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Direct Potable Reuse in Small-to-Medium Sized Inland Communities: Lessons Learned for Public Education and Outreach

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DEDICATION

This thesis is dedicated to my father, Riccardo Pratesi. I could not have done it without his support and help during this journey through graduate school.

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ABSTRACT

Drought, growing populations, and potential conflict over water in the American Southwest have water authorities examining highly treated wastewater as an option to augment municipal supplies. Direct potable reuse (DPR) holds promise for improving sustainability and reliability of potable water supplies by generating high-quality drinking water from wastewater. Despite research demonstrating that DPR can be safe, one of the biggest hindrances to DPR is negative public perception. Attempts to implement some DPR project have failed, while others have proceeded quickly. Using insights from the literature and interviews with water managers, this study aims to: (1) examine existing community conditions related to water scarcity; (2) the mode of project introduction, characteristics of DPR education and outreach programs; (3) public trust in the agencies introducing and/or promoting the DPR project, (4) media attention given to the project; and (5) the system of governance formulating and executing the DPR project. While some scholars have focused on individual disgust at drinking purified wastewater as the explanation for opposition and in some cases rejection of DPR projects, the results from this study demonstrate that explanations for acceptance or rejection of DPR are more complicated. Findings suggests that attitudes toward water reuse are community specific and responsive to local context, which includes geography, geology, climate, perception of existing water quality, perception of water scarcity, public education and knowledge related to water, trust in individuals or entities introducing the project, media coverage, and governance.

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1. Introduction

By 2025, The US Department of Interior (DoI) predicts "hot spots" of conflict over water in the American Southwest (United States Department of the Interior, 2005)(see Figure 1), a region in which water scarcity is projected to remain dire (Tinker, 2014) and climate change is expected to further reduce water supplies (Gutzler, 2012). Communities in these hot spots must choose between numerous supply-side and demand-side options to create sustainable and reliable water supplies (Grant, 2012; Hurlimann & Dolnicar, 2009; Hering, Waite, Luthy, Drewes, & Sedlak, 2013), and currently unexploited sources of water of adequate quality must be proactively identified before shortfall leads to crisis.

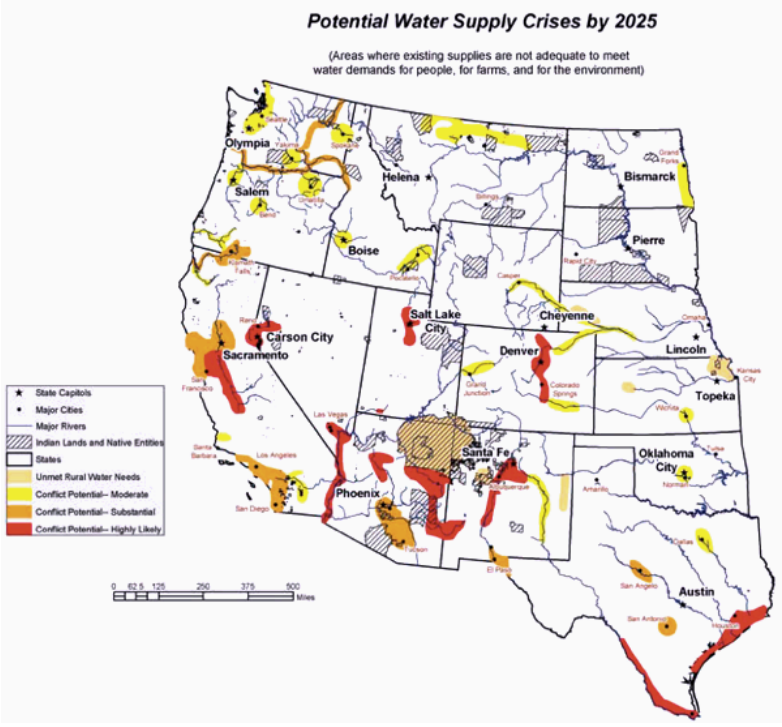

Figure 1. Hot Spots for Potential Water Conflict by 2025

Preventing Crises and Conflict in the West. Used with permission of the US Department of Interior (United States Department of the Interior, 2005).

DPR holds promise for improving the sustainability and reliability of potable water supplies by generating drinking water from wastewater. Prior to distribution, the wastewater is highly treated, either in separate wastewater treatment plant (WWTP) and drinking water treatment plant (WTP) systems, or in a single advanced treatment system (Tchobanoglous, Harold, Nellor, & James, 2011; Law, 2008; Leverenz, Tchobanoglous, & Asano, 2011; United States Environmental Protection Agency, 2012).

While in the United States the EPA provides guidelines for water reuse (United States Environmental Protection Agency, 2012), regulation of reuse is left to the individual states. Several states have developed regulations for non-potable reuse and a few have developed guidance on indirect potable reuse. While no state yet has regulations specifically for DPR (National Research Council, 2012), the regulatory issues needing attention have been identified (Crook, 2010) and the feasibility of establishing regulatory criteria is under investigation in California (Tchobanoglous, Harold, Nellor, & James, 2011). The few DPR plants currently in operation in the US have been approved by states on a case-by-case basis.

Despite research demonstrating the safety of DPR (Rogers & Lauer, 1992; Tchobanoglous, Harold, Nellor, & James, 2011; United States Environmental Protection Agency, 2012; Haarhoff & Merwe, 1996; National Science Foundation, 2010), one of the

biggest hindrances to DPR implementation is public opposition. Research has found that negative public perception can be due to a lack of education about the water **cycle** and the treatment technologies used (Australian Academy of Technological Sciences and Engineering, 2013; Bufe, 2012; MacPherson & Snyder, 2013) and/or misinformation proliferating before the start of formal community education and outreach programs (Hurlimann & Dolnicar, 2010). However, much of the experience related to public opposition comes from large coastal US cities and Australia, and it is reasonable to expect that public acceptance of DPR would be based in part on contextual issues, including water scarcity and perceived availability of additional water supply options. Public responses to potable reuse are still not well understood (Ormerod & Scott, 2013) especially for the inland, small-to-medium-sized community context where the few DPR facilities in the US currently exist.

Many US communities that are candidates for DPR are small-to-medium sized and scattered throughout the inland Southwest (United States Department of the Interior, 2005), as shown in Figure 1. However, there is little documentation from the few successful DPR projects in these communities to help water managers in other inland Southwestern communities understand how to approach DPR projects while effectively communicating about public health, safety, and other matters. Further, many small-to-medium sized inland communities that are candidates for DPR have low-to-moderate household income levels (American Community Survey, 2012), and resources may not be available to thoroughly study public attitudes and approaches to public communication prior to attempting project implementation.

The problem is complicated by the question of who the policy actor or actors are who are responsible for formulating and executing a DPR policy. While on its face the answer to this question is often obvious – a City Council or a water agency board of directors – the locus of policy action is often more diffuse and complex. Key policy actors also can include agency staff (in situations where the governing bodies routinely defer to staff technical recommendations) as well as non-governmental organizations whose unofficial role in the policy process through informal governance networks affords them the role of de facto policymakers. It is crucial to recognize where the locus of policymaking is as one thinks about the role and influence of communication and public understanding in the implementation of DPR projects (Cairney, 2016). While acknowledging the importance of understanding how the locus of policy action may affect the success or failure of DPR projects, the scope of this paper does not afford an in-depth analysis of this topic, which is the subject of a related paper by the same authors.

2. Study Objectives

Using existing literature on the characteristics and outcomes of various DPR introduction strategies, plus new data on project introduction approaches that resulted in DPR implementation, this study aims to fill the gap in the literature on approaches to public communication prior to attempted DPR project initiation in small-to-medium-sized inland US communities. In addition to this contribution to the literature, a second objective is to provide recommendations to water managers, city officials, and/or policy actors in small-to-medium-sized inland communities for approaching DPR projects while maintaining effective public communication. To meet these objectives, we examine the

following issues where DPR projects have been introduced: (1) the existing community conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity; (2) the mode of project introduction and characteristics of DPR education and outreach programs; (3) public trust in the agencies, organizations, or public officials introducing and/or promoting the DPR project, (4) the kind of media attention that was given to the project; and (5) the system of governance that defines the policy actor or actors responsible for formulating and executing the DPR project. Understanding the context of both successful and unsuccessful projects may be instructive in reducing the risk of failure in future DPR projects.

