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Water Fuels Sprawl

An Analysis of Water Transfers and Inefficient Growth in New Mexico

NMPIRG Education Fund

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William Coyne
Jeanne Bassett

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EXECUTIVE SUMMARY

Urban sprawl is eating up New Mexico's landscape, inefficiently consuming our scarce water supplies, damaging our environment, and weakening our economy.

In New Mexico, as in many other Western states, land development is occurring at four times the rate of population growth.[1] By 2050 the population is projected to top 3.3 million, marking an increase of 122% since 1960. In contrast, urban and suburban developed acreage is expected to reach 4.8 million acres by 2050, an increase of 580% from 1960.[2]

Sprawl places undue burden on our already taxed water supply. With every drop of water in New Mexico already appropriated, new development means moving water from existing uses.

Sprawl development uses water inefficiently. Research shows that high-density growth can save up to 35% of total water consumption over low-density sprawl.[3]

Sprawl development also diminishes the quality of our air. In New Mexico, average commuting distances have risen from 8.6 miles to 11 miles from 1983 to 1990.[4] Low-density development is forcing people to drive more frequently and to drive farther distances. With more cars on the road traveling farther, increased emissions from cars are degrading our air.

Sprawl places heavy stress on local economies. The cost of infrastructure in Santa Fe County, $52,597 per housing unit, is eight times higher than for infill of existing development ($6,251).[5]

In New Mexico, water transfers have emerged as the source of "new" water to fuel urban sprawl.

Cities have turned their eyes toward nearby irrigated agriculture for water rights.

- To feed sprawl growth, Santa Fe County has applied for a permit to transfer 588 acre-feet of water from a northern New Mexico farm, Top of the World Farms, to the county's own supply. The proposed transfer of water from Top of the World Farms could set a legal precedent that would make way for the transfer of large quantities of water from northern New Mexico agriculture to cities in central New Mexico. Such a precedent would smooth the way for future sprawling development.
- Albuquerque is growing as if water is no obstacle. Starting in 1980, the city began buying up water rights from downstream agricultural users to meet the demands of the city's growth. The city is now proposing to use 94,000 acre-feet of San Juan/ Chama water.

New Mexico must decide how to guide its growth and water consumption. Do we continue to grow at any cost to our environment, our economies, and important existing uses of water? Or do we guide growth and water consumption down a sustainable path that will preserve the quality of our urban spaces, our water supply, and our environment?

Transfers have other negative impacts.

In addition to fueling the sprawling growth of our urban areas, water rights transfers from rural agricultural areas to the cities have a host of impacts:

- Environmental impacts include loss or fragmentation of riparian habitat and the dust bowl conditions that can result from the retiring of cultivated fields.
- Economic impacts result from the loss of agricultural lands and production and corresponding impacts on agricultural communities.
- Social impacts result from loss of water rights and economic downturn in the area of origin. In Bernalillo, Valencia, Sandoval, and Torrance counties, 90% of water rights purchased have resulted in the retiring of irrigated lands; the remaining 10% came from other municipal and industrial uses.

New Mexico must take the following steps to put urban growth on a sustainable course and reduce the demand for water transfers and their corresponding impacts.

Connect growth management planning and water planning.

- Cities and counties should prepare realistic water budgets that balance supply with present and future demands.
- Cities and counties should approve only those development projects that are compatible with the regional water budget.

Make conservation the focus of urban water management to reduce the need for water transfers.

- Require urban areas to achieve per person per day usages of 150 gallons or less by 2010.
- Require purchasers of water rights to demonstrate efficient use of current water rights.

Work to prevent the impacts of water transfers on third parties and make the transfer approval process more democratic.

- Provide communities with a strong voice in the transfer process. New Mexico should adopt statutes similar to those in place in Arizona that require the consent of the governing body of either the irrigation district, agricultural improvement district or water users association before approving a transfer.[6]
- Encourage "win-win" situations for water transfer opportunities. One possible "win-win" approach is to allow water rights purchasers to pay farmers the cost of upgrading the efficiency of agricultural water use and then gain access to the water rights for the conserved water.

INTRODUCTION

Despite the lack of water in New Mexico, our state's largest urban areas, Santa Fe and Albuquerque, are growing at an alarming rate. Low-density, sprawling suburban development has become the norm, eating up the landscape, driving up infrastructure costs, and increasing air and water pollution. Sprawl has devoured 3 million acres of farmland in New Mexico since 1975.[7]

The new sprawl growth at the fringes of our cities is also consuming huge quantities of water. Large lawns, golf courses, and new infrastructure associated with sprawl use water at an alarming rate. This inefficient water consumption is more than we can afford.

