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Piping Water from Rural Counties to Fuel Growth in Las Vegas, Nevada: Water Transfer Risks in the Arid USA West

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ABSTRACT: The Southern Nevada Water Authority (SNWA) plans to build a 300-mile pipeline to transfer groundwater from five rural basins in north-eastern Nevada south to the greater Las Vegas metropolitan area. Relying on the path dependence literature, we trace the policy choices and legal battles that have led to southern Nevada's proposed Groundwater Development Project. We find that policy decisions over time, often initiated by powerful water policy entrepreneurs, have fuelled southern Nevada's rapid growth and development. After emphasising water demand management for more than two decades, SNWA has revived its controversial plans to increase water supplies by importing water from rural areas. Using semi-structured key-informant interviews and document analysis of water right hearing transcripts, public comments, and hearing rulings, we examine the risks and uncertainties involved in SNWA's Groundwater Development Project. SNWA and the protestors of the project experience different aspects of risk and uncertainty. SNWA believes the Groundwater Development Project is an essential addition to its current water strategy to reduce the political and economic risks from Colorado River shortages that could endanger southern Nevada's longer-term economic survival. Protestors believe the uncertainty of SNWA's mitigation and management plans are inadequate to protect rural basins from the long-term ecological and hydrological risks and uncertainties associated with SNWA's pumping and export of groundwater from their areas. Our analysis reveals a much deeper and longer path dependence trajectory in the USA West of overpopulating an arid region, subsidising decades of infrastructure development to promote economic development, and creating dependencies on increasingly scarce water supplies. A paradigm shift much larger than water demand management is required to reverse this trajectory and deal with the dilemmas of unabated growth in desert metropolitan areas dependent on distant water sources.

KEYWORDS: Path dependence, water infrastructure, policy entrepreneurs, risk assessment, Las Vegas, USA

INTRODUCTION

Many water managers have established opposing strategies in order to meet their mission of supplying water to their constituents (Wong and Brown, 2008; Brown et al., 2009; Fort and Nelson, 2012; Kanta and Berglund, 2015). One water management strategy consists of proposals to use water more efficiently, employing conservation strategies, tiered rate structures, water recycling, and water markets; this strategy is known as the 'soft path' of water demand management (Wolff and Gleick, 2002; Brooks et al., 2009). The other strategy has water managers seeking to increase their water supplies through long-distance water pipeline structures and engineered water delivery infrastructure; this is the more traditional water supply augmentation approach (Wong and Brown, 2008; Fort and Nelson, 2012; Crow-Miller, 2015). The Southern Nevada Water Authority (SNWA) is an urban water supplier that has strategically addressed its water supply concerns through pursuit of both strategies. Through outdoor water conservation initiatives launched in 2003, southern Nevada was able to

decrease its overall water consumption, even while the population grew (Davis, 2011). However, southern Nevada has become acutely aware of its high vulnerability to water shortages emanating from research findings revealing much longer-term drought cycles in the USA Southwest and future climate change uncertainties. Nearly 90% of southern Nevada's water supply comes from one source, the Colorado River. Since 2000, that river basin has been experiencing its longest drought in the last one hundred years (U.S. Department of Interior, 2012). Many other large and growing metropolitan areas of the USA West also depend upon Colorado River water. To respond both to water uncertainties in the Colorado River Basin and to southern Nevada's long booming population, SNWA has pursued development of groundwater rights it filed for in the late 1980s in five rural groundwater basins 300 miles away in north-eastern Nevada (Figure 1).

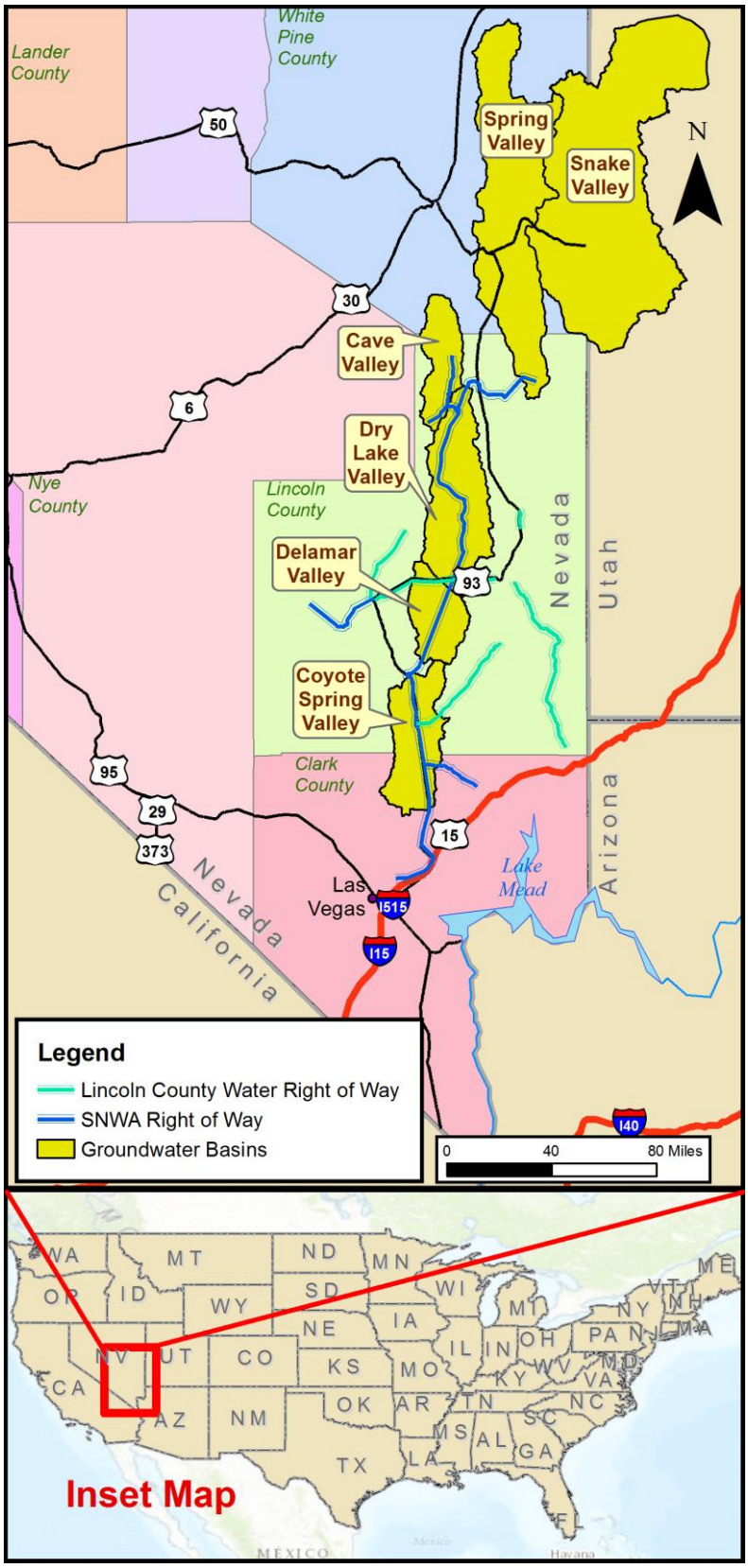
Traditionally, large water conveyance projects have helped growing municipalities to establish reliability in their water supplies when local sources are exhausted. However, many water scholars have pointed out that water policy is in a time of transition as competition over scarce freshwater increases (Blatter and Ingram, 2001; Whiteley et al., 2008; Wong and Brown, 2008; Brooks et al., 2009; Ingram, 2011). Water managers throughout the world are experiencing multiple challenges resulting from climate change, increased droughts, and population growth (Pahl-Wostl, 2007; Wong and Brown, 2008). These challenges are complicated in water systems, such as those in the western United States, where water is either fully allocated or nearly so as many cities grow and compete with one another to secure additional water supplies (Contor, 2010). With these added stresses to existing water systems, new water projects are often not as reliable as past projects and, in fact, could increase water supply vulnerability as communities bear high costs for water infrastructure that makes them dependent on potentially unreliable water sources (Wong and Brown, 2008; Brown et al., 2009; Fort and Nelson, 2012; Crow-Miller, 2015).

