mused about water over broad timescales to put the current water situation in Las Cruces into perspective. For participants, ephemeral and hidden water is more than just a spectacle. It is also a reminder of the impermanence of human society in the desert.

### *Water consumption*

The two exhibit chapters after “Ephemeral and Hidden Water” contained photos that dealt mainly with the topic of water consumption. The “Culture and Community” chapter featured photos depicting the role of water in enhancing Las Cruces’s urban landscape and fostering a local sense of community. The “Using Water” chapter featured photos depicting water being put to uses people tended to be more critical of, such as agriculture, golf courses, and personal consumption. In the exhibit, the “Culture and Community” and “Using Water” chapters contained a total of ten photos. There were four photos not included in the exhibit that would have been included in these chapters.

The attitudes among participants toward the water uses depicted in the “Culture and Community” chapter were mostly positive. Three of the five photos that engaged with this theme depicted water fountains, which participants seemed to value for their ability to make the city landscape more inviting, engaging, and aesthetically pleasing. Said one participant describing his photo of a fountain in Mesilla in December: “The wonder of Christmas expressed in so many ways.” Another participant, who submitted a photo of the fountain in Las Cruces’s downtown plaza, commented on the pleasing way it made water droplets “dance in the night.” A third participant who submitted a photo of a curious child grasping at a stream of water from the same fountain (Figure 12) described the happy scene she witnessed the day she took the photo, recalling how the fountain was “full of children at play.” Similar sentiments were expressed in

the “Culture and Community” chapter’s other two photos, which depicted some of the many murals that have been painted on various water features around Las Cruces. Discussing a photo he took of a mural adorning an underpass traversed by one of the city’s old irrigation canals, which has since been turned into a paved trail, one participant commented on how murals like this one make the old canal trails “a very pleasant place to walk through.” He also mentioned that the photo has helped him cope with homesickness during a temporary leave of absence from Las Cruces. Another participant who submitted a photo of one of Las Cruces’s water supply tanks (Figure 12), which like many across the city has been painted with a mural depicting local history, said the tank’s aesthetic qualities “add to the enjoyment of the city.” Both participants who submitted these mural photos also commented on how they speak to a local sense of reverence for water. “The subject made it plain that the matter of water is something which has to be given lots of thought and money,” said the participant who submitted the water tank photo. Similarly, the participant who submitted the canal trail photo described the mural as a sign that the local community cares about the site.

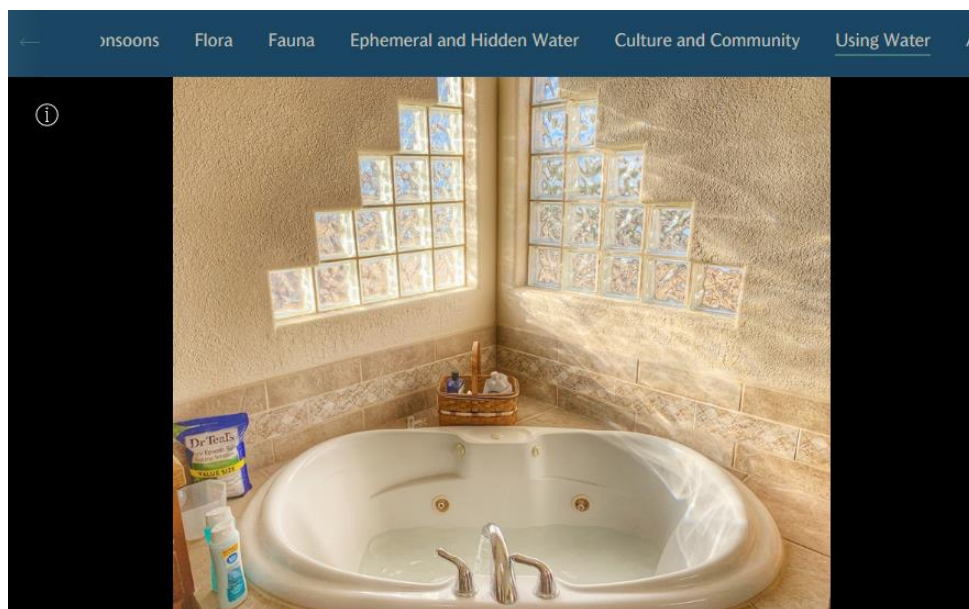


**Figure 12:** Participants capture the cultural and community value of water (screenshots from the Desert Hydrologies virtual exhibit).

By contrast to the largely upbeat manner in which participants described the photos in the “Culture and Community” chapter, participants whose photos fell into the “Using Water” chapter often spoke critically of the subjects they photographed. Two participants who took photos of golf courses reflected on the vast amounts of water golf courses consume. Another participant who sent in a photo of the jacuzzi tub in his bathroom (Figure 13) highlighted the ironies of modern water use:

Rather amazing that we’re in a drought said to be the worst in 1,200 years, yet we humans have water delivered to luxuriate in a jetted tub.

Other participants also criticized less-than-necessary urban water uses, including one who sent in a photo of a gushing broken sprinkler that had been “wasting water for months.” The participant, who titled the photo “Landscape Abuses,” argued that wasting water in a desert community should be “criminal” and said she used the photo to report the malfunction to the city so it could be fixed.

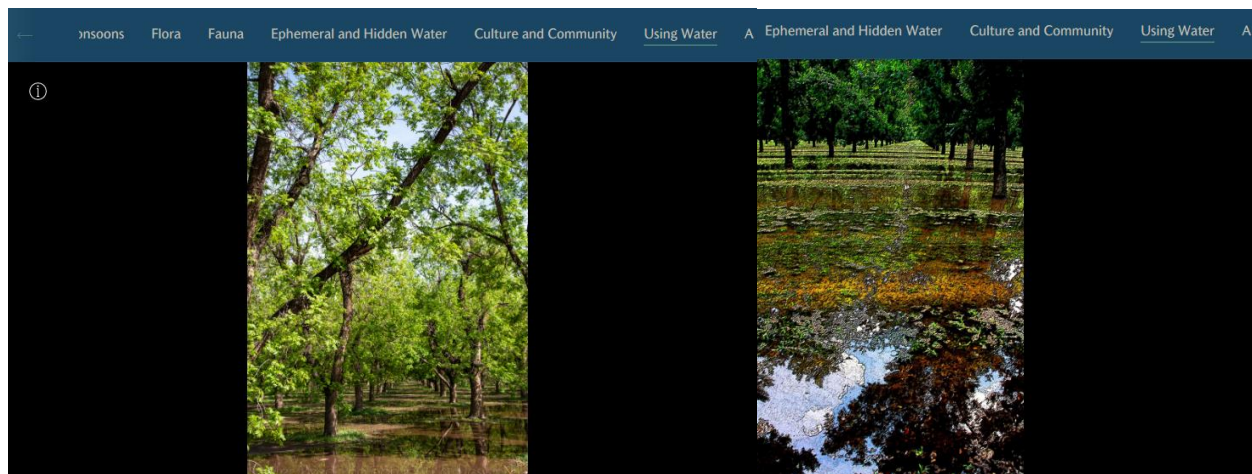


**Figure 13:** A photo of a jetted tub a participant submitted to demonstrate the ironies of water consumption in the desert (screenshot from the Desert Hydrologies virtual exhibit).

Water engineering and agriculture also made appearances in the “Using Water” chapter. The chapter featured two photos of pecan orchards and one of an old dam structure. There was also a photo of a farm field that was not included in the exhibit. Interestingly, the same tension between understanding agriculture as a victim versus a perpetrator of water issues that surfaced in interviews with water professionals and leaders was also evident in participants discussions of agriculture. One participant who submitted a photo of a pecan orchard (Figure 14) and a crop field talked about the “hardships farmers go through” as a result of water scarcity and said her photos “reinforced” her respect and admiration for farming. She described the local agricultural landscape as “part of the charm of Las Cruces” and recounted childhood experiences of driving among the farm fields between Las Cruces and El Paso:

As a child one of my family's favorite things to do was drive from our home in El Paso, Texas to Mesilla by way of the back road, Highway 28, where we would see the beautiful overhanging arches of the pecan trees lining the road—orchard after orchard. We would stop at the pecan shop along the way for gifts and our own personal pecans. When the orchards were being irrigated, the shadows of the trees danced on the water... and we always pulled off of the road to take in the sight. The pecan industry is an important and vibrant manner of commerce here in the Mesilla/Las Cruces area, and it depends on an adequate water source.

The participant who submitted the other photo of a pecan orchard (Figure 14) also made note of their aesthetic qualities, saying that he took the photo because he “liked the visual effect” created by “reflective quality” of the standing water irrigating the trees. However, he also noted that the photo “engendered mixed feelings” because “they irrigate too damned much.” The participant who submitted the photo of the old dam expressed similar mixed feelings about water engineering, noting that while he is fascinated by local landscape features designed to capture water for human uses, he is often “excited to see water in a natural setting, not hemmed in by manmade structures like dikes, dams, levees, etc.”



**Figure 14:** Two photos of pecan orchards, key features of Las Cruces’s landscape that elicited mixed feelings for participants due to the vast amount of water pecan trees consume (screenshots from the Desert Hydrologies virtual exhibit).

It felt as though participants in the “Culture and Community” and “Using Water” chapters were somewhat caught in between recognizing the various ways water enriches their lives and acknowledging the impacts of water consumption. Their photos depicted both the joys of residing in a desert and a keen awareness of the water-intensive nature of desert living. Even the water fountains, which were generally associated with positive emotion, still reminded participants of the thorny subject of water consumption. One participant who submitted a fountain photo made sure to point out that the fountain uses recycled water. Wrote another: “Always thinking, ‘Is this water recirculating?’ I hope so!” Within these tensions, we can make two salient observations. For one, we once again see that in the desert, the prospect of water as catastrophe never seems to be far from people’s minds. Second, we also see participants casting aside the old illusion of water abundance in the arid West. Things that once signified humans’ capacity to “tame” the desert and “make it bloom”—irrigated fields, golf courses, water fountains—produced mixed emotions for participants. In a place like Las Cruces where water is increasingly less abundant, its use and consumption is associated not only with pleasure and gratitude, but also trepidation and reflection.