3. Methods

3.1 Selection of Communities for Analysis

Of the six communities that were able to gain public acceptance, five were small-to-medium sized and located in the inland southwest. The sixth community is San Diego, which gained acceptance on the second try (San Diego County Water Authority, 2016; City of San Diego; Wiseman, 2014).

We identified two communities in which DPR projects did not gain public acceptance (San Diego in its first attempt and Toowoomba, Australia), as well as six communities in the US[1] where DPR projects were accepted by the public (Cloudcroft, Brownwood, Big

[1] At the time of the writing of this paper, these were the only US communities in which DPR had been accepted by the public.

Spring, Wichita Falls, El Paso, and San Diego in its second attempt[2])[3]. We gathered primary data on five of the latter communities because very little has been documented about the education and outreach materials used or the community attitudes towards DPR before and after project acceptance or implementation; all five of these communities were small-to-medium sized and located in the inland southwest.

3.2 Interviews

To help fill the gap in knowledge about the approaches that led to public acceptance of DPR in these five small-to-medium-sized communities, we conducted interviews with city officials and water managers from the communities; some interviews were conducted after DPR implementation, while others occurred following public acceptance, but before actual implementation. In all of these communities, city officials and/or water managers succeeded in obtaining public support for DPR projects.

Interviews were semi-structured to accommodate discussion of other issues that the interviewees felt were important. Nine professionals from the five communities where DPR was successfully implemented or had gained public acceptance were interviewed to understand what had been done to gain public acceptance. Interviewees were selected based on their involvement in implementing (or preparing to implement) DPR through the public entities or organizations for which they worked; knowledge of their involvement was gained from reading, watching, or listening to interviews they had

[2] San Diego is included in both the failed and successful categories because of attempts to implement potable reuse two different times, many years apart. Only IPR was proposed in the first attempt and both DPR and IPR were discussed in the second attempt; even though San Diego's first attempt only discussed IPR, it is included here because it greatly informed the characteristics of the second attempt, which also included DPR as an option.

[3] These are currently the only US communities in which DPR had been accepted by the public.

previously participated in with various news outlets (e.g., television, radio, newspapers, and trade magazines). Potential interviewees were contacted by email or phone with a request to participate; they were also provided with the list of proposed interview questions. All potential interviewees who were contacted agreed to participate. The entities and organizations that the interviewees represented along with their job titles are shown in Table 1 below. The interview questions are shown in Appendix 1. Interviews were conducted by phone. Each lasted between 45 and 60 minutes. Interviews were transcribed immediately following each phone call. Seven interviews were conducted between May 1 and July 20, 2015. The remaining two were conducted during the week of June 16, 2016.

3.3 Review of Literature and Other Documentation

Documents from these same communities were analyzed to assemble additional information about the public processes that were used to educate the local people and ultimately gain public acceptance for DPR. Examples of such documents included trade magazines, newspapers, public meeting agendas and minutes, city and water authority websites, and YouTube videos. We also consulted the peer-reviewed literature was to obtain additional information about the communities and water reuse projects included in this study; this source was particularly important in understanding the details of why DPR projects failed in two communities (San Diego in its first attempt and Toowoomba). Thus far, only DPR project failures have been documented in the peer-reviewed literature.

4. Results

4.1 Failed DPR Attempts

4.1.1 San Diego

4.1.1.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

San Diego has long struggled with water scarcity and multi-year drought (City of San Diego, 2015). In 1947 it began importing water from the Colorado River (City of San Diego, Public Utilities Department, 2011) and by 1990 was importing up to 90 percent of its water supply (Hartley, 2006; City of San Diego, 2015). San Diego has attempted to introduce potable reuse twice in response to two periods of drought. One effort started in 1991 and the other in 2011.

While San Diego has been plagued by water scarcity for decades, in the first attempt at implementing water reuse, the local population knew there were alternative supply options (e.g., desalination and imported water). Unlike the residents of smaller inland communities who could see their reservoir levels falling, the people of San Diego experienced a lush, green city that sat next to over 100 km of shore line (San Diego County Water Authority, 2005). In 1991, residents believed their water supply to be endless (San Diego County Water Authority, 2005).

The second attempt began in 2011, with an intense public education and outreach campaign on water scarcity. Consequently, greater awareness and perception of water scarcity and, the need for conservation and a more diverse water portfolio existed among San Diego residents. The city of San Diego and the San Diego Water Authority (SDWA)

spread water conservation messages on bus exteriors, city trolleys, billboards, and posters that were strategically placed such as entrances to major shopping malls in the city. They also posted ads, created web videos showing conservation commitments from local leaders, and hosted poster and film contest to engage younger audiences (City of San Diego, 2015).

4.1.1.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs.

The first attempt began in response to a 1994 legal settlement, which required the city to build a water reclamation system that would clean the water to drinking water standards. However, because the water was not approved for potable use and there were limited uses for recycled water at the time, millions of liters of purified water were discharged into the ocean every day. Because of the 1991-92 drought and to reduce the dependency on imported water, the city proposed blending highly treated water from the new water reclamation system into the city's potable water supply (Hartley, 2006; Po, Kaercher, & Nancarrow, 2003). Recycled water would be blended with imported water in reservoirs where it would remain for a year. After that time, it would be treated in a conventional water treatment plant before being piped to the distribution system for all uses (Po, Kaercher, & Nancarrow, 2003). This scheme for augmenting the potable water supply was known as San Diego's Water Repurification Project (City of San Diego, 2015).

The SDWA and the City Council understood the importance of public acceptance. Therefore, these entities began a research project to understand public attitudes and perceptions related to water reuse and identify potential issues. Researchers used focus

groups and individual interviews with community leaders and policy makers. The research project also included public education and outreach including video presentations, brochures and fact sheets, stories in newspapers and other media outlets, and a telephone line that residents could call with questions (Po, Kaercher, & Nancarrow, 2003; Katz & Tennyson, 1997). Initially, the study found a high level of support for the Repurification Project among members of the public and community organizations (Po, Kaercher, & Nancarrow, 2003).

The first attempt at implementing the Repurification Project seemed to have several ingredients needed for success, e.g., successful public information and outreach programs and support from the public and community organizations (Po, Kaercher, & Nancarrow, 2003). Despite the initial positive response, political campaigns began accusing the city of committing environmental injustice. The erroneous claims stated that the city intended to take wastewater from affluent communities and distribute it as drinking water to the less affluent, potentially causing health risks. Small opposition groups such as “The Revolting Grandmas” formed in the wake of these claims (Royte, 2008).

The Repurification Project became entangled in political campaigns. Joel Wachs, East Valley City Councilman, popularized the pejorative expression "toilet to tap" during his run for mayor of San Diego. He told Valley residents that if he were elected he would not allow “your toilet water to go into your taps." Other candidates followed Wachs, playing to health and environmental justice concerns among segments of the public (Cavanaugh, 2008). Additionally, opposition and concern among residents increased

when opposition groups spread posters with the slogan “Toilet to Tap” around the city. The local media also started using this expression when referring to the project (Po, Kaercher, & Nancarrow, 2003; City of Diego, 2004). After almost a decade of significant investment, the project was abandoned due to public pressure (Po, Kaercher, & Nancarrow, 2003; Ross, 2014).

Although the first attempt at implementing the Repurification Project was halted, the City of San Diego realized that new alternatives and a broader water portfolio were necessary and it needed to be less reliant on imported water. The *2002 City of San Diego Long-Range Water Resources Plan* and the *2005 Recycled Water Study* reiterated that only ten percent of the city’s water was from local sources, and that although conservation efforts helped, the city would require 25 percent more water by 2030 due to population growth (City of San Diego Water Department, 2004; City of San Diego Water Department, 2002).

In the summer of 2011 the San Diego Public Utility Department began public education and outreach efforts. The efforts involved “three multi-cultural consultants, development of a comprehensive communications plan and strategy, coordination of speakers for bureau presentations, facility tours, community events, production of collateral materials, stakeholder involvement and media outreaches” (Atkinson, 2014). Since June of 2011, San Diego's 3.7-million-liter-per-day “Pure Water” demonstration facility has been open for public tours (City of San Diego , 2016). The program manager of the project estimated that more than 20,000 members of the public toured the facility, and as a result,

the acceptance of purified water rose from 26 percent in 2004 to 73 percent in 2012 (Atkinson, 2014).