In this article, we examine how SNWA and those who are against the project frame risks and uncertainties involved in SNWA's proposed groundwater transfer pipeline project. SNWA considers its Groundwater Development Project as essential to reduce vulnerabilities to Colorado River shortages that pose risks to the survival of southern Nevada's economy. While the Groundwater Development Project would provide SNWA with another source of water separate from the Colorado River, large-scale water projects and pipelines are not without their own set of risks. People living in rural Nevada recognise that water is critical to their livelihoods and believe that the environmental and social risks from such a large water exportation project are too great to bear. Water policy is often characterised by stability and the concept of path dependence, which refers to the importance of the sequencing of events as well as associated technological lock in (Pierson, 2004; Ingram and Fraser, 2006; Brown et al., 2011). A variety of policy decisions over time have facilitated rapid metropolitan expansion of Las Vegas in one of the most arid locales of the USA, creating a growing contradiction between land use and water availability. This study uses insights from the path dependency literature to trace the policy choices that have led to SNWA's decision to pursue the pipeline project. We also examine the multiple perspectives of risk and uncertainty that accompany this water transfer pipeline and explain how imbalances between divergent risk assessments have made the project so highly controversial.

PATH DEPENDENCE, RISK ASSESSMENT, AND POLICY ENTREPRENEURS IN URBAN WATER MANAGEMENT

Pierson (2004) explains the importance of path dependence in understanding current public policies. Choices made in the past can constrain future decisions and reinforce the paradigms under which earlier choices were made. Changing or reversing a policy path can be very difficult and the costs can be high, causing alternative policies to be less likely to be adopted (Pierson, 2004; Ingram and Fraser, 2006; Brown and Farrelly, 2007). To develop the USA West, the Colorado River was altered with dams, reservoirs, and aqueducts to store and transport water to support agricultural production, natural resource extraction industries, and general regional development (Worster, 1985; Reisner, 1993).

Figure 1. Map of eastern Nevada showing the five groundwater basins (Snake Valley, Spring Valley, Cave Valley, Dry Lake Valley, and Delamar Valley) identified in SNWA's water right applications for its proposed Groundwater Development Project.



Technological path dependency has been found to be one of the barriers to establishing new, sustainable methods of water management (Brown and Farrelly, 2007). Nearly 40 million people, major cities, and productive agricultural areas in seven USA states depend on Colorado River water delivered through extensive engineered infrastructure for their continuing survival. Because of this reliance and the investments previously made in that infrastructure, strong incentives exist to find and transport more water from distant places to maintain both the use of existing infrastructure and the same uses of water, even when water supply quantities are threatened (Ingram and Fraser, 2006).

Studies have shown that urban water suppliers, in particular, often depend on water importation or supply augmentation in response to water shortage challenges (Lach et al., 2005; Larson et al., 2009; Fort and Nelson, 2012). The mission of most urban water managers is to supply water to their constituents, avoid any interruptions in water service, and maintain low water rates (Larson et al., 2009). Urban water organisations tend to be timid at innovation and prefer incremental changes in their policies (Lach et al., 2005; Brown and Farrelly, 2007; Dobbie and Brown, 2011). The hydrologic system is complex and water supplies can be uncertain, particularly in arid regions. However, most USA citizens expect water systems to be reliable and infallible, and water managers work to avoid criticism by "routinising the uncertain" through the construction of infrastructure, agreements, and other organisational processes (Lach et al., 2005: 2031). Lundqvist et al. (2001) refer to this often unspoken agreement between the public and urban water managers as the 'hydro-social contract'. Urban water managers generally have been successful at reducing uncertainty in their water systems such that citizens often do not realise the scarcity of water in the western United States (Lach et al., 2005).