New Mexico's rapid growth in the last few decades has occurred without adequate consideration of long-term water supply. The Focus 2050 Regional Plan for Bernalillo, Sandoval, Torrance, and Valencia Counties, which provides land use scenarios for the future growth and development of the region, was prepared without adequate consideration of existing and future water supply needs.[8] At the same time that our cities boom, our water sources are shrinking. The Albuquerque aquifer, once thought to be a vast underground freshwater ocean, has limits that are becoming increasingly clear. The once mighty Rio Grande, the life-blood of New Mexico, dries to a trickle in parts in the summer.

All of New Mexico's water is spoken for. For years our water supply has been fully appropriated; every drop is assigned to someone, somewhere in the state, and is being put to "beneficial" use. In the middle Rio Grande region, the 175 miles stretching from Conchiti Reservoir to the Elephant Butte Reservoir, which is home to 700,000 New Mexicans, water supply is approximately equal to present water demand. Any new growth in New Mexico will require water to be either "created" through conservation or transferred from an existing use.

The only way to guide efficient, sustainable, and beneficial urban growth is to coalesce growth management planning with water supply management. Co-planning will encourage our cities to grow more efficiently, to become water-efficient, and help reduce the need for water transfers, protecting other important non-urban existing uses of water: environmental protection, agricultural activities, and rural communities.

THE WRONG KIND OF GROWTH

The problem with growth in New Mexico is not so much that it is happening, but how it is happening. A 1996 report by planners from the New Mexico Department of Finance and Administration summarizes the problem: "typical of many New Mexico communities since the 1950s is a low density development pattern. This pattern reflects a lifestyle which has evolved on the American frontier."[9] Such growth, occurring in New Mexico and throughout the West, comes with many costs: to the environment, to the economy, and to our society.

Environmental Costs

In New Mexico, as in many other Western states, land development is occurring at roughly double the rate of population growth.[10] Since 1960, the population of New Mexico has grown by 89%, from 950,000 to 1.8 million. At the same time, New Mexico's acreage of developed land has skyrocketed from 826,000 in 1960 to over 2.4 million acres today, a 190% increase. Future growth predictions indicate that by 2050 New Mexico's population will top 3.3 million, an 83% increase from today's numbers. Development will cover 4.8 million acres, or 290% of today's developed area, and 480% of 1960's developed area.[11]

This disappearance of open space dramatically alters the natural landscape, eating up agricultural land and damaging wildlife habitats. New Mexico farmland is home to many species of game and non-game wildlife, including turkey, deer, armadillo, badger, fox, prairie dog, rabbit, and squirrel.[12] Sprawl is also eating up valuable habitat of threatened and endangered species. New Mexico has 15 species of mammals listed as either threatened or endangered.

Sprawl threatens the quality of our air. The growth of sprawling communities has resulted in increased reliance on automobiles, which in turn has hurt air quality. Sprawl assumes and relies on cars; without them residents of low-density sprawling areas would be unable to get to work, school, or shopping areas. In New Mexico, average commuting distances increased from 8.6 miles to 11 miles from 1983 to 1990.[13] With more cars on the road traveling farther, increased emissions from cars are degrading our air. Winter inversions, where upper-level warm air traps polluted cold air near the surface, are common in the Albuquerque valley.

Sprawl also places an impossible burden on our already taxed water supply. Sprawling low-density development uses water far less efficiently than does high-density growth. Water for cooking and most indoor uses is the same in low-density and high-density development. But the large lawns and golf courses that characterize suburban subdivisions require a huge amount of water. In the desert Southwest, lawns are responsible for half of all municipal water consumption in the summer months.[14] A golf course can use up to one million gallons of water per day.[15] In New Mexico, rational growth must take into account our arid weather conditions and use water efficiently. It simply is not sensible to promote lawns and golf courses in an area that receives twelve inches of rain per year.