Currently the city is working on *Pure Water San Diego*, a phased, multi-year program that aims to provide a third of the city's drinking water from local sources by 2035. The Pure Water Program will use water purification technology to produce safe, high-quality drinking water from wastewater (City of San Diego , 2016). In November 2014, the City Council voted unanimously to approve the DPR portion of the *Pure Water San Diego* project to recycle 56,700,000 liters/day by 2023 and 314,000,000 liters/day by 2035 (Wiseman, 2014). Initially, the reused water will go to the San Vincente reservoir where it will be temporarily stored before being introduced into the water distribution system; however the goal is to add multiple barriers of treatment for reliability that will allow direct addition to the water grid (Wiseman, 2014).

4.1.1.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

In spite of efforts to inform and educate the people of San Diego, it became clear that local authorities failed to gain community trust and had to bring to the project to a halt (Po, Kaercher, & Nancarrow, 2003).

As mentioned above, the second attempt included intense public education and outreach. The city launched a demonstration project in 2012, and unlike the first attempt where the project was rejected, there was public approval (Grable, 2014).

4.1.1.4 Media Outreach

Although community and political figures initially supported the Water Repurification Project in the first attempt, the project became many candidates' focus during the tight

races of the 1998 political campaigns. Candidates attacked the project during public hearings, in direct mail campaigns, and in the media.

In the ensuing decades, the Public Utilities Department invested heavily in public relations strategies (City of San Diego, 2016). This new approach included constant work with media outlets to ensure that accurate and complete coverage of the Department's water programs were communicated to the public. There were also constant updates to the city's website about water issues (City of San Diego, 2016).

4.1.1.5 San Diego Governance

The structure of San Diego's water governance can be seen to be a central factor in the community's decisions about whether or not to pursue potable water reuse. The greater San Diego metropolitan area is served by a wholesale water agency, the San Diego County Water Authority, which delivers supplies of imported water to the region's 24 local water retailers, primarily municipalities. The largest of those local retailers is the City of San Diego. San Diego water management represents an example of "polycentric governance", with many sometimes overlapping areas of responsibility for water (Ostrom, Tiebout, & Warren, 1961).

During the debates over the first iteration of San Diego's water reuse proposal, the decision makers were the elected officials of the San Diego City Council. While the San Diego County Water Authority also was involved (Po, Kaercher, & Nancarrow, 2003), the arena of action was the directly elected City Council members of the municipal government. Technical evidence is only one of a number of sometimes competing and conflicting sources of information that may influence decision makers (Cairney, 2016). In

the case of directly elected officials with jurisdiction over the San Diego water agency, political pressure by project opponents was sufficient to overcome the arguments of the city water department's technical experts in influencing the final decision, which was made by officials who were subject to pressure at the ballot box.

In the second attempt, three entities came together to form a broader governance entity. The San Diego County Water Authority (SDCWA), the city of San Diego and San Diego County formed the Regional Water Management Group (RWMG). Such regional institutions do not replace existing institutions, "but rather become a forum for deliberation and planning" at a broader scale and level than is possible by the individual member institutions (Hughes & Pinceti, 2014). RWMG funded, guided, and managed the development of the Integrated Regional Water Management (IRWM) Program. The IRWM Plan and grant applications were formally approved and adopted by the governing bodies of these three agencies (City of San Diego, Public Utilities Department, 2011). The question of whether to pursue water reuse was thus nested within broader questions of regional water governance.

In December of 2006 the Regional Advisory Committee (RAC) was formed to assist in the completion of San Diego's 2007 IRWM Plan. The RAC consists of 31 members with expertise in water supply, wastewater, recycled water, stormwater and urban runoff, natural resources, sustainability, tribal issues, military liaison and environmental stewardship (City of San Diego, Public Utilities Department, 2011). These processes expanded the scope of deliberation, creating a broader base of stakeholders than simply

the elected officials of the city of San Diego, reducing the chances for politicization of the process.

In summary, there were significant differences between the first and the second attempt to introduce recycled water in San Diego—such as the mode of introduction, outreach and education, and governance. Another significant difference was that dire drought conditions afflicted the entire state during the second attempt, and so along with San Diego's outreach and educational program, there was a state-wide effort to educate Californians and restriction and conservation targets were put into place.

4.1.2. Toowoomba, Australia

4.1.2.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

Toowoomba is a community of approximately 115,00 people located 161 kilometers west (i.e., inland) of Brisbane, Australia, and its water is stored in three regional lakes. In 2002, the city implemented level 1 water restrictions—the least restrictive level—due to persistent drought and lack of rainfall. By 2006, restrictions had reached level 5, the highest level at the time. At that point the population was well aware of the city's water scarcity problems (Fishman, 2011).

4.1.2.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs.

Rosemary Morley, one of the eventual founders of Citizens Against Drinking Sewage (CADS) and a long-time resident of Toowoomba, first heard about a plan for potable water reuse at a Ladies Club gathering in May 2005 (Fishman, 2011). At this gathering,

the mayor of Toowoomba publicly announced, "You are all going to drink from the sewer" and discussed a water reuse plan that had been developing over the past six months (Fishman, 2011). This incident occurred about a month before the City Council unanimously supported funding the National Water Commission, which was tasked with securing funding for the project through the Water Smart Australia Program (Hurlimann & Dolnicar, 2009). On July 1, 2005, the Toowoomba City Council announced the Water Futures Initiative as a forum for discussing solutions to the city's water scarcity problems. The initiative was described as more of a bureaucratic formality than a meaningful attempt at public outreach (Hurlimann & Dolnicar, 2009). Among the solutions included was DPR. The Council expected funding from the federal government to build the plant by October 2005.

On July 21st, 2005, CADS was formed (Hurlimann & Dolnicar, 2009). A month later CADS held its first public meeting, which drew over five hundred concerned citizens and provided a forum for non-experts to share stories about the dangers of water reuse. By February 2006, the organization had obtained 10,000 signatures on a petition against the DPR project. The public was aware of water scarcity issues, but it was not aware that the local government was seeking water alternatives until CADS brought attention to the DPR project in the Water Futures Initiative. When the public heard about the project from the CADS instead of local government officials, it felt that the officials were being deceitful and that the project could not be trusted (Hurlimann & Dolnicar, 2009).

Because of the swell in public opposition to DPR, the Parliament Secretary to the Prime

Minister announced in March 2006 plans for a referendum asking residents if they supported the DPR project. Only then did the City Council initiate a 10-week public information campaign. The referendum was held in July 2006; 62 percent of the public opposed the project (Hurlimann & Dolnicar, 2009).

In the case of Toowoomba, it is important to note that CADS was formed and had been educating the public for about 8 months before city officials implemented an educational campaign about water reuse and DPR, or made any formal public communication that the Water Futures Initiative included a DPR project. The local government lacked transparency as it developed the water reuse project without the public's knowledge. All attempts to appease and educate the community came after concerned local citizens had already gathered and distributed material and information against DPR.

4.1.2.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

Toowoomba had clear conditions of water scarcity and limited water supply options, and the public was aware of these conditions (Hurlimann & Dolnicar, 2009; Fishman, 2011). However, due to the mode of introduction and lack of transparency, outreach, and education, the public had little-to-no trust in local authorities regarding the DPR project. Before CADS was formed, the public was not aware that city officials were looking for new water sources, or that DPR was the solution reached.

4.1.2.4 Media Outreach.

City officials in Toowoomba made attempts at media outreach to help educate and inform the public about water reuse and DPR; however, these attempts began months after

CADS had begun its own campaign. CADS took out full-page advertisements in the local paper telling readers, "You deserve fresh water," and calling supporters of the project "sewer sippers". Despite the efforts by Toowoomba's mayor, the Director of Water Services, and the supporters of water reuse to educate and gain public trust, the project opponents were faster at reaching out to the public and more effective at communicating their message (Fishman, 2011).

4.1.2.5 Toowoomba Governance

The governance structure underlying Toowoomba's decision-making process permitted direct involvement by project opponents. Water services in Australia's smaller communities were typically the responsibility of elected local governments (Stenekes, Colebatch , Waite, & Ashbolt, 2006). In Toowoomba, the City Council was initially responsible for the project, meaning that the policy actors were directly accountable to voters (Hurlimann & Dolnicar, 2009; Fishman, 2011). The local governing body was unmoved by project opposition. However, the need for federal funding from the Australian National Water Commission created an added layer of governance, providing a second arena of action for project opponents. In an unprecedented move, the federal government agreed to pay for the project only if it was endorsed by the people of Toowoomba in a referendum (Stenekes, Colebatch , Waite, & Ashbolt, 2006).The multiple layers of governance in this case provided multiple opportunities for opponents to stop the project.