However, as urban water managers attempt to respond to the challenges of climate change, growing populations, and increasingly scarce water supplies, many of them are striving to transition into a more sustainable method of urban water management (Brown and Farrelly, 2007; Brown et al., 2008). Brown et al. (2008) identify six stages cities can transition through when pursuing sustainable urban water management (SUWM): Water Supply City, Sewered City, Drained City, Waterways City, Water Cycle City, and Water Sensitive City. As a city progresses through this continuum, its water management system incorporates additional objectives, with a Water Sensitive City including the goals of water supply security with ecological protection, equity, and resilience to climate change (Brown et al., 2008). In order for a city to transition to SUWM, the hydro-social contract must also undergo changes that require engaged stakeholders to understand their responsibilities in contributing to sustainable water use (Brown et al., 2008; Wong and Brown, 2008).

Water managers tend to trust themselves and other water utilities more than the public when evaluating water management options, relying on strategies that were successful for their profession in the past (Baggett et al., 2006; Dobbie and Brown, 2011). This lack of trust can lead water managers to pursue strategies that require little public cooperation for success, thus endangering opportunities to embrace more sustainable urban water management strategies (Baggett et al., 2006; Brown and Farrelly, 2007). The risk perceptions of a particular strategy are often influenced by whether or not the person favours the strategy (Slovic et al., 2004; Baggett et al., 2006). Both experts and the public perceive risk subjectively, based on their knowledge, values, and beliefs (Slovic et al., 2004; Baggett et al., 2006; Dobbie and Brown, 2011). The differences in risk perception between experts and the public can depend on differing attitudes and trust levels towards water systems and institutions, leading to both emotional and analytic perceptions of risk (Slovic et al., 2004; Dobbie and Brown, 2011).

In southern Nevada, Patricia Mulroy, former general manager of SNWA, led many policy changes to reduce risks from uncertainty in Nevada's water supply so that southern Nevada could maintain its high rate of population and economic growth. SNWA's methods have been wide-ranging, pioneering aggressive implementation of water demand management strategies in the USA West, while seeking additional water supplies through traditional management practices. Kingdon (1984: 214) describes policy entrepreneurs as people who "invest their resources in return for future policies they favour". Policy entrepreneurs have a variety of different motivations and they can be individuals both inside and

outside the government (Huitema and Meijerink, 2010). Pierson (2004: 136) describes policy entrepreneurs as "well-situated and creative actors". While policy entrepreneurs can be important to stimulate policy change, the conditions leading to the need for that change may have been in progress over a longer period of time (Pierson, 2004). In this article, we document the role that some policy entrepreneurs have played in southern Nevada's water development over time. We also discuss a growing shift in thinking about water in southern Nevada through the actions of other policy entrepreneurs, who are concerned about the future ecological and hydrologic sustainability of southern Nevada and rural areas of the Great Basin watershed.

METHODS

This article uses a qualitative case-study-method approach appropriate for conducting policy analysis. This approach gave us the opportunity to examine the uniqueness of this specific case while also finding attributes that are common to many other water transfer and pipeline projects (Yin, 1981; Ragin, 1987). Case studies address qualitative variables, individual actors, decision-making processes, historical and social contexts, and path dependencies, which are all essential elements in understanding how water policy works in reality (George and Bennett, 2005). We used a variety of data-gathering strategies, primarily relying on key-informant interviews and document analysis (Box-Steffensmeier et al., 2008; Cresswell, 2009; Johnson and Reynolds, 2011).

We used primary, archival documents to reconstruct the policy process in the SNWA case study by analysing information produced by the legislative process, including the procedural history of the SNWA pipeline project and the transcripts from the 2011 hearings before the Nevada State Engineer over SNWA's water rights. The 2011 water right hearings took place over six weeks and included testimonies from SNWA managers and scientists and multiple protestor groups. The protesting groups included rural citizen groups from Nevada and Utah counties, environmental organisations, rural businesses, and Native American tribes. We observed the water right hearings in real time through online video feeds. The 29 volumes of hearing transcripts were obtained and purchased from the court reporting firm that prepared and certified the transcripts. We examined secondary, contemporary public accounts by searching for newspaper and other media accounts of the case as it unfolded over time. These public accounts are important because they help to situate issues and define contexts within which policy-makers operate (George and Bennett, 2005).

We also conducted 16 in-depth key-informant interviews. Interviewees included people representing groups and opinions on both sides of the pipeline issue: SNWA water managers, Las Vegas citizens, board members of the Great Basin Water Network (an organisation devoted to keeping water in rural Nevada), and rural Nevada landowners, business owners, and tribal representatives. We asked 26 open-ended questions to understand people's perceptions and opinions about how and why rural Nevada water should be allocated. We asked what people thought of the scientific investigations that have been conducted on the groundwater systems of rural eastern Nevada and western Utah. We also asked more general questions to gauge people's thoughts on how water could be effectively allocated and their opinions on what fair water allocation entails. The interviews ranged from 60 to 120 minutes in length and were tape recorded and professionally transcribed. We received informed consent prior to each interview, and all interviewees opted to remain identifiable so we could cite them as information sources. We also engaged in participant observation in four meetings held by the Great Basin Water Network. These meetings were primarily strategy meetings on stopping SNWA's pipeline to the rural groundwater basins. We integrated the data from the interviews, hearings, meetings, and news sources and used content analysis to identify the main arguments related to SNWA's proposed Groundwater Development Project (Krippendorf, 2004). Through this contextualised case study methodological approach, we were able to gain insight on how SNWA and protestors framed the pipeline project: SNWA framed the project as a necessity and focused on the risks of not pursuing it,

while the protesting people focused on the unsustainability of the project and its possible risks to the hydrology, ecology, and livelihoods of the rural groundwater basins and their residents.