High-density growth saves water. The EPA and HUD in the 1970s found that high-density development can save up to 35% of total water consumption over low-density sprawl.[16] A study conducted by the Santa Fe City Planning Division in 2001 came up with similar results. Reed Liming, senior planner for the City of Santa Fe, noted that high-density development can render a "two for one" benefit over low-density growth. In Santa Fe, the large-lot, high-end Sol y Lomas Neighborhood uses an average of 1/3 of an acre-foot per lot per year; in comparison, the denser Tierra Contenta and Nava Ade subdivisions consume about 1/5 of an acre-foot.[17]

The sprawling growth plaguing Western cities is now infamous, but the corresponding issue of inefficient water use garners far less attention. The average U.S. resident uses 184 gallons of water per day (gpppd). Throughout the Western U.S., residents of major metropolitan areas far exceed this rate of water usage. New Mexico, the third driest state in the nation, now ranks 40th among the 50 states in water efficiency. Albuquerque, the largest city in the state, now uses 209 gallons per capita per day, making it the most inefficient user of water of any city of comparable size in the Southwest.[18]

Communities in the West could dramatically improve their water efficiency. Santa Barbara, CA provides a good example. The city uses 82 gpppd due to high-density growth trends and a successful water-recycling program.[19]

Economic Costs

The fiscal impacts of sprawl on a community and its tax base can be devastating. While the common perception is that any growth is good for the economy and brings tax revenue, in reality sprawling growth can create huge infrastructure and public services costs, driving communities' finances into the red. According to a study by the Urban Land Institute, low-density suburban development can cost two to three times more in infrastructure costs than a traditional community.[20] Utilities, sewers, roads, schools, and treatment plants all cost more money when growth is spread out, especially if there is a discontinuous leapfrog development pattern as in Santa Fe. The cost of infrastructure in Santa Fe County, at $52,597 per unit, is eight times higher than for infill of existing development ($6,251) and 2.5 times the cost of new, planned cluster development for a 300-unit low-density subdivision.[21]

Sprawl is also unfavorable for the growth of business. Though some businesses can benefit from low-density development patterns (transportation-related businesses, mega-stores, etc.), the overall effect of sprawl on community businesses is harmful. In addition to higher taxes to support necessary infrastructure, businesses often need to subsidize transportation costs for workers, or suffer from lack of productivity from employees who have long commutes. Additionally, the movement of population centers away from urban centers can have negative economic effects on businesses in downtown areas.

WATER FUELS GROWTH

Historically, growth and development in the West were fueled by access to water. The Newlands Reclamation Act of 1902 marked the beginning of the process of making water sources accessible to agriculture and growing cities. The dry desert of the Southwest was given the resource that it needed to flourish.

In those days the water dilemma was simply how to move it in order to allow cities and industry to grow. The only measured costs were for infrastructure. Environmental costs were hardly considered.

Today, almost every drop of water in the West is in use. Surface water is all appropriated, and groundwater reserves, especially in New Mexico, are under duress. While growth today throughout the West still requires us to move water, now it means reallocating water from existing uses.

Buying and selling water rights through "water transfers" is the modern mechanism for the reallocation of water in the West, and the system is very complicated. The movement of water rights through transfers, while subtler than the reclamation projects of old, has profound impacts. First, water transfers fuel sprawling growth. Second, water transfers mean a gain of water for one party, but always a loss to another. When water leaves an area, there are environmental, social, and economic implications.

To understand water transfers and their impacts, we must examine the basis of Western and New Mexican water law, the changing demand for water, and the human and natural environments affected by the transfers.

New Mexico's Water History

Water use laws and systems of present-day New Mexico have a history deeply rooted in the Hispanic and Indian cultures of early New Mexico. Historians speculate that Anasazi Indians were irrigating lands in New Mexico in 1000 AD. Spanish explorers saw irrigated fields of corn with systems of canals and bridges upon their arrival in the villages of Pueblo Indians in the early 1500s.[22]

With the arrival of Spanish settlers in New Mexico in the 16th century, two forms of water ditch management systems, or acequias, developed, as explained by the Office of the State Engineer.

> The first [acequia system] functioned as part of a legally formed municipality or an Indian pueblo. The acequia madre was regarded as public property and its management was the responsibility of the municipal government. Early government instructions for the new town of Santa Fe in 1610, for example, gave the municipal council the power not only to distribute lands but also to apportion water for irrigation.
>
> Another type of management system was formed in communities that had limited or no legal status and lacked a town government. The majority of colonists lived in small rural communities of this type. Under this system, the community ditches were voluntarily developed by interested water users. The distribution of water was strictly regulated by an elected ditch boss or mayordomo.
>
> Spanish law established the general principles under which irrigation was regulated in New Mexico. Government documents from Spain stated that all waters in the New World should be common to all inhabitants; that viceroys and other officials should supervise irrigable lands and protect them from livestock; that water should be distributed to colonists on the advice of municipal councils; and that local provisions regarding water distribu-

tion should promote the public welfare.