## *The Rio*

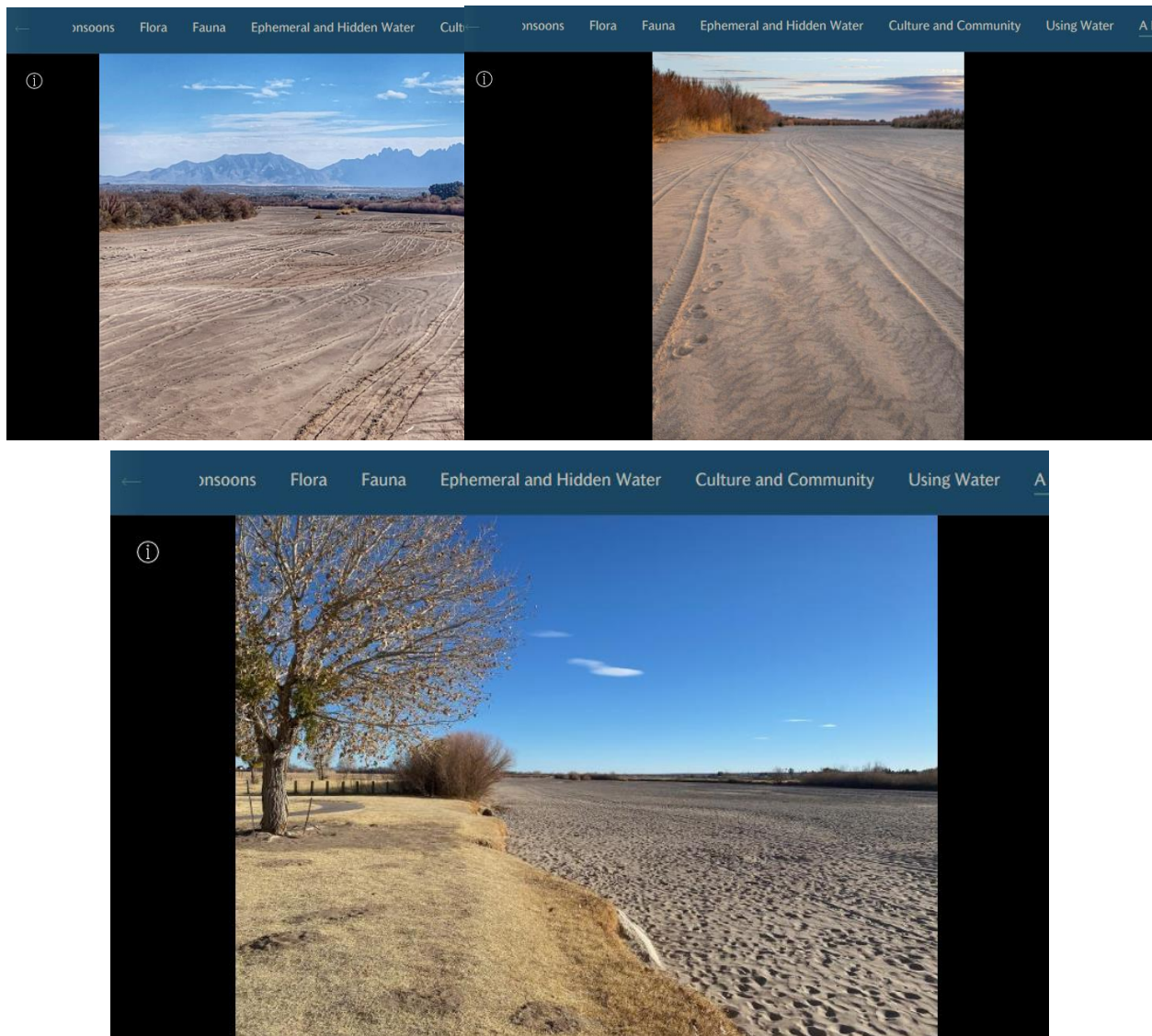
The ninth chapter of the exhibit, titled “A Beleaguered River,” featured photos that engaged with a key focal point for water concerns among participants: the increasingly water-starved Rio Grande. This chapter was the exhibit’s longest, featuring a total of seven photos that mostly depicted the Rio’s dry or near-dry bed. It also was the chapter in which participants expressed the most negative emotion about water and water issues.

The state of the Rio Grande seemed for many participants to be the ultimate irony of the modern-day water situation in Las Cruces. As one participant wrote in a description of a photo he titled “The Rio Un-Grande...” (Figure 15): “No Water at all in one of the world’s most iconic rivers.” Another participant who recently moved to Las Cruces described her first experience seeing the dry Rio Grande:

I expected to see the MIGHTY, flowing river I had always read about. I was astounded when I saw the dry riverbed for the first time. WHAT? Subsequently I educated myself on the Las Cruces section of the river—the dam, winter water diversion and summer fill for irrigation. I was surprised to learn that the flow period has dwindled from ten months to two to four months in recent years due to drought. I am saddened by the devastating effect this has on farming and the local ecosystem. Such a frightening visual of our beautiful earth being ravaged by the environmental change we have anticipated for decades but have failed to address.

Others expressed similar feelings of sadness and frustration over the riverway. A participant who submitted two photos of the nearly empty Rio Grande described them as efforts to “capture both the beauty of the Southwest and the sadness of a drought.” Another who submitted a photo of tracks left by vehicles driving the Rio’s channel (Figure 15) lamented the ecological damage the activity does to the riverway. A third participant, reflecting on the impacts drought and engineering have had on the Rio Grande, wrote: “some of the soul of our landscape and nature itself has been erased.”





**Figure 15:** The dry Rio Grande was a tangible reminder for many participants of the water issues Las Cruces faces (screenshots from the Desert Hydrologies virtual exhibit).

The “Beleaguered River” chapter was also another where dialogues surrounding agriculture and water engineering bubbled to the surface. Interestingly, many of the participants who ventured to discuss the causes associated with the Rio Grande’s dwindling water levels focused more on drought. For some, however, the issue did spur reflection on the ways the river has been altered to deliver water for irrigation. Wrote one participant:



Nearby and visible from where this picture was taken is the dry riverbed of the great Rio Bravo (Rio Grande), fields of pecan trees, and other agriculture—all of which impact the delicate balance of how water and resources in general are used and constructed in the Mesilla Valley.

He went on to write that his photo made him wish that humans' approach to water engineering was "less intrusive to the land." The participant who submitted the vehicle tracks photo, who similarly discussed the ecological impacts of engineering along the Rio Grande in relation to his cottonwood photo featured in the "Flora" chapter, expressed doubt over the future of agriculture in his interview:

I don't think it's sustainable. People keep planting more and more pecan orchards, and I don't know how we're gonna keep doing this for too much longer without some pretty serious consequences.

However, as we have often seen when it comes to local discussions of water and agriculture, participants were generally reticent to cast agriculture as a scapegoat for water concerns. The participant quoted earlier describing her first time seeing the Rio Grande acknowledged that agriculture and engineering contribute to the river's reduced flow but also mentioned the issue's "devastating effect on farming." Even the participants who commented directly on agriculture's sustainability issues tempered their statements to a degree. During his interview, the participant who advocated for "less intrusive" engineering described the Las Cruces area's relationship with agriculture as "challenging" but also expressed that he did not "want to demonize any group." Similarly, the participant who submitted the vehicle tracks photo acknowledged that agriculture, while contributing to the depletion of the Rio Grande, is "hurting too because of the water."

No matter the cause, water levels in the Rio Grande appear to be a tangible and visceral reminder for participants of the water-related challenges their community is facing. For many participants whose photos engaged with this theme, the Rio not only evoked feelings of sorrow and disappointment but also elicited reflection on broader issues related to water scarcity and

human impact on the environment. In some instances, it also led participants to further question the notion of “making the desert bloom” by highlighting the connection between the Rio’s depletion and the legacy of water engineering and agriculture. Whatever the fate of the Rio may be, it seems to be an important means by which participants relate to and interact with water and water issues in Las Cruces.

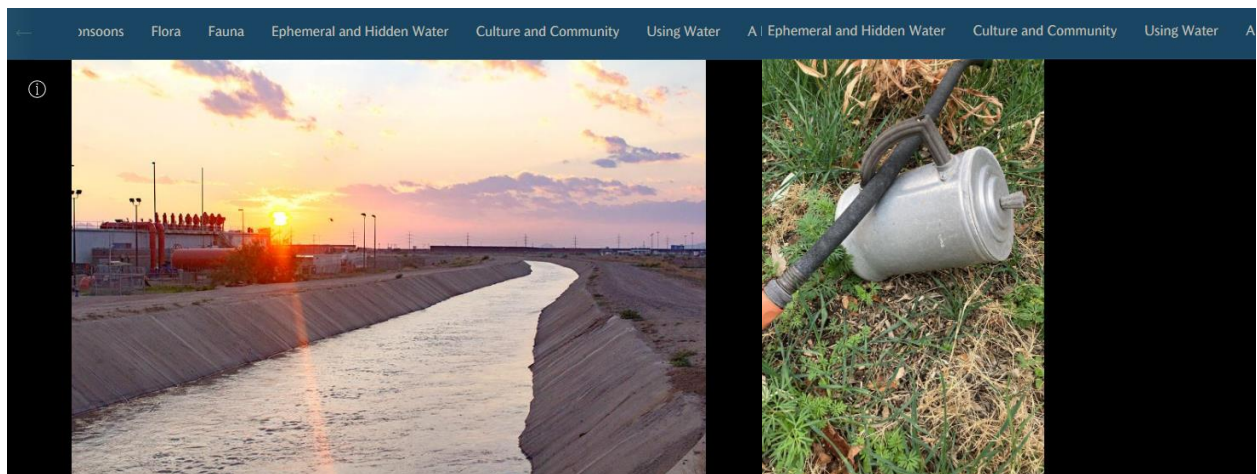
### *Optimism*

The final two chapters of the exhibit, titled “Giving Back” and “The Rio Lives,” encompassed some of the more optimistic dialogues surrounding water in Las Cruces. The four photos in the “Giving Back” chapter mainly featured water conservation and sustainability endeavors, and the three photos in the “Rio Lives” chapter depicted the Rio Grande during the time of year when its channel is full. There was also an additional photo that would have fallen into the “Giving Back” chapter had it been included in the exhibit. These representations of what a better relationship with water might look like in Las Cruces contrasted some of the gloom of the “Beleaguered River” chapter and were featured last to end the exhibit on a hopeful note.