LAS VEGAS' PATH TOWARDS INCREASED DEPENDENCE ON SCARCE WATER

Events leading up to SNWA's proposed Groundwater Development Project are shown in Table 1. The 1922 Colorado River Compact attempted to plan for future needs by dividing the seven Colorado River states into an Upper and Lower Basin so that development could proceed in California, part of the Lower Basin, without depleting the river before Upper Basin states had the opportunity to use their shares in the future. However, the Compact negotiators did not envision all of the issues facing the Colorado River today. Over-allocation of the river's water, multiple competing needs, prolonged drought, population growth, and climate change have stressed the system, and current water policies may not contain the tools to equitably solve the emerging water conflicts. As the Colorado River basin states realise that water will become more scarce and uncertain, water managers have been brainstorming alternative solutions to survive in this new reality (U.S. Department of Interior, 2012). Nevada, in particular, is one state where water managers have been insistent on developing new sources of water to use in conjunction with their Colorado River water.

Table 1. Chronology leading to SNWA's proposed Groundwater Development Project.

1922	The Colorado River Compact is negotiated to allocate Colorado River water among seven states (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming). Of the 20.35 Bm^3 per year of water apportioned from the Colorado River, Nevada is given 0.37 Bm^3 of water per year.
1931-1936	Hoover Dam is constructed, creating Lake Mead.
1950s	Groundwater springs beneath Las Vegas are overpumped, resulting in subsidence issues and Las Vegas' switch to relying on Colorado River water.
1989	Las Vegas Valley Water District (LVVWD) files for half of the unallocated groundwater in Nevada, encompassing 30 groundwater basins in four counties.
1991	The Southern Nevada Water Authority (SNWA) forms and joins the seven individual water entities in the region (Big Bend Water District, Boulder City, Clark County Water Reclamation, City of Henderson, City of Las Vegas, Las Vegas Valley Water District, and North Las Vegas) with a shared shortage arrangement to address water issues on a regional basis.
1998	The Southern Nevada Public Land Management Act (SNPLMA) is enacted and allows the Bureau of Land Management (BLM) to sell public land around Las Vegas.
2004	SNWA requests that the Nevada State Engineer rule on its 1989 groundwater applications in five rural basins: Spring Valley, Delamar Valley, Dry Lake Valley, Cave Valley and Snake Valley (Figure 1).
2004	The Lincoln County Conservation, Recreation, and Development Act (LCCRDA) is enacted and sets aside corridors through public land managed by the BLM for any facilities that support a water development project (Figure 1).
2011	Water right hearings over SNWA's 1989 groundwater applications for four basins (Spring Valley, Delamar Valley, Dry Lake Valley, and Cave Valley) are held over a six-week period.
2012	The Nevada State Engineer grants SNWA the majority of the groundwater rights it filed for in 1989.
2013	In an appeal with Nevada's 7th Judicial District Court, SNWA's approved water rights are referred back to the State Engineer for further study and recalculation.
2016	The Nevada State Engineer holds a status conference and orders a new hearing on SNWA's monitoring, management, and mitigation plans for their Groundwater Development Project to be held fall 2017.

Nevada receives only 0.3% of the total water allocated from the Colorado River and depends on the Colorado River for over 90% of southern Nevada's water supply. Other states are also working to establish their share of Colorado River water before climate change and drought eliminates opportunities for states to put their full allocations to use. Utah, for example, is proposing to build a pipeline from the river to St. George to develop some of its remaining allocation of Colorado River water.

With Mulroy's encouragement and promise to develop rural Nevada water, the seven water entities in southern Nevada joined together to form the SNWA and pooled their water in a shared shortage arrangement to address water issues on a regional basis. In the Cooperative Agreement between the seven agencies, one of the functions conferred to SNWA was

> to acquire the rights of LVVWD [Las Vegas Valley Water District] under applications filed with the Nevada State Engineer to appropriate surface water and groundwater in northern Clark, Lincoln, Nye, and White Pine counties… for the use of such water in Clark County [where Las Vegas is located] (Southern Nevada Water Authority, 1995: 15).

SNWA was formed out of the necessity to help southern Nevada decrease uncertainty in their water supply system, an example of an organisational process that many water entities employ to make access to water more predictable (Lach et al., 2005).

In an interview, John Entsminger (2011), now general manager of SNWA, explained, "[w]e [SNWA] are not a pro-growth or anti-growth agency. We don't make land use decisions… Our job is to be prepared to supply water to whatever growth occurs or doesn't occur". SNWA maintains a rolling 50-year resource plan that is evaluated every year. In the plan, SNWA reviews their existing water sources, projects the water demand in 50 years, and compares its existing supplies to projected future demands (DWR Applications 53987 through 53992 Vol. 1, 2011). Interestingly, Las Vegas' growth was initially limited by the fact that the city is surrounded by public land managed by the Bureau of Land Management (BLM). In her comprehensive series on the history of Las Vegas and water, Emily Green (2008) explains that Nevada was so arid that the state preferred to concentrate its landholdings in areas adjacent to water and welcomed the federal government's management of the remaining 97% of land. However, as Las Vegas continued to grow, Nevada policy entrepreneurs worked to modify the federal land boundary around the city. The key policy entrepreneur in effecting this change was United States Senator Harry Reid from Nevada. He was instrumental in the creation and Congressional passage of the Southern Nevada Public Land Management Act (SNPLMA) in 1998. The SNPLMA allows the BLM to sell public land around Las Vegas. The profits from the land sales stay in Nevada to benefit schools, parks, and conservation efforts. The SNPLMA also directs 10% of the profits to SNWA, a clause inserted into the bill by Patricia Mulroy (Green, 2008). As of February 2014, more than 15,000 acres of land had been sold under the provisions of SNPLMA for a total of $3 billion (Tetreault, 2014).