4.2. Successful DPR Attempts

4.2.1 Cloudcroft, New Mexico

4.2.1.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

Cloudcroft is a small mountain village of approximately 800 people located in southern New Mexico at an elevation of almost 2,743 meters. The local population often doubles on weekends due to tourism, the Village's main industry; consequently, the water demand also doubles (Tchobanoglous, Harold, Nellor, & James, 2011; Livingston Associates P.C, 2009).

The Village's water sources include spring and well water; however, drought conditions have reduced the supply to below demand. The Village hired firms to locate groundwater to augment the local potable supply. Several exploratory wells were drilled, but no additional groundwater was available. Conservation measures were adopted, but with no alternative source of water, the Village had to frequently truck in water to meet demands (Tchobanoglous, Harold, Nellor, & James, 2011; Livingston Associates P.C, 2009).

According to UNM professor Bruce Thomson (Thomson, 2015), everyone in the community was aware of the need for alternative water sources, and in 2006 the Village decided to implement DPR. The long-term solution envisioned by Village leadership was the PURe Water Project, a plan to treat wastewater to better-than-drinking-water quality utilizing a multi-barrier treatment approach and blend it with existing well and spring water (Livingston, 2007).

4.2.1.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs.

Cloudcroft's water scarcity issues and lack of supply options were clear to the community because of the need to haul in supplemental water, although there were no

formal educational campaigns, videos, pamphlets, or official Village announcements relating to scarcity or the need for new supply options (New Mexico Environment Department, 2015). The outreach related to DPR consisted of three public meetings organized by the Village Administration where potable water supply options were discussed. Few had concerns about the quality of the proposed DPR water (Tchobanoglous, Harold, Nellor, & James, 2011; Livingston Associates P.C, 2009). The most significant concern was the cost of DPR and the potential for a rate increase. For very small communities, such as Cloudcroft, the cost of running a DPR system can be prohibitive (New Mexico Environment Department, 2015). The Village, with the assistance of Mike Nivisson, a former Village Administrator, was able to acquire a number of grants, and as a result the community moved quickly in its attempt to implement DPR with no cost to the Village to construct the new system. The grants came from different sources, including the State of New Mexico and the Bureau of Reclamation (Thomson, 2015). Construction of the DPR facilities began in 2009.

Faulty construction led to a series of setbacks. Though some of the construction problems were addressed, a schedule delay was so significant that treatment technologies had advanced significantly by the time construction re-started, requiring process configuration retrofits and new equipment. Eventually, the first system was abandoned (Thomson, 2015).

Despite the setbacks, the Village still plans on implementing the PURe Water Project. Currently, the Village is concentrating its efforts on the new water treatment plant, which

is the first step of the PURe Water Project. Village officials are not certain about the schedule for project completion, though it is most likely years away (Lead-Water-Operator, 2016)

4.2.1.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

While no one in the Village of Cloudcroft conducted formal public education programs about water reuse, city officials did allow for public participation in the decision-making process regarding new sources of potable water. Because Village leaders were transparent and made the search for and deliberation of water supply options a public conversation, lack of trust among the public regarding local officials did not seem to be an issue (Lead-Water-Operator, 2016; Tchobanoglous, Harold, Nellor, & James, 2011). The Village conducted meetings to explain the potential DPR project to the public and answer questions. This allowed for public discussion of the project and community member concerns; consequently, public acceptance was easily gained. No groups were formed in opposition to DPR, and the community was enthusiastic about the project (Thomson, 2015; Tchobanoglous, Harold, Nellor, & James, 2011).

4.2.1.4 Media outreach.

Cloudcroft does not have any local television stations or newspapers. Villagers watch either the Albuquerque or El Paso television news, and none of these stations have reported on the PURe Water Project. The Village receives regional newspapers from New Mexico and Texas; the Alamagordo Daily News is one of the newspapers with greatest circulation. Cloudcroft's Lead Water Operator could not recall any of the regional newspapers reporting on the project (Lead-Water-Operator, 2016). There is a

monthly periodical, the Mountain Monthly, that circulates in the Village, and there are no records of reporting on water issues within the timeframe of the PURe Water Project's existence. In addition, the Editor of the Alamagordo Daily News confirmed that his paper did not report on the project (Editor, 2016)

4.2.1.5 Cloudcroft Governance

The decision to pursue reuse in Cloudcroft was entirely in the hands of local government. But the funding, another potential controversial feature of reuse projects, came from outside the local community, creating a bifurcated decision-making process. Cloudcroft's Water and Wastewater Department is a division of its municipal government, a Village that is governed by directly-elected Village Councilors and a mayor (New Mexico Municipal League 2016, 2016). These departments work in conjunction and are responsible for the PURe Water Project, meaning the primary policymakers with jurisdiction over the decision about whether to proceed with the project are directly accountable to voters. Importantly, however, funding for the work came from the state and federal governments (Thomson, 2015) creating a separate layer of governance over a key part of the decision making process and removing responsibility for that part of the project, and a potential source of opposition, from local taxpayers or utility ratepayers.

4.2.2 Brownwood, Texas

4.2.2.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

Brownwood is a small community in western Texas with a population of approximately

19,000 (Brownwood, 2015). The area began experiencing drought conditions in 2007, and by 2011 severe water rationing was enforced, requiring mandatory conservation and allowing outdoor watering no more than once a week (Director-Public-Work, 2015). Due to the severity of the drought and lack of other water supply options, the city took initial steps toward building a water reuse facility. Funding, through the sale of bonds, was secured by the city in 2012, and Brownwood was the first city in Texas to get approval for direct potable reuse from the Texas Commission on Environmental Quality (TCEQ). Though Brownwood had funding and TCEQ approval for a new DPR plant, it needed City Council approval for the sale of the bonds to secure a $12 million loan before construction could start. However, construction did not move forward. The City Council never voted to approve the sale of bonds because it began to rain. The Brownwood Public Works Director cited the "Hydro-Illogical Cycle" (Figure 2) in describing the fate of the DPR project in his community. He explained,

> The city is in the apathy phase of the "Hydro-Illogical Cycle" because we are getting rain. It started to rain, and for the first time since 2007 water has gone over the spillway. However, we should not wait until we reach the panic phase of the cycle to act; there has to be a plan beforehand. Reuse is a conservation program. We need to recycle. If we recycle water, we have more water in the lake for wildlife, recreation, and to bank for the future (Director-Public-Work, 2015).

The Director notes the groundwork for DPR has been laid in case the city experiences severe drought again: with public acceptance, a facility design, approval from TCEQ, and

a funding mechanism in place, it will take only 14 months to build the facility plus two additional months to test the system before a plant could be fully operational.

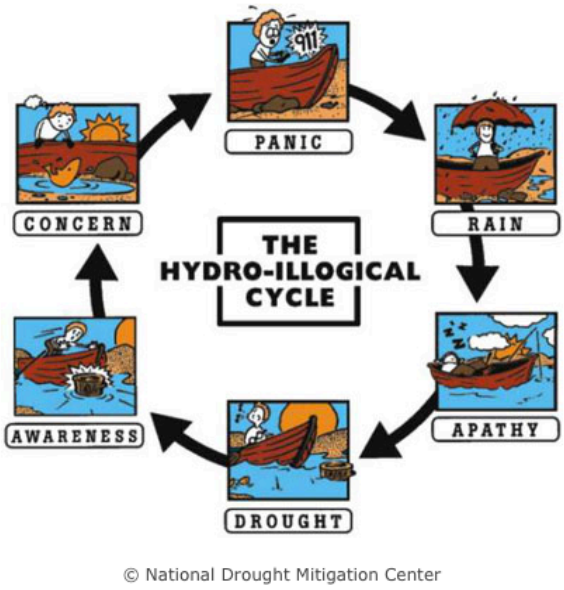

Figure 2
(The Hydro-Illogical Cycle, 2016) by courtesy of National Drought Mitigation Center

4.2.2.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs

Brownwood's DPR project was first presented at the Rotary Club, the Lions Club, the Chamber of Commerce and in City Council meetings. The Public Works Director believed that it was best to present the project to leaders of the community and let them spread the word. The Brownwood Public Works Director said gaining public acceptance of DPR was not an issue. He credited the city's well-established education and outreach program related to water. For the past two decades, the WWTP has offered tours to groups of students and residents of Brownwood, as well as to residents of neighboring

cities. Additionally, in Brownwood's fourth grade curriculum, as part of their environmental science class, students are required to learn about the hydrologic cycle, how the water we drink today is the same water that dinosaurs drank, that Brownwood uses the WWTP effluent from towns upstream, and that towns downstream of Brownwood use its WWTP effluent. The 4th graders also visit the WWTP and are able to witness first-hand how water is treated. Seventh graders from neighboring towns and freshmen college students also regularly tour the WWTP to learn about wastewater treatment (Public-Works-Director, 2015).