Two of the photos that engaged with the “Giving Back” theme depicted water-saving home landscaping projects, and the other three (including the one that was not featured in the exhibit) portrayed water sustainability at broader scales. Participants focused most of their attention on the human and ecological benefits associated with these subjects. The one who submitted the home landscaping photos highlighted both the environmental merits and the aesthetic value of small-scale water conservation, calling the coffee pot he repurposed for irrigation (Figure 16) “yard art.” A participant who photographed a free-flowing stream, as quoted earlier, described being enthused to find water not confined by a dam or some other type of engineering feature. A

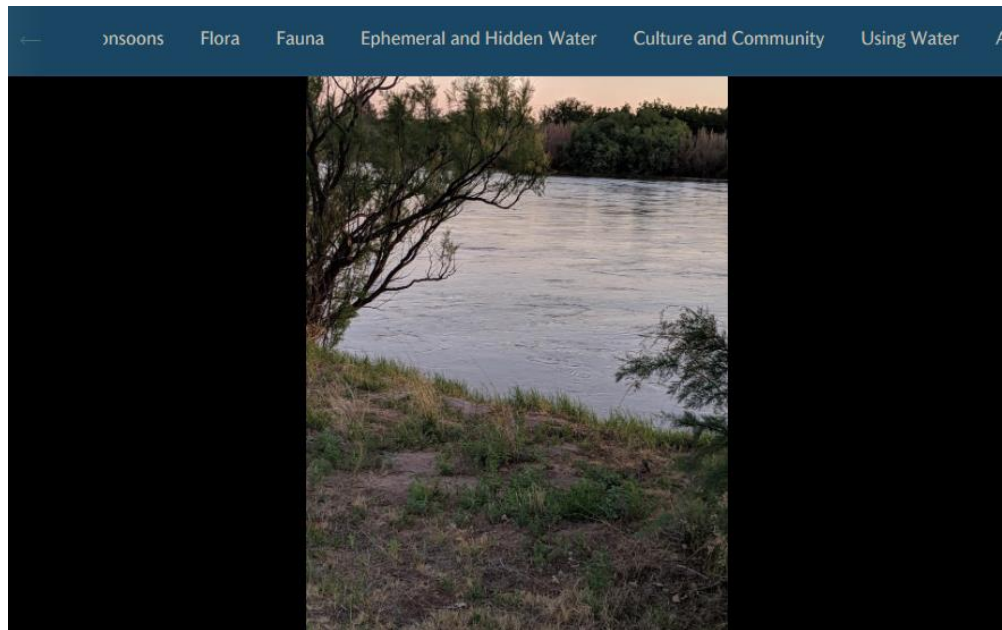
third participant whose photo depicted the aftermath of a controlled burn detailed the way burning both saves water by reducing plant demand and cycles nutrients back into the soil. A fourth participant who submitted a photo of wetland restoration (Figure 16) project along the Rio Grande spoke at length in his interview about the value of providing water for nature:

...I think [the photo] shows how we could use water to sustain the environment. We've used water so far to service ourselves—humanity—but I think we've gotten to a point where we're in a position to give back now. And now that we've channelized all these rivers and have so many dams and such control of water, I think parks like the Rio Bosque that show what we can do with water to service the environment instead of the other way around.



**Figure 16:** Participants depicted various ways water can be given back to nature through their photos (screenshots from the Desert Hydrologies virtual exhibit).

This point of view, one that seemed to be shared among many participants, is similar to those of Sevigny and other writers and scholars who advocate for a more eco-centric view of water in the arid West. It also takes the idea a step further by raising the possibility that human alteration of the natural landscape could cooperate with rather than combat nature. For this participant and the others whose photos engaged with the “Giving Back” theme, the key question seemed to be: How might we “engineer” water for nature’s sake rather than purely our own as we move toward the future in the arid West?



**Figure 17:** A participant’s photo of the Rio Grande “flowing clean” (screenshot from the Desert Hydrologies virtual exhibit).

Photos featured the “Rio Lives” chapter raised similarly provocative questions. As one participant who sent in a photo of the Rio “flowing clean” (Figure 17) pointedly asked:

How do we nourish water rather than just use water? Are the dams really a blessing always?

Like the statements made about the photos in the “Giving Back” chapter, these questions seem to push back on the anthropocentrism that has marked water management in Las Cruces and across the arid West throughout their histories. Other participants whose photos were featured in the “Rio Lives” chapter echoed this sentiment, but also emphasized the river’s value to people as a reason to care for it. For example, the participant who discussed the value of water for nature’s sake in relation to his photo of the wetland restoration project also submitted a photo of a man and a child playing in the Rio Grande. Reflecting on the photo (Figure 18), he wrote about the way the river has enriched the lives of those that have lived near it for generations:

Despite living in the Digital Age, people still flock to the river whenever they can the same way our great ancestors did.... it shows that a living river is a focal point

for communities that have it and serves as a gathering place for bonding and recreation, as its appeal is boundless.

Quite clearly, the human value as well as the intrinsic value of the Rio Grande makes it worth protecting in the eyes of participants as they look toward the future. As the same participant wrote in his survey: “I want to be able to teach my kids how to swim in a river one day.”



**Figure 18:** A participant’s photo of a man and child playing in the Rio Grande. Said the participant about this photo: “This is why the Rio Grande matters” (screenshot from the Desert Hydrologies virtual exhibit).

### Connections and common threads

Though distinct sets of ideas tended to appear around photos depicting different subjects, some unifying observations can be made about what participants had to say about their photos across the board. For one, the subject of water scarcity appeared in dialogues related to just about every chapter theme. Given the high level of engagement with environmental issues participants reported, this was not particularly surprising. One would expect most people who pay close

attention to environmental issues and live in a place like Las Cruces to be very aware of concerns surrounding water supply. However, it is notable that even when discussing photo subjects and themes that brought happiness, such as precipitation, plants, animals, and water conservation, the specter of water scarcity still often came to mind for participants. They frequently framed the ability to continue enjoying these things in the future as a reason to conserve water and pay attention to water issues. Additionally, interviews with participants who associated positive emotion with the subjects they photographed often revealed that their feelings were more mixed than they initially let on in their surveys. The participant mentioned earlier who talked about rain bringing false hope and the one who said rain caused her to reflect on the future viability of her lifestyle are good examples. Another participant I interviewed who had previously spoken at length about the joy she gets from photographing birds along the Rio Grande also discussed the contrasting emotions she experienced during the photography process:

I felt kind of sad.... because when I was walking, I realized that the water I'm seeing is not a true river. It's kind of the stuff that's coming out of the sewage.

Interestingly, in her survey, this same participant pushed back slightly on the idea of the Rio as “not a true river,” arguing that it “is not a lifeless canal as some would have us believe.”—a further indication of the types of conflicting feelings participants associated with water. It truly seemed as though anxiety over water scarcity and potential catastrophe have seeped into even the most enjoyable facets of desert life for participants. The words of one participant describing what he thinks about as he hikes around the desert sum up the feeling quite well:

...it kind of just is like a burden. It sort of weighs on you that you want things to be healthy and alive, you know? And going through the cycles that they're supposed to go through. But it's not. They're not.

Despite this anxiety, however, there were also some more positive sentiments shared among participants. One of these was the sense of appreciation for water that many participants

described feeling as a result of living in the desert. As one put it when writing about a photo of snow she submitted:

Just a reminder of how lucky I am to live in New Mexico where there is so much respect for water and water issues.

Another participant said in her interview that she has developed “more of an appreciation” for water since moving to Las Cruces from California, and a third described respect for water as “just part of living in a dryer desert.” Participants also expressed a deep sense of motivation to raise awareness and help find solutions for water issues. This was not only seen in discussions of photos in the “Giving Back” and “Rio Lives” chapters, but also in dialogues surrounding other photo themes. As mentioned previously, participants frequently used their photos as a call to action of sorts around water issues. Said the participant who submitted the photos of birds along the Rio Grande:

We will need to protect the flow of water in the Rio Grande and make sure it doesn't get pumped dry upstream. Policies will need to be enforced that protect all water birds.

Similarly, the participant who photographed his jacuzzi tub captioned his photo with some words of warning: “Be careful with you water usage, people. It is a precious commodity.” Many others discussed the way water issues compel them to make water-conscious lifestyle choices, such as taking shorter showers, reusing graywater, xeriscaping, etc. While all this again may not be all that surprising given that participants generally came from an environmentally engaged crowd, it does seem that respect and appreciation for water largely lies at the center of their identities as desert dwellers.

A third idea that appeared across multiple photo themes has to do with the various ways participants framed water use and consumption. As mentioned in the first chapter of this thesis, the arid West appears to be in the midst of a widespread rethinking of the ways water has been

managed and used over the course of the region's history. Participants' photos, surveys, and interviews revealed this rethinking being expressed at a local scale in a number of ways. For one, they frequently highlighted the inefficiencies of individual and urban water use. Whether the subject was broken sprinklers, golf courses, or water in the home, they seemed to have a shared desire that water not be taken for granted in the future the way it has been in the past. Said one participant in her interview when asked what she felt were the underlying causes of modern water issues:

Really, it's just the way people use it. Lots of people, they just think it's replenishable—we're always gonna have it, it's always gonna be there—but they don't realize the earth can only produce so much fresh water... I just think that as Americans, we're just: "Gimme what I want, gimme now," and they don't worry about the impact that it has.