Releasing federal lands back into the state of Nevada's ownership seemed like common sense to outside Congressional legislators in the context of the times where devolving federal land to state control was gaining political traction (Green, 2008). However, many people who are opposed to SNWA's Groundwater Development Project think the federal land disposals have played a large part in southern Nevada's growing use and dependence on limited water (Mrowka, 2011). In 1999, drought in the Colorado River Basin began, causing water levels in Lake Mead, Las Vegas' primary source of water, to drastically drop by 15.24 metres by 2002. The drought gave SNWA a wake-up call that "this lake that everybody thought was drought proof might in fact be susceptible to drought" (Davis, 2011). The drought was a trigger event leading to SNWA water policy changes that enacted innovative and effective conservation measures. SNWA worked hard to conserve water and dropped its per capita use of water from 1314 litres per capita per day in 1990 to 488 litres per capita per day in 2014, after accounting for the capture and reuse of indoor water (Davis, 2011; Southern Nevada Water Authority, 2014). However, federal land sales around Las Vegas continued with additional legislation passed to

expand the disposal boundary in 2002 (Mrowka, 2011). Rather than use the drought as a trigger event to limit but sustain southern Nevada's population, southern Nevada continued to grow at a rapid rate. In 2004, SNWA requested that the State Engineer rule on its 1989 groundwater applications in five rural basins: Spring Valley, Delamar Valley, Dry Lake Valley, Cave Valley, and Snake Valley (Figure 1). This request led to a lengthy water right hearing in 2011.

Senator Harry Reid helped pass another Congressional bill to bring the proposed pipeline project closer to construction. He introduced and facilitated passage of the Lincoln County Conservation, Recreation, and Development Act (LCCRDA) (Welsh, 2014). The LCCRDA was passed by Congress in 2004 and sets aside corridors through public land managed by the BLM for any facilities that support a water development project (Figure 1). The LCCRDA states that the corridors are subject to review and analysis under the National Environmental Policy Act (NEPA). However, Penny Wood, BLM project manager, explained that the wording of LCCRDA suggests the BLM cannot reject SNWA's request for a right-of-way in the corridor area the LCCRDA specifies (Wood, 2011). Instead, the BLM is restricted to using the NEPA process to ensure that the project is appropriately mitigated. The LCCRDA helped streamline a very complex interagency permitting process to allow SNWA to build a pipeline across BLM lands. Eight years after SNWA submitted a proposed action to obtain a right-of-way for the 300-mile pipeline from the BLM, the BLM completed the NEPA process and released its record of decision, approving SNWA's pipeline project.

HYDROLOGIC UNCERTAINTIES IN THE GROUNDWATER SYSTEM

Many uncertainties surround the hydrology of the groundwater system that connects the groundwater basins where SNWA has filings on water. How much water is available in the aquifer system is not known with any high degree of confidence. The extent of groundwater flow through and between the basins is also unclear, and it has not been determined how a large-scale pumping project will affect those basins. Many studies have been conducted on this aquifer system. As directed by the LCCRDA, the USA Geological Survey, in cooperation with the Desert Research Institute and the Utah State Engineer's Office, conducted the Basin and Range Carbonate Aquifer System Study (BARCASS). BARCASS, completed in 2007, evaluated the groundwater systems of Lincoln and White Pine counties in Nevada and adjacent areas in Utah. BARCASS did collect some new data, including evapotranspiration (ET) data to estimate groundwater discharge from plant transpiration. However, BARCASS primarily re-evaluated existing information to characterise the groundwater systems of the selected basins (DWR Applications 53987 through 53992 Vol. 3, 2011). Many disagreements exist between SNWA and protestors on how much water flows through the basins. Scientists explain that it is "very complicated given the structural setting and the different lithographic contrasting permeabilities" (DWR Applications 53987 through 53992 Vol. 3, 2011: 601). Dr. James Thomas, research professor of the Desert Research Institute, illustrated the interpretative nature of understanding the data when he explained "the data can be used to evaluate whether a flow path is probable" (DWR Applications 53987 through 53992 Vol. 5, 2011: 1066).

SNWA and the pipeline protestors assess these uncertainties in scientific knowledge of the groundwater basins from different perspectives. Sjoberg (2001) explains that scientific knowledge is always provisional and, in the past, some public environmental concerns tended to be dismissed by scientific experts but later were found to be justified. While many experts tend to evaluate risk using statistical probabilities, both experts and the public maintain a 'multidimensional' perception of risk that integrates qualitative and affective factors (Sjoberg, 2001; Slovic et al., 2004; Dobbie and Brown, 2011). Experts' risk perceptions can also often correlate with their employers' interests (Sjoberg, 2001). In closing arguments, protesting attorney, Simeon Herskovits, said, "[m]any pieces of testimony… seemed pretty clearly keyed, and guided, and marshalled towards the realisation of one thing, an

overarching goal, which is the support of these [SNWA's water right] applications" in rural Nevada basins (DWR Applications 53987 through 53992 Vol. 29, 2011: 6474).

Schneider and Ingram (1997) discuss that science can be used to 'objectify' issues, resulting in ordinary citizens believing there is one objective answer only experts can find. This process can result in ordinary citizens feeling as if they do not have the skill or information to participate meaningfully in political decisions informed by science. However, according to Schneider and Ingram (1997), local citizen groups can often gain confidence due to their familiarity and experiential knowledge of an area. In these circumstances, these groups will often perceive the issue in question as an equity issue rather than a technical issue. In the case of the SNWA Groundwater Development Project, the protestors recognise the uncertainty in the known science and raise the technical issues in their protests. However, the main point of their protests focuses on the fairness in how SNWA has chosen to manage the scientific uncertainties entailed in their pipeline project.