Brownwood also offers opportunities for adults to learn about water-related topics. The local chamber of commerce offers a program called Leadership Brownwood, which has been in place for almost two decades. This is a 12-week program aimed at young professionals who have either recently moved to Brownwood or have been promoted to a managerial position. For a small fee, participants gain knowledge of the city and the community and visit facilities, such as the WWTP, the landfill, and other public service areas. Community service organizations such as the Rotary Club, the Kiwanis, and the Lions Club can request periodic updates from the water authority. These updates are used as opportunities to educate club members about the water cycle and water reuse.

According to the Brownwood Public Works Director, "Visitors see how the water comes in, what is done to it, and how it comes out". In his view, "calling [water reuse] 'from toilet to tap' is very offensive: it completely eliminates all the work we do – [the water] comes out a lot cleaner than the lake water that is currently treated and used as drinking water." The Director believed that almost everyone in the community had been to the

WWTP. The city received letters of support from industry, businesses, and the local university in support of the DPR facility. The Public Works Director had no recollection of any formal opposition to the facility.

4.2.2.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

Because the city quickly gained public acceptance of DPR, the Public Works Director believed that public trust in the city officials who proposed DPR was reasonably high. Further, he explained, "Because city officials are very open, there is trust from the public; the public does not feel like there is information asymmetry and believes that city officials have their best interests at heart".

4.2.2.4 Media Outreach.

City officials reached out to the local media before presenting the DPR project to the public. They explained the process and the need for DPR as part of the city's water portfolio, and requested the media's help in explaining these things to the public. According to the Director, the media was very supportive. There was only one talk radio show in town, and each week it hosted a city official to give an update of local happenings related to the official's line of work. The Director of Public Works has historically participated about three to five times a year to discuss issues such as line replacements, drought conditions, and tips for conserving water; the radio show provided an opportunity to publicly talk about DPR. The Director joked, "It is a small community, therefore, even getting new sod for the soccer field is big news" (Public-Works-Director, 2015).

4.2.2.5 Brownwood Governance

In Brownwood the entire decision-making process – both about reuse and the funding for reuse – lay at the local level. The Water and Wastewater Department of Brownwood is governed by the City of Brownwood and is under the Department of Public Works, which reports through a city manager to elected City Councilors and a mayor. Decisions about reuse are thus made by policymakers who are directly accountable to the voters of Brownwood. Importantly, funding decisions were also in the hands of the City Council through a proposed bond issue that would have been repaid by users of the water system.

4.2.3 Big Spring

4.2.3.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

The Colorado River Municipal Water District (CRMWD) comprises the cities of Odessa, Big Spring, and Snyder. CRMWD's Operations Manager said the decision to implement DPR in Big Spring was unique in that the region was not in a drought when CRMWD staff began looking for alternative water sources to increase water supply reliability. However, it was clear that the area could not continue to grow without a larger, more diverse water portfolio (Operations - Manager, 2015; CRMWD , 1981).

In considering IPR versus DPR, DPR made more sense: the district already had three surface reservoirs for water storage and there was no room for more; IPR using surface storage (e.g., a reservoir) was not a practical option because of the area's high evaporation rate (over 60 inches per year); and a suitable aquifer for potable water storage was not available (General-Manager, 2015; CRMWD, 2015). Since the groundwater in the area is brackish, the possibility of desalinating brackish water

emerged as well, and this became one of the two primary options for consideration, along with DPR. In 2003, the CRMWD conducted a feasibility study of the two options and determined that DPR would be more cost effective.

In 2007, the CRMWD decided that Big Spring, a city of almost 29,000 people (United States Census Bureau , 2015) should be the DPR facility headquarters because of its central location for water distribution. In 2008, a detailed design of the DPR facility was completed. In 2009, CRMWD purchased property for the new facility and began pilot testing. A "tent city" was created and equipment companies were invited to present their products and place bids. This is also when the permitting process began. According to CRMWD General Manager, "initial public approval was easy – getting permission from the Texas government to move ahead was the hard part" (General-Manager, 2015).

In May of 2013, the CRMWD began operating the United States' first DPR plant, which could treat up to 7.5 million liters per day of wastewater effluent to drinking water standards. While some Texas cities benefited from rains in 2015 that filled their reservoirs, the reservoirs near Big Spring were still at less than 17% of capacity by August 2015 (CRMWD, 2015). The new DPR plant provided needed water supply reliability.

4.2.3.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs

In 2005, the CRMWD General Manager and the Water District Engineer presented the idea of DPR to the public in multiple town-hall style meetings in the district cities and neighboring cities that contract with the CRMWD for water. The presentation explained

the treatment processes and discussed public acceptance. The General Manger said, "The idea was well received, and in a meeting presented in Midland, a man joked that the idea was great because he would get to drink his beer twice" (General-Manager, 2015).

The General Manager also noted that gaining community support for DPR was not as difficult as some might expect. Despite the "yuck factor" often associated with potable water reuse, community members were mostly supportive of DPR from the outset. He believed West Texans to have a better appreciation for water scarcity than people in other parts of the country, noting that,

> Although there were concerns, most people were okay with it once we provided them with information. We held public meetings, we did news releases, we did television and radio, and we went around to civic clubs and did talks.

Public meetings continued throughout 2007, and there were no big public relations campaigns. The public was encouraged to call CRMWD to ask questions or to request educational presentations to clubs and associations, though few presentations were requested. The CRMWD General Manager attributes the public support for the DPR project to a few factors: customer education about water reuse and DPR, media assistance (as described below), and an already existing heightened appreciation of water scarcity among the general public.

4.2.3.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

The CRMWD District Manager felt that were no problems related to public trust in the

officials and agencies involved in the DPR project planning or implementation. Also, he was unaware of any opposition groups that formed in reaction to the project. His explanation for this was a perceived openness to the public process related to introduction and implementation of the DPR project; he believed that the public felt like it was given all the information it needed to form an educated opinion on the project and that officials were being transparent throughout the process.

4.2.3.4 Media Outreach.

There are three media markets in the area around Big Spring—television, newspaper, and radio—and CRMWD contacted all of them about the DPR project. According to the CRMWD General Manager, the media was accustomed to issuing occasional press releases related to water reuse and it was helpful in reporting the news fairly and accurately (General-Manager, 2015). Since Big Spring was the first DPR facility in the nation to go online and serve customers, CRMWD made national headlines. The General Manager felt that the national media treated the event differently: "Unlike the local media, the national media created the news instead of reporting it, and gave it a negative spin".

The local newspaper, The Big Spring Herald, has a circulation of approximately 4,000 newspapers a day. A reporter who had worked in the newsroom during the early stages of the DPR project related that the project was one of their major news stories, estimating the number of articles written on the project from its beginning in the early 2000s to be "in the hundreds."

4.2.3.5 Big Spring Governance

The governance for Big Spring's DPR decision was one step removed from direct voter involvement. CRMWD is a regional wholesale raw water provider, providing water to over 140,000 people in the district, and additional water contracts with the cities of Midland, San Angelo, Stanton, Robert Lee, Grandfalls, Pyote, and Abilene, as well as the Millersview-Doole Water Supply Corporation. CRMWD provides raw water to customers and the customers send the raw water to water treatment plants before making it available to rate payers. The Texas legislature authorized the agency's creation in 1949. CRMWD staff, under policies set out by a Board of Directors (CRMWD , 1981), make all decisions related to water supply sources and treatment prior to distribution to customers, subject to approval by the TCEQ. The members of the CRMWD Board of Directors are appointed by the City Councils of the cities served by the CRMWD. As the policymakers responsible for the potable reuse decision, the CRMWD's members are thus one step removed from influence by voter sentiment.

4.2.4 Wichita Falls TX

4.2.4.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

In 2012, the reservoirs in Wichita Falls, Texas, were less than 20 percent full. Groundwater was not available as a backup. The region had a brackish lake, and the city had previously installed an advanced water treatment system, which included microfiltration and RO, to treat the lake water for potable use. In anticipation of a water scarcity crisis, city officials looked to Big Spring's example and decided to follow suit since DPR appeared to be a viable means of meeting potable water demands. The local

population was well aware of the community's water crisis.