Criticisms like this, which were repeated by other participants, ring similar to those often found in broader dialogues around the historical public denial of water's scarcity in the arid West. Participants, like many writers and scholars writing about other places across the region, seemed to have a sense that we have failed to properly acknowledge Las Cruces's status as a desert city and adjust our lifestyles accordingly. Participants also seemed to be questioning (or beginning to question) the legacy of water engineering. As mentioned earlier, their criticisms related to this subject were not as harsh as those seen in broader regional water conversations. Some even argued that water engineering has "pros and cons"—that its impact has not solely been negative. However, there was also a lot of reflection among participants around the issues associated with human engineering of the natural environment. Similar to much recent scholarship on water in the West, participants mourned the loss of the free-flowing Rio Grande, lamented engineering's impact on local landscapes and ecosystems, casted doubt on the merits of dams, and called for a more eco-centric relationship between humans and the natural world. The words of a participant who submitted a photo of the Rio Grande captures these sentiments:



Hard to imagine how this flowed before the dams. Before water rights issues. Before the carelessness that many of us display by tossing stuff that ends up in the Rio.... We grew up thinking we only needed to worry about the campsite downriver from us. Now I begin to understand this water has been here from the beginning and will remain until the end.

## CONCLUSION: REFLECTING ON DESERT HYDROLOGIES

Ultimately, the Desert Hydrologies project proved highly effective in shedding light on local expressions of water dialogues in the arid West. Many of the ideas that came up in participants' photos and surveys mirrored those found in the various water frames and narratives discussed in Chapter One (especially the "water as catastrophe" frame). In many cases, participants' photos and the conversations they generated also offered nuanced interpretations of the water frames they engaged with. For instance, photos of ephemeral and hidden water added dimension to the idea of water as catastrophe by visualizing a metaphorical connection between the fleeting nature of water and civilization in the desert. Similarly, participants' photos of plants, animals, water stewardship practices, and the flowing Rio Grande made tangible the concept of eco-centric thinking and made a compelling visual case for the more-than-human value of water. These examples demonstrate participatory photography's capacity to add texture to the social dynamics of environmental issues by highlighting the extent to which those issues are lived through people's interactions with their local landscapes. Encounters with nature and natural resources are often more than just mundane, everyday occurrences. They are also an important means through which people formulate their understanding of the natural world and humans' place within it.

Encouraging Desert Hydrologies participants to utilize additional avenues for artistry and creative expression through their photos also proved successful. Though most participants chose to edit their photos minimally (or sometimes not at all), those who did were able to add layers of meaning to their photos. For example, one participant discussed the way he gave the sky in his photos a "falsified" pinkish hue to both highlight the rare presence of moisture in the air and to evoke dreams he had of "walking along a golf landscape with this color palette" after a

car accident put him in a coma. Another participant layered multiple images of horizontal lightning bolts in a photo he submitted of an evening monsoon storm. Though he did not comment specifically on what motivated him to do this aside from aesthetics, the photo did a fantastic job of capturing the raw power of monsoon storms, which tend to be short but highly intense.

Participants more often opted to add meaning to their photos through artistic decisions made during the capturing stage of the photography process. Participants, especially those with extensive photography experience, often spoke at length about the ways they used visual language to communicate ideas about water. One participant I interviewed who has been taking photographs for nearly two decades discussed the ways he used leading lines, a common aesthetic device in photography, to draw the viewer into the “sad story” of the dry Rio Grande depicted in his photo. Another participant, a senior photojournalism student at NMSU, described the way he used lighting and composition to accentuate the aesthetic qualities of a canal he photographed funneling treated water toward a restored wetland. According to him, he did this to make what some might feel to be an unsightly humanized landscape around the canal reflect the beauty he sees in the endeavor to provide water for the wellbeing of nature:

I was very deliberate with the composition, because if you follow with your eye the flow of the canal, it kind of whips around and it takes you to where the sun is. It would have worked a bit better if I went a few minutes earlier, but that being said, I’m not sure if I could have got this brilliant streak of orange that cuts through the photo, which is another reason why I chose this picture.... I think the fact there’s a sunset enables it to be a pretty photo, and I think it’s nice to be able to take something human-made and cast it in that light as being pretty. Because I think even though I really love nature and would prefer that the river—the Rio Grande—to be as untouched as possible, that’s not the case anymore, you know?

These are just a few examples of how the Desert Hydrologies project’s engagement with participants’ creativity and artistry added depth and richness to the conversations it produced. As

geography continues its “(re)turn” toward the arts, geographers have a chance to further explore participatory photography as a means of “artistic engagement with place” (Hawkins 2015, 249).

Participants also responded positively to photography as a way of engaging with water and water issues. The survey question asking participants if taking photos influenced the way they think about water usually did not garner an explicit “yes” or “no.” However, the fact that many answered the question by offering further (and sometimes extensive) comments on water suggests that participatory photography was both engaging and generative for them. Even when participants said the photography process did not significantly change their way of thinking about water and water issues, they often noted that it reinforced their convictions related to water and/or made them think more deeply about the subject. As one participant wrote:

Although taking this photo did not change the way I think about water issues, it did make me have some sense of wanting for the way we approach the engineering of our natural world to be less intrusive to the land and the historical cultures of the area.

In his interview, this participant also said he enjoyed the way the project forced him to “think outside the box” when it came to capturing water—something that he said “elevated” the importance of the topic in his mind. Other participants who took photos specifically for the project described similar experiences that influenced their relationships with water. One said that waiting for water to appear so he could photograph it for the project made him “realize just how infrequently it rains” and gave him “a sort of urgency” as he hoped for rain before the submission deadline. “I appreciate it much more now when it rains because I know it will be a while before it does again,” he wrote in his survey. Even some participants who submitted photos they already had on hand said the photography process influenced their thinking around water. Wrote one participant:

...taking this photo caused me to reflect on how I utilize [water] and also the politics involved in the flow of the river and water supply. This caused me to want to be more intentional about conserving water

Another said:

Water and drought are brought to the forefront when I view this photo. Do not waste precious water!

Reactions to the exhibit from viewers were similar to participants' reactions to the photography process. There were a number of viewers who said in their surveys that the exhibit did not change their overall outlook on water and water issues, but the reason typically cited for this was that they were already concerned and engaged with water issues prior to viewing the exhibit. Those whose thinking around water was influenced by the exhibit often gave extensive feedback. Wrote one commenter:

As an individual that moved to the area in 2019, I have heard a lot of opinions and concerns about water consumption impacts here. I've seen some of the examples photographed and discussed but had little context of why it is this way or what sort of changes there have been. This exhibit has given more insight to my questions and impacted the way I think about my own consumption and impacts.

Another exhibit viewer who sent in a survey echoed some of the sentiments of participants around past misuse and mistreatment of water:

...having lived in Las Cruces my entire life, I've seen how water and access to it has changed through the years. As a community, the city probably took water for granted years ago and now we are at a point in time that each year we can see how scarce it's becoming—where we have watering rations, the river is open less each year, etc. So yes, this has given a fresh look that we all have to do our small part to conserve wherever we can for the future of the city and generations to come.

There was also an encouraging reaction to the exhibit from participants. As mentioned earlier, many emailed me with positive feedback in the days immediately following the exhibit launch. In a couple of cases, these emails turned into lengthier conversations about water and water issues with participants who were curious to know more about what the future of water might look like in Las Cruces. I also noticed that several participants shared the link to the

exhibit via their social media pages, which to me indicates they were at least somewhat excited about it. In addition to this, it appears that the exhibit made an impression on participants that lasted beyond the days immediately following its launch. Just a few days ago, nearly two months after the exhibit first went live, I received an email from a participant who said he recently showed the exhibit to a friend of his.

The feedback I received on the photography process and the exhibit bodes well for the future of participatory photography in human-environment research. Desert Hydrologies was able to generate what I felt was a fairly decent amount of buzz around the subject of water for its size. This makes it exciting to think about what an expanded version of a project like Desert Hydrologies might look like. What if the survey component were made optional and photos were collected in a way more akin to crowdsourcing? Could things like recorded soundbites be curated along with photos to more fully capture participants' experiences of place related to the research topic? While these things might involve more work for the researcher and sacrifice some ability to obtain detailed perspectives from participants, they might also result in a project that attracts more attention and engagement.

This is not to say that a project similar in size to Desert Hydrologies is of limited value, however. There are many areas of human-environment research in which participatory photography projects with modest amounts of participants can be useful, even optimal. For instance, in fields like political and cultural ecology that often focus on smaller communities, participatory photography would fit very nicely into the qualitative research process. In fact, many of the existing participatory photography projects that focus on human-environment relationships have been part of broader political and cultural ecology studies (Berbés-Blázquez 2012; Bignante 2010; Maclean and Woodward 2012; Margulies 2019). Smaller participatory

photography projects might also be useful in areas like the spatial humanities, where some recent work has been done to spatialize and map human experiences of nature and the environment (Bauch 2016; Cooper and Gregory 2011). Some of this work has already utilized photography. Nicholas Bauch's (2016) web monograph "Enchanting the Desert" used photos of the Grand Canyon taken by an early-twentieth-century landscape photographer to "spatially narrate the cultural history" of the national park. Might participant-submitted photos be similarly used to "spatially narrate" people's interactions with nature, landscape, and or environmental issues? While the StoryMap component of the Desert Hydrologies project did add a small degree of spatial dimension to participants' photos, there is much room to explore this potential application of participatory photography.

For future projects like Desert Hydrologies that focus on a small portion of a broader community, there are several recommendations I would make. One is to find ways to involve people from more sectors of the local community. Due to the financial limitations of being a graduate student and the social limitations of being new to Las Cruces, finding ways to disseminate the recruiting call for the project outside of the circles I was connected to via my university was difficult. As a result, the project appeared to mostly reach members of the community who were white, middle to upper-middle class, and already concerned with water issues. The project still produced valuable insights despite this, but it would be interesting to explore the capacity of a project like Desert Hydrologies to engage people of a wider variety of backgrounds. Another recommendation of mine has to do with photo submission requirements and deadlines. Though requiring participants to take brand new photos for the first submission deadline initially impeded participation, it was helpful to have some participants who could speak to the ways the affective process of taking photos impacted their thinking on water and

water issues. Were I to do this project again, I would keep the initial stipulation that photos must be new but move up the first photo submission deadline. There were almost three months between the start of recruiting for Desert Hydrologies and the first photo submission deadline, yet only seven photo submissions were sent in during this period. Knowing now that more time does not necessarily equate to more photo submissions, I expect that shortening the first photo submission period and getting to second submission period (with the relaxed photo requirements) sooner would have yielded more participants.