MULTIPLE PERSPECTIVES ON UNCERTAINTY AND RISK IN THE GROUNDWATER DEVELOPMENT PROJECT

SNWA's risk perspective: Water security for urban southern Nevada

Many decisions made over time in this case study were driven by water policy entrepreneurs operating within a certain managerial framework and have led to SNWA's belief that the Groundwater Development Project is necessary to decrease the risk of catastrophe in southern Nevada. The main rationale offered by SNWA for the Groundwater Development Project is to mitigate risks from drought on the Colorado River (Welsh, 2014). John Entsminger, now general manager of SNWA, explained: "[if] 90% of your water supply is imperilled, [and] your job is to provide a safe and reliable water supply for two million people, can you afford not to build the project?" (Entsminger, 2011). As an urban water system, SNWA is focused on its mission to provide water to constituents in its service areas. Lach et al. (2005) explain that water organisations are so intent on meeting their clients' needs that they limit their decision-making scope only to their geographic jurisdiction. SNWA does not fully consider the effects of its proposed water transfer project on the rural communities at the water's source, because those five groundwater basins are not within SNWA's jurisdiction.

The USA Bureau of Reclamation released their Colorado River Basin Water Supply and Demand Study in December 2012. This study projects that the Colorado River may not be able to meet all of the demands on it by 2060. As the Colorado River Basin states realise that water will become more scarce and uncertain, water managers have been brainstorming alternative solutions to survive in this new reality (U.S. Department of Interior, 2012). SNWA has pursued water demand management by increasing both indoor and outdoor water conservation and water reuse through multiple educational, financial, incentive, and water use restriction programmes (Southern Nevada Water Authority, 2014). Nearly all water used indoors is reused, either by returning it to the Colorado River or delivering it to other municipal uses, such as golf course irrigation and power plant use (Southern Nevada Water Authority, 2014). SNWA's Water Smart Landscapes Rebate Program offers citizens incentives to replace traditional lawns with water-efficient landscaping. However, despite these efforts, SNWA water managers insist that demand management is not enough when southern Nevada's main source of water has been in continual shortage that may only increase with climate change (DWR Applications 53987 through 53992 Vol. 1, 2011). In addition, SNWA's efforts in water demand management have helped SNWA justify additional water supply and infrastructure projects. SNWA argues it has stretched its existing Colorado River supplies as much as possible and now needs to develop new sources of water to meet future water needs of southern Nevada (DWR Applications 53987 through 53992 Vol. 1, 2011).

SNWA is most concerned with reducing the uncertainty of southern Nevada's urban water supply. Consequently, it is intent on creating a water system to respond to the worst case shortage scenario, even if it may not occur (Lach et al., 2005). Many protestors state that SNWA does not need the

groundwater from rural Nevada at this time, because Nevada's growth has slowed significantly since the USA economic downturn that began in 2009 (Frey, 2012). However, SNWA asserts that "under-forecasting population could be potentially very serious for us (…) if we are under-forecasting, we may end up short of resources" (DWR Applications 53987 through 53992 Vol. 2, 2011: 312). SNWA also maintains that it is important to undergo the complete permitting process for the pipeline project so that when Lake Mead levels drop below 327.66 metres elevation (the level that triggers the first federal shortage declaration on the Colorado River), they can instantly begin construction on the project (Davis, 2011). Mulroy explained that when Lake Mead hits 327.66 metres, the elected officials of the greater Las Vegas urban area in southern Nevada will need to confront a risk assessment. "And it will be a question of how much risk are you willing to expose this community to?" (DWR Applications 53987 through 53992 Vol. 1, 2011: 96).

Rural Nevadans' risk perspective: Undefined mitigation plans

Protestors of SNWA's Groundwater Development Project are also concerned about risks to their communities, but the risks they face are from implementation of SNWA's proposed pipeline. People in these rural valleys of Nevada have been fighting to protect their communities for a long time. Many people in the Great Basin Water Network (GBWN), the major group protesting SNWA's pipeline project, have been working together for over 30 years, dating back to their opposition to the MX Missile System proposed for sites in eastern Nevada and western Utah in the late 1970s to early 1980s. The MX Missile project, which has since been terminated, would have established a missile system throughout the Great Basin Desert. Over time, rural residents have been forced to consider and protect their future in light of multiple outside interests proposing to make changes to Great Basin landscapes and communities. Steve Erickson, policy advocate for the GBWN, explained that SNWA's pipeline project is "the third major project that we've had to fend off out there" (Erickson, 2011). Erickson said, "[t]hese people know how to stand up for themselves and be heard… I think [their past experiences have] been really a critical part of the overall battle" (Erickson, 2011). These past experiences have also contributed to a lack of trust protestors have towards outside institutions, a factor in how protestors perceive the risks from the Groundwater Development Project (Baggett et al., 2006).

Protestors oppose SNWA's Groundwater Development Project for many reasons and fear the project will destroy social and environmental resources in rural Nevada (Welsh, 2014). They are working every possible angle to stop the project, because they are uncertain what SNWA will do if its pumping causes adverse impacts. In the mitigation and management plans for the project, SNWA does not include quantified thresholds or triggers that would force them to stop pumping. Herskovits explained, "[y]ou [SNWA] must do necessary work upfront to establish objective quantified triggers and thresholds and goals, and you must have concrete measures that will be implemented in a certain way when those triggers are reached" (DWR Applications 53987 through 53992 Vol. 29, 2011: 6484). The protestors seek some kind of certainty that rural cultural values and ecology of the area will be preserved. However, SNWA maintains that it is too early to establish thresholds and that more test wells and monitoring are needed to understand how the groundwater system works. SNWA says that stresses need to be applied to the system in order to better understand both the hydrology of the system and the effects of pumping (DWR Applications 53987 through 53992 Vol. 16, 2011). According to SNWA, it will use an adaptive management approach after the pipeline is constructed and the pumping begins that will allow it to learn about the aquifer system and use that knowledge to make management decisions (DWR Applications 53987 through 53992 Vol. 8, 2011). SNWA contends that its groundwater flow models help pinpoint where monitoring should occur. It defends not using the models to predict impacts from pumping, because the models would simply show more drawdown without taking into account the changes in pumping that SNWA would make. However, SNWA is not explicit on what those changes will be and the conditions that would initiate them (DWR Applications 53987 through 53992 Vol. 29, 2011).