Spanish water law recognized a number of important principles still relevant in today's modern water law. Such principles include prior use rights, need, the protection of third parties, the relationship between the proposed use and the public interest, and a legal right and whether the use was by a public community or private individuals.

When New Mexico became a territory, it continued to pass laws governing acequias. In 1851, the legislature protected acequias by prohibiting the disturbance of their courses. In 1866, the government ordered that deteriorating ditches be re-established. Acequias were recognized as community organizations in 1895, when the territorial legislature declared them public involuntary quasi-corporations with the power to sue or be sued.[23]

In the early 20th century, Anglo settlers of the New Mexican territory, without the help of the federal government, adopted a different system to allocate water rights based on the doctrine of prior appropriation, described as "first in time, first in right." The earliest user to put the water to "beneficial use" acquired the right to use the water with priority over other users. While the actual water remains a public resource, this new system encouraged economic development and "productive" use of water by allowing individuals to use water for private enterprise. This system became the basis for water law in the Western U.S.

Hence, modern water law in New Mexico is a combination of Spanish colonial law and the prior appropriation system adopted by early Anglo settlers. The law today treats water as a public resource for the benefit of all, but also as an individually owned, tradable commodity. This seemingly contradictory premise is at the heart of the debate over water transfers.

What Are Water Transfers?

When water becomes scarce, some kind of reallocation system is required. In the West, the first method of reallocation was large reclamation projects. Today water transfers have become the most common method of reallocation of water.

A water right is normally regarded as a property right which can be bought or sold, is retained as long as the water is applied beneficially, and is forfeited only when no longer used.[24] A key aspect of water rights is that they are not restricted to any one use, place, or person. Water rights can be transferred, meaning their designated use, owner, or geography can change.

Historically, many impacts have been overlooked in the water transfer process. These include effects on agriculture in the form of lost farmland, social impacts on rural communities, and environmental impacts on fish and wildlife and their habitats. As the pressure from Western development to acquire new water rights increases, these impacts must be considered.

The Pressure of Sprawling Growth

New Mexico's urban areas are heading down the wrong path. Development is racing outwards from our urban fringes, gobbling up open space and our water supply and harming air quality. The more our cities sprawl, the more they seek to increase their water supplies through water transfers. But inefficient growth in the high desert is unsustainable; while water transfers can continue to fuel sprawl growth in the short term, we risk the long-term stability of our water supply

and threaten beneficial water uses throughout the state.

Albuquerque, the state's largest city, exemplifies the problems of sprawl growth and water consumption in New Mexico. Albuquerque is sprawling outwards. From 1940 to the present the city has exploded from 11 square miles to 163 square miles. Subdivisions are proliferating on the west side, where green lawns and golf courses put unnecessary stress on our water supply.

Sprawl growth can use up to twice as much water as high-density development. Especially in the hot and dry climate of New Mexico, a majority of municipal water is consumed by the lawns and outdoor landscaping common to sprawl development. [25]

Albuquerque's development pattern has also made it one of the most inefficient users of water of any city of comparable size. [26] Only Phoenix and Denver use more water than Albuquerque's 209 gallons per day per person. In contrast, comparable municipalities such as El Paso and Tucson have achieved a per capita daily usage of 159 gallons.[27]

Even if Albuquerque's water consumption becomes somewhat more efficient in the future, current patterns indicate that by 2040 we will need 70% more water than we use today. Were water efficiency to rival that of El Paso or Tucson, our needs 40 years from now would be only 20% larger than they are today.

The current San Juan/Chama diversion is a shortsighted strategy to meet Albuquerque's immediate needs. Long-term projections indicate that if Albuquerque fails to improve its water efficiency, huge amounts of additional water will be required in the future.

The other main source of new water is downstream agricultural water rights. In a worst case scenario assuming continued inefficient water use, the city will need to purchase 36,000 acre-feet of water rights by 2010 – 61,000 acre-feet by 2040. (See Table 3.) That water would have to be transferred from agricultural uses. Acquisition of that amount of water would require that 30,000 acres, an area one-third the size of Albuquerque, be retired from agricultural production, leading to severe ecological, economic, and social consequences.