These shortcomings aside, the Desert Hydrologies project largely accomplished what it set out to do. The initial goal of thirty or more participants was reached, response to the project was positive, and it both uncovered and produced some interesting dialogues around water, water issues, and water-society relationships. There are many things that make participatory photography a useful means of studying how people relate to the world around them. Not only is it a fun and engaging way to bring a community into a research project, it also produces byproducts—photos—that are naturally suited to relating what comes out of the research project to a broader audience. As many participants and exhibit viewers said to me, photography is very much a “universal language”—one that has the potential to speak across the often harsh borders imposed by things like distance, ideology, and culture. For projects like Desert Hydrologies, the photos they feature have the unique ability to elucidate experiences of place, landscape, nature, and environmental issues through both visualization and creative expression. Geographers and other humanists who study human-environment relationships have put a great deal of effort into understanding, as Cooper and Gregory (2011) put it, “the phenomenological experience of being in the world.” As we look toward the future, participatory photography stands out as a potentially valuable means of achieving this goal.



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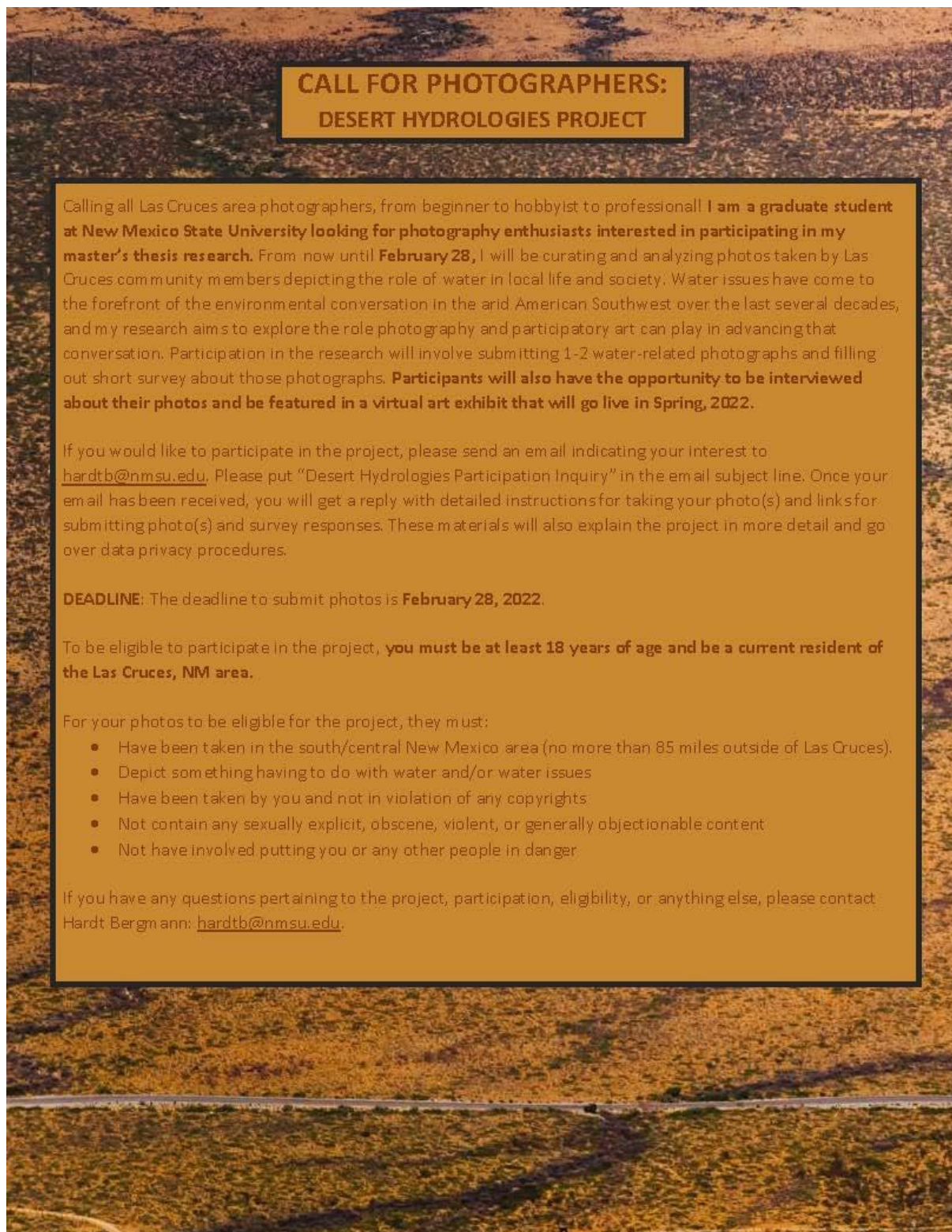
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## APPENDIX A: RECRUITING CALL FOR DESERT HYDROLOGIES (UPDATED FOR EXTENDED DEADLINE)



**CALL FOR PHOTOGRAPHERS:  
DESERT HYDROLOGIES PROJECT**

Calling all Las Cruces area photographers, from beginner to hobbyist to professional! **I am a graduate student at New Mexico State University looking for photography enthusiasts interested in participating in my master's thesis research.** From now until **February 28**, I will be curating and analyzing photos taken by Las Cruces community members depicting the role of water in local life and society. Water issues have come to the forefront of the environmental conversation in the arid American Southwest over the last several decades, and my research aims to explore the role photography and participatory art can play in advancing that conversation. Participation in the research will involve submitting 1-2 water-related photographs and filling out short survey about those photographs. **Participants will also have the opportunity to be interviewed about their photos and be featured in a virtual art exhibit that will go live in Spring, 2022.**

If you would like to participate in the project, please send an email indicating your interest to [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu). Please put "Desert Hydrologies Participation Inquiry" in the email subject line. Once your email has been received, you will get a reply with detailed instructions for taking your photo(s) and links for submitting photo(s) and survey responses. These materials will also explain the project in more detail and go over data privacy procedures.

**DEADLINE:** The deadline to submit photos is **February 28, 2022.**

To be eligible to participate in the project, **you must be at least 18 years of age and be a current resident of the Las Cruces, NM area.**

For your photos to be eligible for the project, they must:

- Have been taken in the south/central New Mexico area (no more than 85 miles outside of Las Cruces).
- Depict something having to do with water and/or water issues
- Have been taken by you and not in violation of any copyrights
- Not contain any sexually explicit, obscene, violent, or generally objectionable content
- Not have involved putting you or any other people in danger

If you have any questions pertaining to the project, participation, eligibility, or anything else, please contact Hardt Bergmann: [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu).



## APPENDIX B: PHOTOGRAPHY PROMPT FOR DESERT HYDROLOGIES PARTICIPANTS

### PHOTOGRAPHY PROMPT: DESERT HYDROLOGIES PROJECT

Water is a key area of environmental concern in Las Cruces and the greater American Southwest. It has permeated popular myth, sparked bitter conflict, created complex political and legal conundrums, and posed threats to the wellbeing of the region's residents (both human and non-human) as it has disappeared with increasing rapidity over the decades. Though we live in a place known for its dryness, water arguably plays a larger role in society here in the desert than it does in places with abundant water. As we look for ways to better understand our relationship with water in this arid environment, photography stands out as a practical and accessible way to explore and represent that relationship.

The Desert Hydrologies Project will involve curating photos and seeking perspectives on water and water issues from Las Cruces community members. Participants will submit photos, provide thoughts on their photos in a short survey, and have a chance to be interviewed about their photos. **The project will culminate in virtual exhibit featuring participants' photos that will go live in spring, 2022. The exhibit is open to all participants, but it is not required!** If you would rather not have your photo(s) featured in the exhibit, you can indicate that preference on the [Desert Hydrologies Photo Submission Form](#). You also have the option to have your photo(s) featured but be credited for them anonymously or with an alternative name. The exhibit will be hosted by ArcGIS StoryMaps, a digital mapping and storytelling platform created by the Environmental Systems Research Institute (ESRI). The exhibit will be publicly viewable. Viewers will be able to leave comments on the exhibit and fill out private surveys about their viewing experience.

This project is part of my master's thesis research (NMSU geography), which will be completed in summer, 2022.

#### Steps for participating in the project:

1. Read this prompt.
2. Take photos or find some you already have that fit the theme (see "What kind of photo(s) should I submit?" section below). Taking new photos is encouraged, but old photos are acceptable.
3. Submit photo(s) and fill out survey via the [Photo Submission Form](#). **Limit is 2 photos per person.**
4. OPTIONAL: If participating in the Desert Hydrologies Virtual Exhibit, fill out the [Exhibit Entry Form](#).
5. OPTIONAL: Fill out the [Supplementary Survey](#).

**DEADLINE FOR SUBMISSIONS:** Monday, February 28 (by 11:59 pm)

**All photos must:** have been taken approximately 85 miles or less outside of Las Cruces; depict something related to water/water issues; have been taken by you and not be in violation of any copyrights; not contain sexually explicit, obscene, violent, or objectionable content; and not have involved putting you or anyone else in danger.

#### What kind of photo(s) should I submit?

Submit photos that depict how you perceive or relate to water in the context of our arid local environment here in Las Cruces. What role(s) does water play in daily life? What is the importance of water to life and society here in Las Cruces and the greater arid Southwest? When you hear the word "water" associated with Las Cruces and its desert surroundings, what images come to mind? These are some examples of questions you can keep in mind to help guide your photography process. Feel free to think outside the box with your photos! They can depict anything from actual water features (e.g. rain, snow, storms, puddles, lakes, rivers, reservoirs) to things more abstractly related to water, like dry riverbeds, canals, crop fields, or gardens. You may also choose to take photos that comment on water-related environmental issues like climate change, drought, threats to wildlife and ecosystems, etc. Your photos do not have to depict outdoor subjects or landscapes. A photo of your kitchen faucet, bathtub, or a bottle of water is just as acceptable as a photo of a lake, river, or irrigated field. You are also encouraged to edit your photos if you'd like (e.g. cropping, filters, adjusting in Photoshop or Lightroom), but this is not a requirement. **Photos can be taken using any device you'd like (cell phone, disposable camera, point-and-shoot camera, DSLR camera, etc.).** If you have any questions or need anything clarified, please reach out to Hardt Bergmann: [hardt@nmsu.edu](mailto:hardt@nmsu.edu). Happy shooting!