SNWA is also not clear on what it considers to be adverse impacts. SNWA explained that it was impossible to define adverse impacts ahead of time, because each impact would need to be considered on a case-by-case basis (Utah Division of Water Rights, 2009). In an interview, Patricia Mulroy explained,

> Cities cannot, rural communities cannot, ranchers cannot take water from a source without having some kind of impact. That impact range is very broad. Where on that continuum will it fall, and what are we willing to say is an acceptable impact and what is an unacceptable impact? (Brean, 2014).

SNWA has not had that conversation with the pipeline protestors to determine what would be considered acceptable and unacceptable impacts. Instead, SNWA plans to use hydrologic data collection and other techniques so that a technical working group can decide later if impacts are unreasonable and caused by SNWA pumping (Utah Division of Water Rights, 2009).

Determination of whether impacts should be considered unreasonable or not, however, is not simply a scientific question. Failing et al. (2007) explain that it is important to include public involvement in controversial environmental decisions. Guston (2001) explains that there is no clear dividing line between science and policy, because both science and policy contain elements of rationality and value judgments. Similarly, Schneider and Ingram (1997) show that increasing the role of scientists in policy-making does not cause policy to be more objective, because the scientific process itself is socially constructed. Guston (2001: 405) proposes the use of boundary organisations as an approach that combines the interests of science and policy while preventing the 'politicisation of science' and the 'scientisation of politics'. A successful boundary organisation is one that satisfies members on both sides of a boundary while remaining stable by continually negotiating the interests of the opposing sides through a variety of boundary-spanning processes. Such an organisation is not part of the development or operation of the SNWA pipeline project. The lack of a mechanism for continuing dialogue and conflict management creates serious political risks from the project protestors' perspective.

In 2012, the Nevada State Engineer released his rulings on SNWA's water right applications and granted SNWA the majority of the water it filed for back in the 1980s. However, the protestors appealed the decision to Nevada's 7th Judicial District Court. In December 2013, Judge Estes returned SNWA's approved water rights back to the State Engineer for further study. Judge Estes agreed with the protestors that SNWA's vague mitigation plans are unacceptable without "objective standards to determine when mitigation will be required and implemented" (White Pine County et al., v. King, 2013: 15). Judge Estes also ruled that if there is not enough scientific information to establish thresholds, then "it is premature to grant water rights" (White Pine County et al., v. King, 2013: 23). Herskovits explained that Judge Estes' ruling was significant, because it could "fundamentally change the way regulators review [SNWA's] controversial pipeline" (Brean, 2013). Judge Estes' ruling indicates that viable approaches for addressing uncertainties and managing risks emanating from SNWA's Groundwater Development Project have yet to be identified.

DISCUSSION

This case study contributes to understanding why some water managers are pursuing large infrastructure projects, furthering water supply management principles. SNWA's efforts to obtain water from all possible sources has shown that demand management and supply management are not necessarily alternatives to one another. While SNWA uses water demand management strategies to manage current water demand, water supply augmentation through the pipeline project would allow SNWA to support additional water demand from population and urban growth. Resource managers are often under a 'bureaucratic imperative' and cannot always wait for further studies to solve uncertainties before making decisions (Steel et al., 2004: 5). However, the protestors of SNWA's

Groundwater Development Project have advocated for slower and more thoughtful decision making so that the uncertainties can be more carefully considered, and strategies and contingencies for dealing with risks those uncertainties pose can be devised in advance. Taking time works to the advantage of these pipeline protestors because the pressure to decide quickly is being driven by distant urban development and a larger regional competition over scarce water supplies. Once made, urban land and water development investment decisions take people down a certain path that is hard to reverse because it establishes, demonstrates, and reinforces a municipal demand for water that is protected above all other uses under prior appropriation water law in the western USA.

Similarly concerned about pipeline development pressure, the neighbouring state of Utah decided not to sign an interstate agreement with Nevada allocating water in the shared, transboundary Snake Valley Basin. While some people fear Nevada could start using the transboundary water without a compact with Utah, refusal to sign buys Utah more time before Nevada begins allocating Snake Valley water to SNWA (Welsh, 2014). Water in the USA West is threatened by climate change. Yet both SNWA and the rural residents of the Great Basin want guarantees that they will continue to have water to support their values and ways of life. The way rural values are maintained if the Groundwater Development Project is built is through determinations of the nature of negative impacts and assurances on how impacts will be mitigated and addressed. While SNWA is correct that we cannot know exactly how hydrology of the aquifer system in rural Nevada works, having political certainty that SNWA must stop pumping in defined situations could give protestors the certainty they need that SNWA's water use will not interfere with their own. In essence, protestors are seeking the basic protection of non-interference from other water users that forms the foundation of western prior appropriation water law and that underpins the principle of equitable apportionment between states. Given the many hydrologic uncertainties posed by groundwater and climate change, minimising legal and political uncertainties that pose additional risks to their ability to access scarce water becomes their entrepreneurial imperative.

SNWA has been so focused on reducing southern Nevada's risk to drought in the Colorado River Basin that it has neglected to consider the risks of investing in expensive infrastructure and becoming dependent on rural Nevada groundwater, particularly if that groundwater is depleted. The path southern Nevada has followed avoids limiting growth as a way to manage water scarcity. Because urban utilities are entrenched in how they manage water, water managers have difficulties changing their missions from supplying their constituents with water to managing constituent water demand (Brown and Ferrelly, 2007; Burnham et al., 2016). Water systems can be so complex that it takes a long time to know and understand them. By the time new employees become familiar with how a system works, they are often indoctrinated with the agency's mission and professional culture (Lach et al., 2005). When Patricia Mulroy retired as general manager of SNWA in early 2014, many people wanted SNWA to conduct a national search for her replacement. Instead, the board unanimously appointed John Entsminger, who served as Mulroy's deputy general manager. Entsminger is an obvious choice as he has been instrumental in Colorado River negotiations and understands the complex relationships between SNWA and other entities. However, many people were disappointed at the loss of an opportunity to bring new perspectives to SNWA.