Since an advanced water treatment system for the lake water already existed, the city did not need to build a new facility for DPR, allowing DPR to be implemented quickly. A 13-mile above-ground pipeline was built to connect effluent from the WWTP to the advanced treatment system at a cost of $13 million. The pipeline was completed in December 2013, and the water authority and city and state tests verified treatment adequacy. The TCEQ approved a permit on June 28, 2014, and the facility provided 18.9 million liters of water per day (1/3 of the city's daily demand).

It took 27 months – from the first meeting between the city and water officials of Wichita Falls and the state TCEQ in 2012 – to obtain the required permit to operate DPR. The system came online on July 8, 2014.

Once the drought was over, the city reconfigured the system to operate as IPR instead, delivering between 30 to 37 million liters per day of treated wastewater to Lake Arrowhead (Jerome, 2016). Prior to the perceived water scarcity crisis, the city had been planning to implement IPR, so the reconfiguration was consistent with the city's long-range water supply plan.

4.2.4.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs.

Public education was a key to DPR's success in Wichita Falls. Early in the drought, before presenting DPR to the public, city and water officials engaged the city's doctors, university professors, and the media to ask for their support. City officials also created videos to educate the local population about water conservation efforts and describe the

DRP project. The videos were broadcast on the local news and then made available on YouTube. City officials made public communication and outreach a priority. In the words of the Public Works Director,

> Technology is easy. The hard part is public acceptance. You have to put a name and face on the project, and people have to know what the money is going for. [In Wichita Falls], people knew what the money was going for, and the public believed in the project (Public-Works-Director, 2015).

The Public Works Director himself introduced the public to DPR through the media, town-hall meetings, and in YouTube videos. More videos were created featuring utility representatives, doctors, and experts from local universities who talked about the treatment process and the safety of potable water reuse. The city considered these videos to be a success.

City staff at the water and wastewater treatment plants presented the proposal for a DPR facility to the public on February 6, 2013 as drought prompted city officials to limit lawn watering to a few hours once per week (City of Wichita Falls , 2015). Soon after, city officials held an emergency press conference at Lake Arrowhead (City of Wichita Falls , 2013) where they stood at a podium with Lake Arrowhead at 40% capacity as the backdrop, visually highlighting the problem of water scarcity. The mayor opened by talking about conservation efforts and the importance of water conservation during the drought. He was followed by the city Manager who emphasized conservation and

introduced the water reuse project that city officials planned to implement. The Utility Operations Manager then talked about a new system of hefty fines for irrigation violators. The Public Works Director and the Assistant Director of Health spoke about the necessity of a DPR facility in Wichita Falls and how public safety would be ensured.

The Public Works Director met with the Chamber of Commerce and other local organizations in order to educate members about the necessity of DPR in the community and how it could be implemented safely. The Mayor regularly held town-hall meetings to discuss public concerns, but there is no record of anyone going to the meetings to talk about DPR; the Mayor attributes this apparent lack of public concern to the success of the media outreach efforts. The water authority set up a hotline to directly handle questions and concerns from community members, though few people called. No groups were organized in opposition to the DPR project.

There were tours of the water treatment facility, but these tours were mostly requested by board of commerce and industry officials, businesses, civic organizations, state representatives, and congressional representatives. According to the Utilities Operations Manager, "It is hard to quantify how long it took to gain public acceptance – there was some initial skepticism, but in very little time there was 100% acceptance" (Utilities-Operation-Manager, 2015)

When asked why he thought DPR was accepted by the Wichita Falls community, the Utilities Operations Manager said:

> It is very easy to distrust public officials and we knew that form the start. We were very transparent and hid nothing from the public. We talked to the public about the treatment, the levels of treatment, the steps we took with the state, we brought in medical and university professors and asked for the public's approval. We pulled back the curtains. We wanted them to get the information from us and not to get some sort of wrong information off the internet.

4.2.4.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

The Utilities Operations Manager believed that the Wichita Falls Water Authority and the public felt that city officials were acting in their best interests. The water utility is a regional water supplier and supplies water to the cities of Holiday, Iowa Park, Burkburnett, Dean Dale, Freeburg Cooper, Pleasant Valley, Scotland, Wichita Valley, Archer County Municipal Utility District, and Sheppard Air-force Base. These water agencies and customers were also educated, and some of them visited Wichita Falls and took information back to their communities. Therefore, trust was gained not only in the City of Wichita Falls, but also among these customers, utilizing the same strategy of transparency as described above by the Utility Operations Manager.

4.2.4.4 Media Outreach.

According to the Public Works Director of Wichita Falls,

> [We told the media,] "This is the news we need you to get out there." The media was awesome. There was some sort of news—either newspaper or TV—on the

subject on a daily basis.

A few times the entire six o'clock news was dedicated to news on the drought and DPR.

4.2.4.5 Wichita Falls Governance

The Water Department of Wichita Falls is governed by the City of Wichita Falls under the Department of Public Works, which reports through a City Manager to an elected City Council and mayor (City of Wichita Falls , n.d.)**.** The policymakers are thus directly accountable to voters.

4.2.5 EL PASO TX

4.2.5.1 Existing conditions related to water scarcity, feasible water supply options, and public perceptions of scarcity.

The City of El Paso experiences drought to some extent at least once every decade, so there is great awareness of water scarcity among residents. A drought in the 1950s was the most significant in the city's history, both in duration and intensity (Texas Water Development Board , 2016). In the 1970s, the Texas Department of Water Resources developed hydrologic models, which predicted that the region would run out of water by 2010 due to a decline in ground water and an increase in water demand. Although the predictions did not prove to be correct, they did raise awareness that the region needed to diversify its water supply portfolio (Texas Water Development Board , 1984; Texas Water Development Board , 2016). Recent conditions have kept water scarcity on residents' minds: a drought lasting from August 2010 to October 2014 ranks as the second most severe and the second-longest on record, and 2011 is considered the worst one-year period of drought on record.

4.2.5.2 Mode of DPR project introduction and characteristics of DPR education and outreach programs

Public outreach for a new DPR facility began in June, 2015. Residents were welcomed to tour a pilot facility that was built on the site of the proposed future facility. Fact sheets on DPR were distributed to pilot facility visitors. The El Paso Water Utilities (EPWU) created a water reuse education program and provided speakers to visit with clubs, schools, and businesses to explain the project and the treatment process.

City officials built on past public outreach and education experiences in developing the recent programs focused on DPR. Outreach and conservation programs began decades ago as a response to the hydrologic modeling done in the 1970s. EPWU's Chief Technical Officer attended a local elementary school in the 1980s and remembers water utility employees visiting his classroom to provide conservation tips, such as turning off water while washing hands and brushing teeth, taking shorter showers, and limiting use of AC and swamp coolers during the summer (Espinola A. , 2016).

EPWU has been a pioneer in water reuse, delivering reclaimed water to the community since 1963 and operating one of the most extensive and advanced reclaimed water systems in Texas for industrial and landscape irrigation. For the proposed DPR plant, El Paso will treat a portion of the effluent from the local WWTP in an advanced water purification facility and the purified water will augment the potable water supply (El Paso Water Utilities, 2007). El Paso's DPR facility is expected to be ready for operation by 2017 and serving customers by 2018 (Vice-President-of-Marketing, 2015).

4.2.5.3 Public trust in the entities and individuals introducing and/or promoting the DPR project.

Due to longstanding water scarcity issues in the region, El Paso residents and EPWU saw the need to collaborate and form an informal partnership, which included mutual trust and cooperation (Espinola A. , 2016; Vice-President-of-Marketing, 2015). Many water management strategies have been in place since 1991, and a successful water conservation program has been in place for decades.

4.2.5.4 Media Outreach.

Following the examples of Big Spring and Wichita Falls, one of the first steps EPWU took in introducing the DPR project was to reach out to the media and educate them about the need for the DPR facility and how it would work. Through this outreach and education, EPWU staff felt that they were able to get the media "on board" with accurate reporting and coverage related to the plant. According to the Vice President of Marketing and Communications, the ***El Paso Times*** regularly features data analysis on local conservation efforts on its front page.