APPENDIX C: DESERT HYDROLOGIES PHOTO SUBMISSION FORM (PRINTED AS PDF  
FROM SURVEY123 WEBPAGE)

## Desert Hydrologies Photo Submission Form

The following survey allows you to submit photos and answer a few questions about your photo(s), the thought process that went into your photo(s), and your experience with the photography process. **Please fill out the survey once for each photo you submit.** Questions marked with a red asterisk are required - the survey cannot be submitted if they are unmarked.

### INFORMED CONSENT

**Please read items 1-10 and fill out item 11 to confirm your willing participation in this research.**

#### Project Title

*Desert Hydrologies: Assessing and developing water discourse in southern New Mexico through participatory photography*

#### Researcher

Carl (Hardt) Bergmann  
Master's Student  
New Mexico State University  
Department of Geography  
(651) 528-3543 - [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu)

#### Researcher's Advisor

Dr. Eric Magrane  
Assistant Professor  
New Mexico State University  
Department of Geography  
(575) 646-6494 – [magrane@nmsu.edu](mailto:magrane@nmsu.edu)

#### Research Description

I, Hardt Bergmann, am a master's student in the Department of Geography at New Mexico State University. For my master's thesis, I am investigating local perceptions of water and water issues in the Las Cruces area using mixed qualitative methods and participatory photography. For a complete description of the research project and what you will be asked to do as a participant, please refer to the "Background" section of the photography prompt you received in response to your participation inquiry email.

## Eligibility Criteria

To be eligible to participate in the project, **you must be at least 18 years of age and be a current resident of the Las Cruces, NM area.**

For your photos to be eligible for the project, they must:

- Have been taken in the Las Cruces area (**no more than 40 miles outside of town**)
- Depict something having to do with water and/or water issues
- Have been taken by you and not in violation of anyone else's copyright
- Not contain any sexually explicit, obscene, violent, or generally objectionable content
- Not have involved putting you or any persons in the photo in danger

## Voluntary Participation

Your participation in this research is voluntary. You may withdraw from this research at any time. If you decide to withdraw your participation, you will experience no penalties or loss of benefits to which you are not otherwise entitled.

## Confidentiality

All photos and survey responses you provide are being collected using ArcGIS Survey123 by ESRI. Survey123 submissions/data for this project will be stored on ESRI's secure servers and only be accessible via my or my advisor's password-protected ESRI account. All data downloaded from Survey123 will be stored in a secure, password-protected folder encrypted using VeraCrypt software. Submissions/data will be not shared with anyone other than myself and my advisor.

## New Information

Any new information obtained during this research that may affect your willingness to continue your participation will be provided as soon as it comes to light.

## Risks and Benefits

No major physical or psychological risks are expected to arise from this project. Some of the data you provide, such as opinions expressed in your photo submission form or demographic information you provide in the supplementary survey, may be considered private. To protect your photo(s) and the data you provide, everything you submit will be stored in an encrypted digital folder.

As part of your participation in this research, you can choose to have your photo(s) featured in a public online exhibit associated with the project. This could potentially allow you to get more eyes on your work! More information on the exhibit can be found in the Desert Hydrologies Virtual Exhibit Entry Form. The photos and other data you provide may also help spread awareness about water issues in the Southwest and contribute to research exploring new methods of public engagement in environmental issues.

## Consent to participate\*

By answering "yes" below, you voluntarily consent to participate in this research. You should only consent if you have read items 1-10 above (or have had them read to you) and fully understand their contents. If you have questions about this research and/or your participation in it, contact Carl (Hardt) Bergmann at [hardt@nmsu.edu](mailto:hardt@nmsu.edu). If you have questions about your rights as a research subject/participant, please contact the New Mexico State University Institutional Review Board (IRB) Chair through the Office of Research Compliance at New Mexico State University: (575) 646-7177 – [ovpr@nmsu.edu](mailto:ovpr@nmsu.edu)

Yes, I consent to participate in this research

No, I do not consent to participate in this research

What is your name?

Please provide first and last.

Please upload a JPEG file of the photo you would like to submit here.\*

Maximum file size is 10 mb.

**IMPORTANT NOTE: If you took your photo inside your home or on your property and you used a cell phone or another device with a built-in GPS feature, please ensure that the photo coordinates are not included in the file properties before you submit.**

Select file (support: jpeg, jpg)

What is the title of your photo?

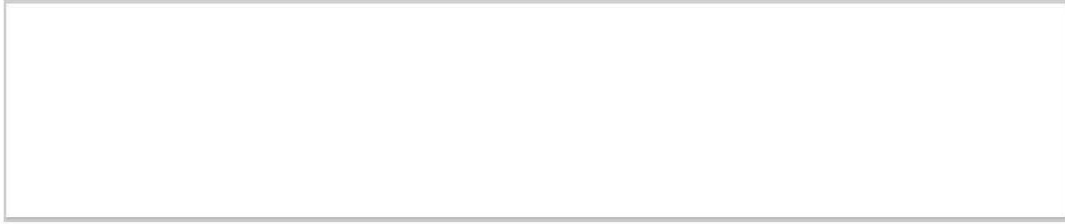
Feel free to be as creative as you'd like!

Where was your photo taken?

You can provide GPS coordinates, a nearby address or intersection, a nearby landmark, neighborhood, or anything that provides a general sense of where you were when you took this



photo. If your photo was taken inside your home or on your property, please **DO NOT** provide an exact address or coordinates.



When was your photo taken?

Exact date would be best, but an approximate or estimated date works too (e.g. month/year, season/year, or just year).



What did you use to take your photo?

For example: cell phone, disposable camera, point-and-shoot camera, DSLR camera, etc.



What does your photo depict?

Please describe in as much detail as possible.



Did you make any artistic decisions while you were taking your photo (e.g. lighting, angle/composition, etc.)? If so, why?

Yes

No

**OPTIONAL: Artist statement for project exhibit**

If you answered yes to the above question and you would like to add an artist statement to accompany your photo in the exhibit, please add one below. Your artist statement can be a **maximum of 150 words**.

Would you like to be contacted for an extended interview about your photo(s)?\*

Interviews can be conducted in person or through Zoom depending on your availability and preference. If you select Yes, you can expect to be contacted in mid-February, 2022.

Yes

No

**If you answered yes to the above question, please provide your contact information below.**

Home phone

Cell phone

Email

Please select your preferred method(s) of contact.

If nothing is selected, email will be the default option.

Email

Phone call

Text message

Thanks so much for your photos and survey responses! If you indicated interest in an extended interview, you will most likely be contacted in December or January. Please feel to reach out to the the researcher, Hardt Bergmann, at [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu) if you have any questions.

Submit

APPENDIX D: DESERT HYDROLOGIES VIRTUAL EXHIBIT ENTRY FORM (PRINTED  
AS PDF FROM SURVEY123 WEBPAGE)

## Desert Hydrologies Virtual Exhibit Entry Form

Please read the following form carefully and ensure that you answer all questions.

### Project Title

*Desert Hydrologies: Assessing and developing water discourse in southern New Mexico through participatory photography*

### Researcher

Carl (Hardt) Bergmann  
Master's Student  
New Mexico State University  
Department of Geography  
(651) 528-3543 - [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu)

### Researcher's Advisor

Dr. Eric Magrane  
Assistant Professor  
New Mexico State University  
Department of Geography  
(575) 646-6494 – [magrane@nmsu.edu](mailto:magrane@nmsu.edu)

### Research Description

I, Hardt Bergmann, am a master's student in the Department of Geography at New Mexico State University. For my master's thesis, I am investigating local perceptions of water and water issues in the Las Cruces, New Mexico area using mixed qualitative methods and participatory photography.

You are being asked to fill out this form because you indicated that you would like your photo(s) featured in the Desert Hydrologies Virtual Exhibit. The exhibit will be hosted online using ArcGIS StoryMaps (by ESRI) and will go live in spring, 2022. The exhibit will contain all photos submitted by participants who chose to have their photo(s) featured in the exhibit. It will also include the artist statements each participant wrote in their photo submission forms (if you opted to leave this section of the form blank, no artist statement will be included in the exhibit). Additionally, participants have the option to have their names and social media handles included in the exhibit with their photo(s). You can indicate your preferences in these regards in the "Copyright Use/Permissions" section of this form. The exhibit will be advertised through New Mexico State University and various other local channels, and the URL for the exhibit will be shared with all research participants as soon as it is launched. Participants may share the URL with whomever they would like. The exhibit will also include a public message board to allow participants and



viewers to leave comments and a link allowing viewers to take private, anonymous surveys about their viewing experience.

More information about ArcGIS StoryMaps can be found [here](#).

### Eligibility Criteria

Participation in the exhibit is limited to project participants who indicated on their photo submission forms that they would like to have their photo(s) featured in the exhibit.

### Risks and Benefits

No major physical or psychological risks are expected to arise as a result of the exhibit. As with any situation in which photos are posted publicly online, viewers downloading or screenshotting your photo(s) for their own use is a potential concern. It should be noted that you are automatically granted copyrights over your photo(s) as soon as you take them, and you are within your rights to take legal action against anyone who uses your photo without proper consent (more on photo copyrights in the "Copyright Use/Photo Credits" section of this form). If the possibility of unfair use of your photos is a concern to you, you may wish to add a watermark with a copyright symbol to your photos before submitting them.