Mulroy believes, "you can't control growth through your utilities", and furthermore, growth is not something that can reasonably be stopped (Brean, 2014). Mulroy's statement acknowledges that it is not very feasible to stop cities from growing. Tarlock (2005: 94) explains that cities will be able to obtain the water they need because they have "the political power, the resources, and the technical capacity to overcome most limitations on growth posed by uncertain supplies". Furthermore, many public utilities are subject by law to "duties to serve" (Tarlock, 2005: 81). Utilities are required to serve customers if the system can absorb the cost, and they have a duty to seek additional sources of water supplies when they are needed (Lach et al., 2005; Tarlock, 2005).

Municipalities in the western United States are also allowed to hold water applications and rights for future growth and delay putting water to beneficial use, without the threat of losing them under normal forfeiture or abandonment provisions that apply to almost all other water users (e.g. see Nevada Revised Statute 533.380). SNWA was allowed to hold its water right applications in rural, north-eastern Nevada for 25 years before it asked the State Engineer to rule on them. In a newspaper article, a business woman in Baker, NV, said,

> Holding on to these rights for 25 to 50 years without putting them to beneficial use not only flouts the prohibition against speculation in Nevada water law, but it unfairly inhibits opportunities for future growth and development in the affected basins in Lincoln and White Pine counties (Brean, 2012).

Sustainable urban water management and wet growth are emerging concepts that recognise the relationship between land use and water resources in planning, regulation, and development (Arnold, 2005). Traditionally, land use planning and permitting have neglected to consider water quality and quantity issues. While 'smart growth' planning is an attempt to develop land in a sustainable way by eliminating urban sprawl, concerns over water quality and quantity have received little attention in the smart growth literature (Li et al., 2017). Many water scholars have recommended that water managers should have greater input into land use decisions (Arnold, 2005; Thompson, 2005; Li et al., 2015). Thompson (2005) suggests that before land can be developed, cities should ensure that a proper water supply is available for the new development. However, the Southern Nevada Public Lands Management Act (SNPLMA) does not require new urban development to have a guaranteed water supply before land can be acquired from the federal government. In fact, the SNPLMA gives 10% of the land sale profits to SNWA, perhaps encouraging the idea that water will always be supplied to and follow land development in southern Nevada. Rob Mrowka, an ecologist with the Centre of Biological Diversity, explained that if the federal government does not expand the land disposal boundary past the current border, "Las Vegas can't continue to grow" (Mrowka, 2011). Analysing SNWA's 50-year resource plan to understand how SNWA builds scenarios to determine future water needs and demands would provide further insight into how southern Nevada could approach transitioning into a more 'Water Sensitive City'. Las Vegas and SNWA have shown that while water demand management has helped push back the need for the Groundwater Development Project, without a fundamental paradigm shift connecting growth management and land use with water management, cities will continue to encourage traditional supply-side water management approaches through large-scale pipelines and infrastructure development to support growing populations.

CONCLUSION

As Patricia Mulroy stepped down from being SNWA general manager at the beginning of 2014, she reflected on what she believed the legacy of her leadership would be:

> The team we brought together was able to keep this community with a reliable water resource and facilities. Nobody ever was slowed down, hampered or in any way obstructed from building wherever they wanted to build in the valley, and that was a Herculean effort. We kept this valley going during its most phenomenal growth spurt. I mean when I started, the valley had less than 600,000 people in it. Today it has two million. The change has been unbelievable in 25 years. And when people down the road look back, they'll say that this team was able to keep that going (Brean, 2014).

However, Steve Erickson wondered if we had to do it all over again, "would we grow cities in the desert?" (Erickson, 2011).

Water pipeline projects need to accurately portray various risks and the projects' scientific and political uncertainties must be balanced so that water is managed fairly. Commonly, entities proposing large-scale water pipeline infrastructure projects are cities that hold power and have the political, economic, and legal resources to move water to geographically concentrated populations. The path

dependency goes deep – permanent settlement of arid regions led to large-scale water infrastructure projects to transfer water to places where people and industries wanted to locate. Policy entrepreneurs pushed policies to encourage growth that led to increased dependence on imported water and fuelled the need for additional water supplies, leading to a seeming unending cycle where large engineered pipeline projects for water management are still being proposed. In addition, long-term investments in acquiring water rights, conducting scientific and engineering studies, and engaging in legal lawsuits make abandoning any previously proposed water infrastructure projects difficult. However, other policy entrepreneurs have been trying to reverse this cycle and bring recognition to the environmental and social impacts of water pipeline infrastructure and unchecked growth in arid locations. So while water pipeline infrastructure projects are increasingly being reconsidered as viable options to decrease localised water scarcity in arid regions, our analysis shows that more thoughtful debate and discussion regarding the appropriateness of these projects and how these projects will be managed over their full life-cycle need to accompany such proposals.

Countries around the world cannot easily get rid of the cities that are already located in water-scarce regions, but the increasing challenge they will face is how to make sure that people in these cities have the water they need without harming other communities and nature. Barriers to sustainable urban water management include the lack of a coordinated institutional framework and poor community participation (Brown and Ferrelly, 2007). While southern Nevada water managers have coordinated through formation of SNWA, such coordination has been nonexistent across Nevada's rural-urban divide. In addition, many rural Nevada residents do not believe SNWA officials have made an honest effort to reach out to them (Brauer, 2011; Marasco, 2011; Spilsbury, 2011). Stakeholders must be involved to successfully transition a city into a potential 'Water Sensitive City' that is committed to water supply security, equity, ecological integrity, and resilience to climate change (Lundqvist et al., 2001; Brown and Ferrelly, 2007; Brown et al., 2008). The rural communities from which water is exported must also become part of a new hydro-social contract that recognises the links between access to multiple water sources, ecological protection, and sustainable lifestyles (Brown et al., 2008; Wong and Brown, 2008). Furthermore, urban water managers and urban citizens must acknowledge the rural communities' importance in this new hydro-social contract.

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