We need to put a check on sprawl in New Mexico if we want to stabilize our water supply. The problems that Albuquerque will face in the coming years threaten many New Mexican cities. Sprawl growth is running rampant in Santa Fe, Las Cruces, and Roswell. These areas will be looking desperately to increase water supplies in the future.

New Mexico cannot afford to let the demand for water increase by 70% in all of its urban areas. Sprawl would envelop more of our state, and water transfers would be in high demand.

Impacts of Water Transfers

Water transfers are often thought of as the solution to our urban water woes, but transfers only shift the locus of the problem. In addition to fueling the sprawling growth of our urban areas, large-scale water rights movement from rural agricultural areas to the cities damages the environment, state and local economies, and social structures.

Environmental Impacts

Damaged Habitat and Ecosystems

Transfers of water can have significant impacts on plant and animal species in Western riparian and wetland ecosystems. In the desert Southwest, often the most productive ecosystems thrive in thin bands within and along the banks of waterways. Water transfers can drastically affect stream flows and water levels. Reduced stream flows, or even changes in the timetable for stream flows, damage habitats and ecosystems. Many

Western species of flora and fauna are endangered or threatened with extinction due to damaged or lost habitat. In New Mexico, the plight of the Rio Grande silvery minnow is an example of how reduced stream flows have fragmented habitat and threatened a local species with extinction. Nationally, the plight of salmon of the Pacific Northwest has drawn attention to the problem of altered flows.

Desiccation of Retired Farmland

In a moist climate, farmland that is "retired" from irrigation experiences rapid plant succession. In the desert Southwest, the process can be entirely different: most farmland does not naturally return to its pre-irrigation state. Once irrigation ceases, soils that have been watered for years are often unable to support local native species due to increased salinity and organic content. Tumbleweed, an aggressive non-native plant, is usually the first species to take hold. It then prevents other species from growing. Without sufficient plant cover, dust from wind erosion of the land leads to increased air pollution. In Arizona, where massive water transfers forced retirement of irrigated lands over twenty years ago, many formerly cultivated areas have still seen little or no vegetative growth.

Land retired from agriculture can use more water than the previous agricultural activities. Non-native plant species that invade land taken out of irrigation can use twice the water of cultivated agriculture. Also, such lands are typically developed themselves once the water is sold off; new owners can apply for a domestic well permit to pump the same amount of water that was transferred from the land.

Years of irrigation can also produce new wetland areas or expanded riparian zones, and species that rely on irrigated water. Cottonwood trees commonly grow near irrigated land. Once irrigation stops, these habitats are destroyed, contributing to the environmental decay of the landscape and increasing pressure on threatened species.

Economic Impacts

Agriculture is one of the primary industries in New Mexico. In 1999, there were 15,200 farms and ranches in the state. Irrigated agriculture cultivated 725,900 acres of land with a net income of $494.2 million for New Mexico. According to the 2000 census, 15% of the state's population between 18 and 65 years of age works on a farm. Thousands of New Mexico families rely directly on the industry for employment, and countless more families rely on businesses indirectly associated with agriculture.

When water is transferred away from its area of origin to urban uses, irrigation ceases and agricultural land must be retired. Loss of irrigated land means loss of jobs, state net income, and state and local tax revenue. Loss of local tax revenue can be particularly devastating to rural Western counties. When land is purchased for its water rights by a tax exempt municipality, that land is immediately taken off the tax rolls. In areas such as La Paz County, Arizona, where private land makes up only 5% of the total land area, removing land from the tax rolls has immediate impacts on local tax revenue. In the late 1980s, La Paz County lost almost 50% of its property tax base when municipalities bought land and appurtenant water rights.[28]

At the local level, water transfers have many other direct and indirect economic impacts. In addition to the loss of agricultural jobs, areas suffer declining income and production in non-farm businesses and households. Retail stores, restaurants, and local services may be affected by a decline in agriculturally-linked jobs and income.

The 'marginality argument' suggests that agricultural to urban water transfers will not impose large and sudden shocks on rural economies because the worst lands would be retired first. In actuality it has more to do with what water is available and easy to ac-

quire, regardless of the value of its current use. In some cases, particularly in Arizona and Colorado, water from high-value cropland such as pecan orchards has been purchased, and more economically marginal grain fields have been ignored. "Water buyers seek senior water rights to water sources that can be conveyed easily to the new location of use. Generally whole farms are purchased, not just less productive portions of the farm."[29]

Societal Impacts

The loss of water through transfers can have detrimental social impacts on an individual community, putting its continued existence at risk. In New Mexico, the social problem of loss of water rights is compounded by the cultural importance of the communities at risk: the rural acequias.