Your participation in the exhibit will not only help spread awareness about water and water issues, it will also provide you a chance to have your photos seen by more people! If you have social media pages where you often post your photography, you have the option to have your social media handle(s) included along with your photo(s) in the exhibit (see "Copyright Use/Photo Credits" section below). You may want to delete this from the survey.

### Voluntary Participation

Your participation in the exhibit is voluntary. You may withdraw your photo(s) from the exhibit at any time, even after the exhibit has gone live. If you decide to withdraw your photo(s), you will experience no penalties or loss of benefits to which you are not otherwise entitled.

### New Information

Any new information obtained during this research that may affect your willingness to continue your participation will be provided as soon as it comes to light.

## Copyright Use and Photo Credits

As a photographer, you are granted an automatic copyright over each photo you take as soon as you press the shutter button. This copyright lasts 70 years, and it grants you exclusive rights to the image you created. This includes the right to reproduce your photography, create derivative works based on your photography, distribute copies of your photography, and publicly display your photography. More on photo copyrights can be found [here](#).

Since you are the copyright holder of your photo(s), you will indicate how you would like to be credited for your photo(s) in the exhibit below. Please fill in the following information:

Name\*

Please enter your name the same as you did on your photo submission form.

Photo Title(s)\*

How would you like to have your photo(s) credited in the exhibit?\*

Please check **one** box.

Please credit me as the photographer with my full name as I entered it on this form and on my photo submission form

Do not credit me as the photographer (your photo will be given an "anonymous" credit if you select this option)

Please credit me as the photographer, but use a different name from the one I put on my photo submission form (enter below)

Would you also like to include a link to your Instagram page, website, or other place where you share/distribute your work?\*

Yes

No

If you answered yes to the above question, please list all social media handles, URLs, addresses, or other information about places you share

your work here:

## Research Confidentiality

As I write up the final results of this research, situations may arise in which it is useful for me to specifically reference or quote one or multiple parts of your responses to the questions in the photo submission form. Should this happen, I will leave out your name and any other specific identifiers associated with your responses. However, if the responses I reference or quote contains information about the photo(s) you submitted, and you chose to both participate in the exhibit and be credited by name and/or social media handle(s), it may be possible for a reader to link you to your survey response(s) by finding your photo(s) in the exhibition. **If you would like me to refrain from including information about specific elements of your photo(s), such as the title or specific places, landmarks, or other elements depicted in the photo(s), please indicate that preference below.** Should you choose to have me omit specific references to your photo(s), I may still reference or quote your responses, but I will not include any information about your photo within or along with those quotes or references.

Would you like me to refrain from specifically referencing your photo in the final write-up of this research?\*

Check one of the two boxes. **Please read the above "Research Confidentiality" section carefully before answering this question.**

Yes, please refrain from specifically referencing my photo(s)

No, I do not mind if you specifically reference my photo(s)

## Permission to use photo(s) in the virtual exhibit\*

Answering "yes" below certifies the answers to the above questions and indicates that you are giving the researcher permission to use the following in the Desert Hydrologies Virtual Exhibit:

- The photo(s) you submitted
- Your artist statement from the Desert Hydrologies Photo Submission Form
- The name and social media handle(s) you chose to be credited with

You should only answer "yes" if you have read this entire form (or have had it read to you) and fully understand its contents. If you have questions about the exhibit, the research project, and your participation in them, contact Hardt Bergmann at [hardt@nmsu.edu](mailto:hardt@nmsu.edu). If you have questions about your rights as a research subject/participant, please contact the New Mexico State

University Institutional Review Board (IRB) Chair through the Office of Research Compliance at  
New Mexico State University: (575) 646-7177 – [ovpr@nmsu.edu](mailto:ovpr@nmsu.edu)

Yes

No

Submit

APPENDIX E: DESERT HYDROLOGIES SUPPLEMENTARY SURVEY (PRINTED AS PDF  
FROM SURVEY123 WEBPAGE)

Desert Hydrologies Supplementary Survey

This second, **optional** survey will ask you to provide a little more information about yourself, how you engage with the environment and environmental issues, and your experience with photography. Questions marked with a red asterisk are required - the survey cannot be submitted if they are left blank.

**The same informed consent information from the Desert Hydrologies Photo Submission Form applies to this survey.** If you would like to review that information, please re-open that form and read through items 1-10. By submitting this survey, you are consenting to have your responses included in the data for this research.

What is your name?

Please provide the same name you provided on your photo submission form so that the your responses to both surveys can be matched.

What are your preferred gender pronouns?\*

She/her/hers

He/him/his

They/them/theirs

Prefer not to say

Other (enter below)

Which of these best describes your age range?\*

18-24

25-29

30-34

35-39

40-44

45-49

50-55

55-59

60-64

65+

Prefer not to say

Are you of Hispanic, Latino, or Spanish origin?\*

Select multiple if more than one apply.

No, not of Hispanic, Latino, or Spanish origin

Yes - Mexican, Mexican-American, Chicano

Yes - Puerto Rican

Yes - Cuban

Prefer not to say

Yes - another Hispanic, Latino, or Spanish origin (enter below)

Which of these best describes you?\*

Select all that apply.

Black or African American

American Indian or Alaskan Native

Asian

Native Hawaiian/other Pacific Islander

Prefer not to say

Something not listed here (enter below)

Which of these best describes your annual household income?\*

Less than \$20,000 per year

\$20,000-\$40,000 per year

\$40,000-\$60,000 per year

\$60,000-\$80,000 per year

\$80,000-\$100,000 per year

More than \$100,000 per year

Prefer not to say

How long have you been living in Las Cruces?\*

Less than 2 years

3-5 years

5-10 years

More than 10 years

Prefer not to say

Check this box if you have been living in Las Cruces your entire life.

<

Check this box if you moved away from Las Cruces and then returned.

<

If you checked the box for question 9, how long were you away from Las Cruces?

To the level of specificity that you are comfortable with, explain what you do for a living.

For example: student, school teacher, retail worker, business executive, etc.



How concerned are you about environmental issues?\*

They are of utmost importance/concern (should be at the very top of the political agenda)

They are of great importance/concern

They are of moderate importance/concern

They are of little importance/concern

They are of no importance/concern (should not even be on the political agenda)

Prefer not to say

10. How do you normally engage with the environment and environmental issues?\*

Select all that apply.

I pay close attention to environmental news (newspapers, magazines, TV news, etc.)

I frequently post on social media and share news about environmental issues

I volunteer with environmental groups/organizations

I donate to environmental organizations/causes

I try to live a sustainable lifestyle (e.g. buying local, reducing carbon footprint, reducing water use, etc.)

I study or work in a field that intersects with environmental topics/issues

I spend a lot of time outdoors (hiking, running, biking, gardening, etc.)

I do not frequently engage with the environment/environmental issues, and I am fine with that

I do not frequently engage with the environment/environmental issues, but I would like to engage more than I do

Prefer not to say

I engage with the environment/environmental issues in a way not listed here (enter below)

Feel free to expand on any of the answers you provided for question 13 here:

Which of these best describes your prior experience with photography?\*

Neophyte: I rarely take photos and have minimal photography experience or

knowledge.

Beginner: I like to casually take photos with my phone, but I don't have much photography experience or knowledge beyond that.

Point-and-shoot: I frequently take photos with my phone and/or camera, but I do not usually edit my photos or pay close attention to camera settings and composition

Enthusiast: I frequently take photos with my phone/camera, and I know some basic camera settings, composition techniques, editing techniques.

Hobbyist: I consider photography a hobby. I pay close attention to camera settings, image formats, lighting, composition, etc., and I know a number of advanced editing techniques.

Professional: Advanced photography is or has been part of my job.

Prefer not to say

Thanks so much for taking the time to fill out the supplementary survey! If you have any questions or concerns, please reach out to Hardt Bergmann: [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu).

Submit

APPENDIX F: DESERT HYDROLOGIES EXHIBIT VIEWER SURVEY (PRINTED AS PDF  
FROM SURVEY123 WEBPAGE)

## Desert Hydrologies Exhibit Viewer Survey

The following survey will ask you for some basic demographic information and your impressions/opinions on the Desert Hydrologies Virtual Exhibit. **This survey is completely anonymous.**

### INFORMED CONSENT

**Please read items 1-19 and fill out item 10 to confirm your willing participation in this research.**

#### Project Title

*Desert Hydrologies: Assessing and developing water discourse in southern New Mexico through participatory photography*

#### Researcher

Carl (Hardt) Bergmann  
Master's Student  
New Mexico State University  
Department of Geography  
(651) 528-3543 - [hardtb@nmsu.edu](mailto:hardtb@nmsu.edu)

#### Researcher's Advisor

Dr. Eric Magrane  
Assistant Professor  
New Mexico State University  
Department of Geography  
(575) 646-6494 – [magrane@nmsu.edu](mailto:magrane@nmsu.edu)

#### Research Description

I, Hardt Bergmann, am a master's student in the Department of Geography at New Mexico State University. For my master's thesis, I am investigating local perceptions of water and water issues in the Las Cruces, New Mexico area using mixed qualitative methods and participatory photography.

The following survey will ask you for to provide basic demographic information as well as some thoughts on the Desert Hydrologies Virtual Exhibit. Your survey responses will help me gauge public reaction to the exhibit and its environmental themes.

### Eligibility

To take the survey, you must have viewed the Desert Hydrologies Virtual Exhibit and **be 18 years of age or older**.

### Risks and Benefits

No major physical or psychological risks are expected to arise from this research. The survey is completely anonymous, and all data collected from the survey is protected by Survey123's secure servers. Any data downloaded from Survey123 will be stored in an encrypted digital folder.

Your input will help develop research that explores public perceptions of water and water issues in Las Cruces and new strategies for environmental outreach and public engagement.

### Voluntary Participation

Your participation in this research is voluntary. Completion of this survey is completely optional, even if you begin filling it out and change your mind.

### Confidentiality

This survey is anonymous, and all survey responses will be kept confidential. All data collected via this survey will be stored on ESRI's secure servers and only be accessible via my or my advisor's password-protected ESRI account. All data downloaded from Survey123 will be kept in a secure, password-protected folder encrypted using VeraCrypt software. The folder will not be shared with anyone other than myself and my advisor.