4.2.5.5 El Paso Governance

The El Paso Water Utilities is, for financial and legal reporting purposes, a part of the City of El Paso's municipal government. But since 1952 it has been operated as a quasi-independent agency. It is governed by a Public Service Board that consists of the city of El Paso's Mayor and six residents of El Paso County appointed by the El Paso City Council (El Paso Water , 2015). Policy decisions are thus one step removed from officials who are directly responsible to voters.

5. Discussion

The idea of implementing potable water reuse received different receptions in the various communities included in this study. While the communities of Brownwood, Cloudcroft, Wichita Falls, Big Spring, and El Paso accepted the idea fairly readily, the communities of San Diego and Toowoomba rejected the idea (at least initially, in the case of San Diego). In each case, decision making reflected a process of "bounded rationality" on the part of both the public and decision-makers, in which scientific information about the safety and utility of DPR competed with non-technical issues, including fear of water scarcity, the "yuck factor" response to DPR, the cost of the project, and other non-technical elements. DPR is not unique in this interplay between scientific and non-scientific issues in efforts to pursue evidence-based policymaking (Cairney, 2016), but provides a particularly sharp example of the issues raised. In light of the many competing technical and non-technical facets of DPR that affect decision-making, what actions or pre-existing conditions in communities likely contribute to public knowledge related to water and acceptance or rejection of potable reuse? In the sections below, we explore various factors that may have contributed to acceptance or rejection of potable reuse in the communities included in this study.

5.1 Local context

Although all communities included in this study experienced water scarcity, how residents viewed water scarcity and its possible solutions differed. Ormerod and Scott (2013) demonstrate that "potable reuse is a politicized issue, where expressed concerns reflect social values more complicated than simple revulsion," and that individual perceptions of scarcity are shaped by local context. It is critical to recognize the way in which reactions of both revulsion (which may lead to opposition to DPR) and fears of

scarcity (which may lead to support) are manifestations of psychological processes characterized as "System 1" reactions that happen autonomously and quickly in the brain, racing ahead of the slower and more "rational" "System 2" reactions in which the brain processes the more complex scientific information offered by way of explanation and defense of the safety and value of DPR (Kahneman, 2011). In addition to perceptions of water scarcity and climate conditions, the local context surrounding a water reuse project includes the people, authorities, and institutions that initiate discussions about recycled water, public trust in those authorities, and how public outreach and communication is conducted – all of which will influence System 1 and 2 reactions. Local context is different in situations where public conversations about potable reuse have not yet started prior to project introduction, or where ongoing water-related educational programs do not exist.

Residents of communities such as San Diego believed there were other options such as desalination that could be explored, possibly leading to the choice paradox, where having too many options may be detrimental or stressful, ultimately negatively affecting decision making (Schwartz, 2004). In San Diego's second attempt at gaining public acceptance of potable water reuse, a large-scale outreach and education campaign raised the population's awareness of water scarcity and the need for a more diverse portfolio of potable water supply sources. This coincided with a time of widespread awareness of persistent drought in California, which included state-imposed restrictions on water use (Bakdassare, 2014). This combination of education and outreach programs with a severe drought, possibly coupled with public knowledge about new potable reuse plants in

Texas, likely significantly changed the local context conditions between San Diego's two attempts at implementing potable reuse.

5.2 Project introduction and education

While some studies suggest that the effects of public outreach and education on public perception are unclear (Ching, 2010; Dingfelder, 2004), other scholars believe that public outreach and education have a positive effect on acceptance of water reuse (Hartley, 2006; Lohman, 1987; Nellor & Millan, 2010). These conflicting results may be due to differences in the outreach and education approach. The traditional project introduction approach of "decide, announce, and defend" (Po, Kaercher, & Nancarrow, 2003; Macpherson & Slovic, 2011), or attempts at public education after the project has been announced (e.g. in Toowoomba and in San Diego's first attempt) have largely been found to be unsuccessful (Po, Kaercher, & Nancarrow, 2003). However, similar strategies have succeeded in some communities with authoritarian government systems (Po, Kaercher, & Nancarrow, 2003) and in those where governance is one step removed from elected officials (e.g. Big Spring), though in the latter case it is unknown how community understanding of water scarcity and/or lack of alternative supply options impact this success. Po et al. (2003) recommend a strategy that incorporates a bottom up, community empowerment approach. Studies also demonstrate that a combination of water conservation programs, public tours, in-school and community education and outreach programs has shown positive results (Po, Kaercher, & Nancarrow, 2003; Tchobanoglous, Harold, Nellor, & James, 2011; Lohman, 1987). In an experiment by Lohman (1987), demonstration tours of the water recycling facility along with informational handouts had the greatest positive influence on the subject's opinion of

recycled water. The present study suggests that acceptance of water reuse is greatly improved when communities with cyclical conditions of drought maintain ongoing public education and outreach programs. For example, Brownwood and El Paso have longstanding water conservation, education, and outreach programs that include in-school education and facility tours.

Recycled water projects in Europe, Australia and the USA have failed or been abandoned due to a lack of community confidence in the projects or the authorities promoting them. In each case, community misgivings could be attributed, in part, to inadequate communication between the organizations promoting water reuse and their stakeholders (Dolnicar, Hurllimann, & Nghiem, 2010; Stenekes, Colebatch , Waite, & Ashbolt, 2006; Po, Kaercher, & Nancarrow, 2003). Those misgivings then feed back into the decision process as policymakers either react to public opposition or join the opposition. In some cases, members of the public opposed to DPR suspected planning was being undertaken in secret and that their concerns were being ignored. In others, water organizations failed to adequately promote the benefits of their operations. Even more detrimental was the failure of reuse organizations to alleviate stakeholder fears about possible health and environmental risks associated with water reuse (Khan & Gerrard, 2006). Because of the speed with which "System 1" revulsion reactions can take hold, moving ahead of more science-based "System 2" explanations of the science behind risk and safety, such opposition once developed can be difficult to dislodge.

Vocabulary and image choices must be carefully considered in communicating with the public on potable reuse because they influence public perceptions and acceptance (Macpherson & Slovic, 2011). In public communications, policy makers, water authorities, politicians and the media should not confuse the debate by conjuring images of a tall glass of human waste (Ching, 2010; Frew, 2005) or using pejorative phrases such as "toilet to tap".

Evidence from the case studies included here suggests that disgust may play a role in rejection of a potable reuse project, particularly when opposition groups organize and use disgust to rally against the project and are able to communicate with the public before and/or more effectively than the individuals or entities promoting the project. San Diego had the vocal and active opposition group the Revolting Grandmas, which sought to influence the project outcome by sitting on a California task force to fight potable reuse (Royte, 2008), sending out news releases attacking the City Council's water reuse plan, calling citizens to participate in City Council meetings, and releasing ads against the project (Potter, 1998). Toowoomba had the vocal and active opposition group CADS, which also played on public fears and feelings of disgust and used similar strategies to rally the public. In both cases, opposition was a significant if not a determining factor in project failure.

5.3 Public trust

Bottom-up or collaborative processes can build public confidence and trust in controversial water reuse projects (Hering, Waite, Luthy, Drewes, & Sedlak, 2013; Hartley, 2006). Hartley (2006) specified a framework for "public outreach, education,

participation, and planning" to gain public support for water reuse projects. Experiences documented in the literature reinforce the validity of this framework, both in creating "community-based, consensus-driven solutions" (Ingram, Valerie, Millan, Chang, & Tabucchi, 2006) and in failure to gain public trust (Dolnicar, Hurllimann, & Nghiem, 2010; MacPherson & Snyder, 2013).

The literature offers additional insights into how issues of trust can contribute to the success or failure of water reuse projects. For example, trust in the local officials and/or authorities introducing a water reuse project (Ormerod & Scott, 2013), timely communication with stakeholders, and transparency in the decision making process (Hurlimann & Dolnicar, 2009) all appear to be critical to project success. It is also essential that community members believe they are being properly informed about the safety of the reused water and potential health risks (Hurlimann & Dolnicar, 2009) in order to establish a strong relationship between trust and acceptance (Ross, 2014). The deliverer of information related to water reuse also seems to be important: for example, research has shown that people tend to trust regulators (such as the EPA) and the medical community, but have less trust in others such as politicians and developers (MacPherson & Snyder, 2013; Ormerod & Scott, 2013). These studies reinforce the idea that public trust is one of the most important aspects of any water reuse project (MacPherson & Snyder, 2013; Australian Academy of Technological Sciences and Engineering, 2013; Bufe, 2012).