The term acequia is of Arabic origin and refers to both an irrigation ditch and the community that forms around it. The acequia communities of northern New Mexico controlled water allocation in the state until the period of reclamation in the early part of the previous century. Today there are still 800 acequia communities in New Mexico that irrigate 160,000 acres on 12,000 farms.

Acequia water rights are owned by individuals who receive their share via the community ditch. The acequia association is both a water institution and a local political subdivision, with the power to tax members for upkeep. The association is controlled by an elected commission, and water is apportioned by a mayordomo, all of whom are members of the association.

For acequias, water is the tie that binds the community together. The loss of water or loss of control of water can diminish the stability of the community. The National Research Council in its research on the impacts of water transfers on area of origin communities reported: "one pervasive effect of water transfers on areas of origin is loss of local self-determination as the future of an area moves beyond the control of its residents. It is this sense of uncertainty, frustration, and vulnerability, as much as the visible, tangible damage, that is fueling the demands for regulation of water transfers from rural areas of the West."[30]

The Public Process

The transfer process is nonrepresentative. Many affected parties have narrowly limited channels for participation in decisions to transfer water rights. Water transfer laws in most cases protect only the buyer and seller of water rights, leaving third parties – including other water rights holders, agriculture, the environment, urban interests, ethnic communities and Indian tribes, rural communities and federal taxpayers – without a strong voice in decisions that affect their well being directly and indirectly.[31]

Much discussion surrounds the role of third parties in the transfer process. The controversy is a manifestation of the age-old tension between individual property rights and the community interest. The free market system of water transfers values individual property over the interests of the community. For most commodities, the right of the individual to trade it comes at no cost to the community or public interest, but this is not the case for water.

The trading of water as a commodity has both direct and indirect effects on a set of third parties. Those third parties in the community should be given a more effective voice in the transfer process. The community should be allowed to make a decision as to whether the benefit to the individual seller of water comes at too great a cost to the greater community.

How Transfers Changed the West

With the era of huge subsidized reclamation projects over and virtually every drop of water in the West fully appropriated, competition for water is increasing. In the past, when major competing interests all held substantial water rights, competition for water was easier to address. Agriculture, hydroelectric power, industry, and growing cities have always required water but they were able to share existing supplies in relative peace. For example, water rights were pooled to support large-scale irrigation. When water rights were short and more agricultural production was needed, the federal government stepped in and subsidized huge reclamation projects bringing large amounts of water from distant sources.

The initial growth of most Western cities was fueled by modest appropriations of new water rights in areas where water had not been developed intensely. As cities grew they looked to expand their water supplies. Due to political pressures to protect agriculture and/or restrictions on transferring water from agriculture, cities looked to "trans-basin" transfers to bring water from distant sources. For example, in the first half of the 20th century, Denver, Colorado looked toward the western slope of the Rockies, pumping water over the Continental Divide in order to avoid retiring local agricultural production.

Today, Western cities are turning their eyes toward nearby irrigated agriculture for water rights. Sprawling growth and its inefficient water use have driven urban demand for water rights through the roof.

Urban growth patterns across the West in recent decades continually tell the same story. Unfettered urban sprawl is plaguing urban areas with air and water pollution, devouring open space, and consuming scarce water resources inefficiently. This inefficient expansion has been fueled by the large-scale transfer of water rights, mainly from agricultural activity. The impacts of these transfers, both the sprawl they produce and the environmental, economic, and social impacts they leave behind, demonstrate the need to merge growth management and water management planning and to reduce the need for water transfers and their impacts.

The cities of Denver, Phoenix, and Reno demonstrate the harsh realities that could face New Mexico in the future.

Phoenix: From Ranchland to Sprawl Land

The growth of central Arizona since 1950 demonstrates the ability of humans to defy the restrictions of the natural environment. Central Arizona, one of the very driest regions in the country, has become a major population center. Phoenix is now the sixth largest metropolitan area in the nation, having grown from a population of 106,000 in 1950 to 1,240,000 in 1999. In comparison, at 473 square miles, the physical size of the city is twenty-eight times what it was in 1950. Aggressive annexation policies by the City of Phoenix and access to scarce water helped fuel this expansion.[32]

Phoenix used water transfers to help fuel its growth into the sixth-largest metropolitan area in the nation. Recognizing the threat to the state's rural communities, Arizona officials have taken steps to give the public more say in future transfers.