### Consent to participate\*

By answering "yes" below, you voluntarily consent to participate in this research. You should only consent if you have read items 1-10 above (or have had them read to you) and fully understand their contents. If you have questions about this research and/or your participation in it, contact Carl (Hardt) Bergmann at [hardt@nmsu.edu](mailto:hardt@nmsu.edu). If you have questions about your rights as a research subject/participant, please contact the New Mexico State University Institutional Review Board (IRB) Chair through the Office of Research Compliance at New Mexico State University: (575) 646-7177 – [ovpr@nmsu.edu](mailto:ovpr@nmsu.edu)

Yes, I consent to participate in this research

No, I do not consent to participate in this research

What are your preferred gender pronouns?\*

She/Her/Hers

He/him/his

They/them/theirs

Prefer not to say

Other (enter below)

Which of these best describes your age range?\*

18-24

25-29

30-34

35-39

40-44

45-49

50-54

55-59

60-64

65+

Prefer not to say

Are you of Hispanic, Latino, or Spanish origin?\*

Select multiple if more than one apply.

No, not of Hispanic, Latino, or Spanish origin

Yes - Mexican, Mexican-American, Chicano

Yes - Puerto Rican

Yes - Cuban

Prefer not to say

Yes - another Hispanic, Latino, or Spanish origin (enter below)

Which of these best describes you?\*

Select all that apply.

Black or African American

American Indian or Alaskan Native

Asian

Hawaiian/other Pacific Islander

Prefer not to say

Something not listed here (enter below)

Which of these best describes your annual household income?\*

Less than \$20,000 per year

20,000-\$40,000 per year

\$40,000-\$60,000 per year

\$60,000-\$80,000 per year

\$80,000-\$100,000 per year

More than \$100,000 per year

Prefer not to say

How did you hear about the exhibit?

What made you want to view the exhibit?

How would you describe your interest in photography?\*



I'm generally not that interested in photography

I have some interest in photography

I am moderately interested in photography

Photography is one of my preferred/favorite art forms

I love photography! I consider myself a photography enthusiast/hobbyist.

I am a professional photographer.

Prefer not to say

How concerned are you about environmental issues?\*

They are of utmost importance/concern (should be at the very top of the political agenda)

They are of great importance/concern

They are of moderate importance/concern

They are of little importance/concern

They are of no importance/concern (should not even be on the political agenda)

Prefer not to say

How do you normally engage with the environment and environmental issues?\*

Select all that apply.

I pay close attention to environmental news (newspapers, magazines, TV news, etc.)

I frequently post on social media and share news about environmental issues

I volunteer with environmental groups/organizations

I attempt to live a sustainable lifestyle (e.g. buying local, reducing carbon footprint, reducing water use, etc.)

I study or work in a field that intersects with environmental topics/issues

I spend a lot of time outdoors (hiking, running, biking, gardening, etc.)

I do not frequently engage with the environment/environmental issues, and I am fine with that

I do not frequently engage with the environment/environmental issues, but I would like to engage more than I do

Prefer not to say

Other (enter below)

What did you like about the exhibit?

What did you dislike about the exhibit?

Did the exhibit provide you any new perspectives on water/water issues or make you think differently about those subjects? Explain.

Thank you for taking the time to fill out the survey!

Submit

## APPENDIX G: NMSU IRB APPROVAL MEMO FOR DESERT HYDROLOGIES PROJECT



### Office of the Vice President for Research

#### INSTITUTIONAL REVIEW BOARD (IRB)

**Dr. Merranda Romero Marin, Chair**

MSC 3 RES

New Mexico State University

P.O. Box 3001

Las Cruces, NM 88003-8001

Phone: 575-646-7177

Fax: 575-646-2480

Email: [ovpr@nmsu.edu](mailto:ovpr@nmsu.edu)

DATE: October 6th, 2021  
FROM: The Office of Research Integrity and Compliance  
TO: Carl Bergmann  
Faculty Advisor: Eric Magrane  
Department Head: Carol Campbell  
SUBJECT: **Decision Memo for Application #22135**

Project Title: Geography Masters Thesis Research  
Application Type: New  
Review Type: Expedited  
Approval Period: 2021-10-06 - 2022-10-05  
Parent Application:  
Review Category: 6, 7

The NMSU Institutional Review Board Chair, Dr. Merranda Marin, has reviewed and approved the above application for the conduct of research involving human subjects.

The application was reviewed in accordance with the review process outlined in 45 CFR 46.110(b)(1) - Category 6, 7.

The research must be conducted according to the proposal/protocol that was approved by the IRB. Any changes in the research, instruments, or the consent document(s) must be submitted to the IRB prior to implementation. Additionally, any unexpected hazards or adverse events involving risk to the subjects or others must be reported immediately to the IRB, using the appropriate form, within the time frame specified in the NMSU Principles and Procedures for the Conduct of Research Involving Human Subjects.

Note: Data collected during a period of lapsed approval is unapproved research and can never be reported or published as research data.

Please note that the IRB approval is valid for one (1) year. Pursuant to NMSU institutional policy, the IRB must review and approve all research protocols involving human subjects at intervals appropriate to the degree of risk, but no less than once per year. Therefore, in order to continue your project after the above approved period, you must submit an annual Status Report prior to the above-referenced approval period.

Given the current COVID-19 outbreak, investigators should consider whether at any point their research procedures should be revised to limit personal contacts, for example by reducing or eliminating in-person visits or replacing in-person interviews with telephone or Internet contacts. Researchers must ensure that they are not endangering the safety of participants in the current pandemic.

If you should have any questions, please do not hesitate to contact the Office of Research Integrity and Compliance at 646-7177 or via e-mail at [ovpr@nmsu.edu](mailto:ovpr@nmsu.edu).

## APPENDIX H: INTERVIEW GUIDE FOR WATER PROFESSIONALS AND LEADERS

### **---Personal background---**

1. Provide a quick overview of your personal background.
  - a. Did you grow up in the Southwest?
  - b. What areas/regions have you lived in over the years?
  - c. What did you study in college, grad school, etc.?
  - d. How did you end up in [location] in your current position?

### **---Work background (with water issues)---**

2. Briefly describe your work and how it intersects with water/water issues in the Southwest.
3. Prior to your current position, did you do work that intersected with water issues in the Southwest (or elsewhere)? If yes, describe that work.
4. Were water issues in the Southwest on your radar before you came to the region/started working with water issues? If yes, to what extent?
  - a. What was your perception of water issues in the Southwest before coming to the Southwest/starting to work with water issues?

### **---Current perception of water issues---**

5. Has your perception of water issues changed since you came to the Southwest/started working with water issues? If yes, how so?
  - a. Have you noticed any differences in the ways water/water issues are talked about in the various places/positions you have worked? Has your perspective on how water issues are framed/talked about changed at all (since moving to the Southwest or starting your current position)?
  - b. How does the agency/organization/company you work for tend to perceive and approach water issues?
  - c. Do you have any observations about how the general public in the Southwest understands/approaches water issues?
  - d. In your observation, do you feel the public is generally well informed/aware of water issues and their various intricacies?
6. From your perspective, what are the most important water related issues/concerns in the Southwest? Why are these issues/concerns of particular importance?
  - a. In what ways do you attempt to address those issues/concerns in your work?
7. What kinds of opportunities and barriers to addressing water issues do you tend to encounter in your work?
  - a. Do you feel these opportunities/barriers are unique to your line of work, or do you feel they are indicative of broader opportunities/barriers when it comes to addressing water issues in the southwest?
  - b. Would you say you lean more toward the optimistic or side or the pessimistic side when it comes to our ability find solutions to water issues in the Southwest? Perhaps it's a bit of both or somewhere in between? Explain why.
8. From your perspective, what kinds of water solutions/goals we should be focusing on?

- a. Do you have optimism that these solutions/goals will be implemented/gain the appropriate amount of attention?
- b. In your opinion, what needs to be done for these solutions/goals to be attained?

## APPENDIX I: INTERVIEW GUIDE FOR DESERT HYDROLOGIES PHOTOGRAPHY PARTICIPANTS

1. What drew you to this project? What made you want to participate?
  - a. How did you hear about the project?
2. As someone who lives in a place known for having very little water, how would you describe your relationship with water?
  - a. Is water (and/or water issues) something you think about often?
  - b. What are some ways you interact with water in your daily life?
3. Are there any particular water-related environmental/social/economic issues that tend to weigh on your mind? What are your general opinions/thoughts on these issues?
  - a. Would you consider yourself someone who is highly engaged or pays close attention to water issues or environmental issues in general?
  - b. What is your general understanding of/opinion on water issues in the Southwest?
4. Explain in further detail the subjects/landscapes you chose to include in your photo(s).
  - a. What caught your eye about these subjects/landscapes?
  - b. How did the idea(s) for your photo(s) come to mind?
  - c. Explain the process of taking your photos. Where did you go? How did you get the shot(s)?
  - d. Did you set out with a specific shot (or shots) in mind from the beginning, or did the idea come to you spontaneously?
5. Why did you compose your photo(s) the way you did? Expand on your answer from the survey.
  - a. Comment on specific elements of the photo(s) composition, angles, lighting, etc.
6. If you edited your photo, what changes did you make and why? Expand on your answer from the survey.
  - a. What made you want to edit your photo?
  - b. Did you plan to edit the photo from the start?
  - c. Do you usually edit your photographs?
7. How do you see your photos relating to the prompt? Expand on your answer from the survey.
  - a. In what ways do you believe this photo encapsulates your relationship with water or tells a story about water/water issues?
8. Were there specific water issues/topics you set out to capture with your photo(s)?
  - a. If yes, which issues/topics does your photo (or photos) deal with?
  - b. Explain how your photo broaches those issues/topics?
9. What parts of the photography process did you enjoy the most? Least?
  - a. Overall, how would you rate the photography experience?
  - b. Would you do this type of activity again?
10. After participating in this project – going through the photography process – do you think about water/water issues any differently than you did before? If yes, how so?
  - a. If yes, what specific parts of the process were most impactful?

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