5.4 Media attention

Media influences how people think about issues, and the social constructivist theory posits that the media itself constructs norms. In other words, media has the power to create knowledge and shape social norms related to water reuse (Ching, 2010) and agenda setting by the news media instructs the public what to think about (Wolfe & Baumgartner, 2013). Likewise, the agenda setting hypothesis states that the extent of media attention given to particular issues determines the degree of public concern for these issues (Atkinson, 2014; Behr & Iyengar, 1985; Saroka, 2002). Journalistic norms may also drive reporting of more extreme stories (Boykoff and Boykoff, 2007); "toilet to tap" certainly creates the basis for a more extreme story than does the advanced technology used to purify water for drinking.

In the case of Toowoomba, more media coverage was given to voices that opposed DPR than to voices promoting the project: stories in opposition to water reuse received 39 percent more coverage in the Australian media than those promoting it (Ching, 2010). This was due in part to the city's failure to reach the public before opposition groups, combined with the opposition's aggressive populist marketing tactics. Australia's media coverage of water reuse issues contained emotive language often used by local political leaders on both sides of the issue. Also, there was a puzzling use of negative terms to describe purified water even by leaders who supported the reuse project. As the Sydney Morning Herald pointed out: "It doesn't help when politicians, both for and against recycling water, confuse the debate by suggesting people will be drinking human waste" (Ching, 2010; Frew, 2005). According to Fishman (2011), those opposing water reuse in Toowoomba were better at

populist politics and marketing than project proponents. By contrast, community leaders in Big Spring, Wichita Falls, and El Paso, worked closely with media outlets to provide accurate technical information from the beginning, resulting in more objective media coverage and precluding the opportunity for opposition groups to reach the public with misinformation first. DPR appears to be a sensitive issue that is easily vilified by detractors—attracting pithy labels such as "Toilet to Tap," with its supporters dubbed "Sewer Sippers"—and public opinion can swing one way or the other depending on the characteristics of media coverage.

5.5 Governance

While public education and outreach played a significant role in influencing public acceptance of water reuse, either positively or negatively, the governance structures under which the potable water reuse decisions were made likely significantly impacted project outcomes as well. This is important because successful institutional management requires more than simply public acceptance in some general sense, but also an understanding of the ways in which public understanding is reflected in the particular decision making process. This extends not only to public understanding of reuse itself, but also to broader public awareness of water issues more generally, including the fiscal implications of projects and the water scarcity context in which the decision is being made.

Situations in which the policymakers making the reuse decision are directly accountable to the public, either through direct City Council election or direct plebiscite on the reuse question, pose the greatest challenges and the greatest risk that non-scientific fears can be politically exploited to undermine a poorly presented project. Governance structures

where the connection between policymakers and the public is less direct, such as an agency with an appointed board of directors, or a water wholesale agency whose customers are other utilities rather than the general public, face less of a risk. Less democracy, in short, makes reuse easier, while a policy process more directly accountable to the public raises the importance of an effective education and outreach effort.

6. Conclusions and Recommendations

While some scholars have focused on individual disgust at drinking purified wastewater as the explanation for opposition and in some cases rejection of DPR projects (Parkinson, 2008; Schmidt, 2008), the results from this study demonstrate that explanations for acceptance or rejection of DPR are more complicated. This study examines both failed and successful DPR projects in drought -prone communities and suggests that attitudes towards water reuse are community specific and responsive to local context, which includes geography, geology, climate, perception of existing water quality, perception of water scarcity, public education and knowledge related to water, trust in individuals or entities introducing the project, media coverage, and governance.

While some cities have struggled to successfully implement DPR projects, their introduction and acceptance into others, such as Wichita Falls and Big Spring, have been much quicker and less controversial. In the latter cases, this study suggests that public perception of the water scarcity risks, effective education and outreach programs, objective media coverage, and effective communication of the water situation helped create positive outcomes for DPR. Longstanding water conservation, education, and outreach programs that include in-school education and facility tours were likely keys to

success in Brownwood and El Paso. There is a gap in the literature on the effects of long-term, ongoing outreach and education programs on public acceptance of potable water reuse, and these results suggest that such programs improve community acceptance. Economic feasibility may play into the types of education and outreach campaigns that communities can launch. While San Diego was capable of obtaining acceptance in the second attempt, this was due in part to a massive public outreach and education campaign that was (presumably) very expensive. Education and outreach expenditures may look quite different in communities that have steadily invested in long-term, ongoing programs.

The following is a list of recommendations for those tasked with water planning in small-to-medium-sized inland communities that are considering the feasibility of DPR. These recommendations are not in order of importance, but rather should be considered equally important components of an action plan.

Recommendation 1 – Have an ongoing outreach and educational program

Water scarcity is often a cyclical occurrence with drought conditions returning on decadal scales. In areas experiencing water scarcity, it is essential to maintain education and outreach programs. Programming may include water conservation, in-school education, water and wastewater facility tours, and tours of water reuse demonstration systems. It is essential to continually support public awareness of water issues, sources of current supply, and possible alternative supplies so that communities are prepared with both public understanding and policy options when drought arrives. Developing a basic information campaign that includes testimony from credible third parties, i.e., regulators

or doctors, may also be helpful. Pointing out that DPR uses established technologies, describing successful projects elsewhere, and highlighting the safety of the purification process is critical as well (Po, Kaercher, & Nancarrow, 2003).

Recommendation 2 – Be mindful of the mode of project introduction

It is essential to have timely communication and maintain community involvement when introducing the possibility of DPR; a concerted public participation process is needed to ensure that the public is involved in the decision making phase (Po, Kaercher, & Nancarrow, 2003). Bottom up approaches that involve the public and collaborate with other organizations, including university or health professionals, increase public trust and support. Involving city and water utility staff in the communication process helps to create uniform message development and dissemination (Nellor & Millan, 2010).

Recommendation 3 – Gain public trust

The public's trust in the individuals or entities introducing the project has been shown to be one of the key factors for successful DPR implementation. It is important to be upfront and proactive, visible and creative, and transparent in the process of introducing the project (Po, Kaercher, & Nancarrow, 2003). Prior to project introduction, talk with stakeholders to understand their values, interests, concerns, priorities, understanding of water quality issues, attitudes towards the utility, and trusted information sources (Nellor & Millan, 2010).

Recommendation 4. Engage the Media

Identify all local media outlets and work closely with them from the outset to understand their needs, and tailor communications accordingly (Po, Kaercher, & Nancarrow, 2003; Nellor & Millan, 2010). By making accurate technical information available to the media,

the public can be reached with objective project details before opposition groups release misinformation.

Appendix 1

Interview Questions

1. Is the utility that provides water to your community publicly owned, privately owned, or a mutual domestic?

2. Please describe the water scarcity situation in your community prior to implementing direct potable reuse (DPR).

3. How was the idea of direct potable reuse (DPR) presented to the local residents?
    a. Who presented the concept of DPR to the community?
    b. In what venue?

4. Was information presented to the public about alternative sources of water (in addition to DPR), along with their costs and risks?

5. What, if any, educational materials were used to help the public understand the concept of water reuse and DPR?
    a. Was this material distributed before or after presenting the idea of DPR to the public?

6. Did the city or water authority use any forms of outreach, such as focus groups, to understand public attitudes/perceptions about water reuse or DPR?

a. If so, was the outreach performed before or after presenting DPR as an option?
b. Please describe the outreach performed and the public response to the outreach.

7. How did members of the community communicate their questions/concerns about DPR?
    a. Did the city hold meetings to address questions or concerns?

8. How long did it take from presenting DPR as an option to gaining public acceptance?

9. Please describe the decision making process that led to selection of DPR.
    a. Who made the final decision?

10. Did the community form one or more organized groups related to water reuse?

11. Was there at any point resistance to DPR from the community?
    a. If so, please describe.
    b. If so, how was the resistance addressed?
    c. Overall, was there public support for the final decision to implement DPR?

12. Due to the costs of construction and operation of the new DPR system, will there be a rate increase for water customers?

13. Is there anything else about the program that I have not asked and that you feel is important to the process of DPR being implemented in your community?

Table 1

Interviews	
City	Interviewees
Cloudcroft	Lead Water Operator Professor Bruce Thomson, Editor Alamogordo Daily News
Brownwood	Director of Public Works
Big Spring	Operations Manager General Manager Reporter Big Spring Herald
Wichita Falls	Public Works Director Utilities Operation Manager
El Paso	Vice President of Marketing

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