Due to its pattern of land use and the availability of "new" water sources, Phoenix is one of the most inefficient users of water in the country. In 1996, city residents were consuming an average of 220 gallons per person per day – a major improvement from the

294 gpppd they used in 1988, but still almost 50 gpppd more than the national average.

Growth has been fueled by distant water sources, including both the Colorado River and water transfers from agriculture. Due in large part to state laws encouraging long-distance transfers, Phoenix and its neighboring suburbs Scottsdale and Mesa spent the 1980s actively buying up large ranches and agricultural land in distant parts of western Arizona solely for their water rights. Water ranching, as it is called, enabled these booming burgs to keep stretching out into the surrounding Sonoran desert.

Sprawling Growth

The Phoenix area has become a textbook example of uncontrolled sprawl growth, wreaking havoc on the regional environment.

Phoenix's first era of growth began in the late 1960s. By 1970, seven planned communities existed or were in the process of being built in Phoenix. By 1972, Greater Phoenix had 16 major planned communities in various stages of development, ranging in size from 640 to over 10,000 acres.[33] In 1980, 40% of the land within the city limits was vacant, though subdivisions continued carrying the urban boundary outward.[34] From 1980 to 1986, Phoenix's population grew 26%, the nation's highest growth rate.[35] By the mid 1980s sprawl was eating up an acre an hour of Phoenix area land, and all of these new houses, lawns, and people required water.[36]

Phoenix's growth in recent years is not only enormous, but also remarkably inefficient with respect to land use. The Phoenix area includes within its boundaries 43,385 acres of undeveloped land.[37] These vacant parcels are the result of leapfrog development, where developers skipped the land closest to the urban boundary and bought cheaper land farther out. This discontinuous development disrupts the social and economic fabric of the city, creates unstable property values, and makes public services and utilities more expensive.

The impacts of Phoenix's sprawling growth on the local Sonoran Desert environment are severe. According to a recent study by the Morrison Policy Institute, a research arm of Arizona State University, the Phoenix area has lost 40% of its farmland and 32% of its desert since 1975 due to inefficient development.[38] Further, present inhabitants' unfamiliarity with desert land and water management poses profound threats for most land, water, vegetation, and wildlife resources within a half-hour's drive of the region's largest metropolitan areas. The magnitude of urbanization in the Phoenix area has contributed to habitat conversion and fragmentation, disruption of riparian corridors, killing of wildlife by automobiles, toxics, and pets, and astronomically expensive damage to local hydrological systems.

Water for Growth

Before 1980, Phoenix and other rapidly expanding central Arizona cities mined their plentiful groundwater reserves. Pre-1980 water law failed to recognize the relationship between surface water and groundwater and thus allowed for unrestrained pumping of groundwater sources. Groundwater was not even subject to the minor conservation limitations imposed by the doctrine of prior appropriation, which attempts to limit water use to specific amounts defined by their water rights.

The Groundwater Management Act (GMA) of 1980 was an insufficient attempt to achieve safe yield in groundwater pumping by 2025. The law placed central Arizona aquifers under the control of the metropolitan areas of Phoenix and Tucson and provided the institutional structure to regulate pumping. It also encouraged cities to look far beyond their own boundaries for additional water resources.

The passage of the GMA in 1980 spawned a new market for water transfers. Virtually

all obstacles to water transfers were removed. The act also stipulated that developers must demonstrate a 100-year water supply for their projects, creating strong incentives to transfer water rights from rural agricultural users to secure new suburban developments.[39]

To secure long-term supplies, cities started to engage in "water ranching"; purchasing large tracts of agricultural land for the sole purpose of retiring them from cultivation and transferring the associated water rights to the cities. In 1986, Phoenix, Tucson, Mesa, and Scottsdale all purchased "water ranches" yielding 13,500 to 60,000 acre-feet at costs ranging from $11 million to $30 million.

The lasting effects of water ranching may not be known for many years. Most of the major water rights purchases of the mid-1980s are not currently being drawn upon and are in reserve for future use. But some serious impacts are already being felt.

Environmental Impacts

The most significant environmental problem relating to loss of agricultural water rights in Arizona is the inability of native vegetation to return to formerly irrigated lands. With revegetation an impossibly slow cycle in the dry Arizona desert due to altered soil composition and high salinity, recently retired cropland provides an opportunity for tumbleweed. Tumbleweed, or Russian thistle, prevents the growth of other vegetation and leads to erosion problems. Wind and water carry away large quantities of topsoil from tumbleweed-covered fields. Wind erosion leads to air pollution from dust storms in Arizona. Fatal automobile accidents along Interstate 10 in the early 1970s were linked to blowing dust from nearby abandoned farmland.

Gary Woodard, a professor of hydrology and an expert on sustainable water use at the University of Arizona in Tucson, warns that retired irrigated land in the desert will not return to its natural state. "After many years of cultivation, you have a completely different kind of soil," says Woodard. "If you quit growing cotton or alfalfa, you don't get the native plants coming back in—you get nuisance plants like tumbleweed. It can cause serious dust problems."[40]

Cities trying to increase their water supply often act with a lack of consideration for the environment. One of the most egregious examples of environmental damage caused by water ranching is the case of Scottsdale's purchase of water from the Planet Ranch in La Paz County in 1984. The ranch, which raises thousands of acres of crops, is irrigated by a large shallow aquifer, which is in turn supplied by the Bill Williams River. To avoid losing the ranch's water rights before the city begins to use it for municipal purposes, and in an attempt to obtain more water rights, Scottsdale increased the acres of irrigated agriculture on the ranch and has acquired 75,000 acre-feet of flows upstream from the Alamo Lake. As pumping of the aquifer has increased, the riparian forests adjacent to the ranch have died, forests downstream in a wildlife refuge are stressed, and stream flows on the river have decreased, impacting fish and riparian wildlife.

Economic and Societal Impacts

Charles Howe, an economist at the University of Boulder, has examined the impact of water transfers on local economies. According to Howe's research, the large-scale purchasing of water rights and farmland by municipalities has serious economic impacts. Phoenix and nearby cities have purchased 205,000 acre-feet of water on 78,000 acres of land. According to Howe, this means a loss of more than $4 million in state net revenue due to the retiring of irrigated lands. Transferring water rights to tax-exempt municipal entities also means taking substantial amounts of land from the property tax base. Already in Arizona, purchases will lead to over $1 million dollars in lost county government revenue, much of it from La Paz

County, where the majority of transferred water will come from.[41]

The McMullen Valley in La Paz County is a prime example of an area of origin with an unknown future. Phoenix purchased 23 farms encompassing 14,000 acres in the McMullen Valley in 1986 but does not plan on using the associated water until at least 2005. For now Phoenix, as well as Tucson, Mesa, and Scottsdale, are holding their ranches and continuing cultivation until the water is needed, at which time they will either move to less water-intensive crops or retire the farms altogether; a possibility that has local residents worried. Already, Phoenix area municipalities have purchased almost 50% of the private land in the county in order to secure water rights. One purchase of a La Paz County ranch by an Arizona municipality removed 10% of the taxable land from county tax rolls.[42] With the property tax base already cut in half, loss of agricultural production in the near future will compound local economic problems.

In the McMullen Valley, some area residents hope that Phoenix's agreement to make payments toward their municipal services will help offset lost property taxes from the buyout. Phoenix has agreed to pay an annual sum to the county, yet to be determined, for local school and fire districts.

A survey of community leaders in rural areas of Arizona found that most believe their communities will suffer substantial losses if water is removed and that these losses cannot be compensated by fiscal transfers.[43] The sentiment expressed in the survey demonstrates the strong bond that ties rural communities to water. Rural Arizonans value their communities and their way of life. A loss of water rights means a decline in agricultural production, lost economic opportunity, and ultimately a loss of community self-control over its future. While fiscal transfers or compensatory payments may restore some of the lost tax revenue, they cannot restore economic opportunity, cultural lifestyles, or the security and self-determination of a community.

Correcting the Problem

Legislation passed in 1994 and the bursting of the real estate bubble in Phoenix in the early 1990s have put a halt to water ranching in Arizona. New statutes protect rural communities from thirsty cities by giving local communities a voice in the process. New laws mandate that those who wish to purchase and transfer water rights must have the permission of the local irrigation district, agricultural improvement district, or water users association. For transfers that are approved, Arizona law suggests that cities should make payments to area of origin communities to make up for lost property taxes.[44]

Colorado's Front Range and the Arkansas River Valley

Sprawl has become the norm in Colorado, and its impacts have become the focus of the media, politicians, and voters in the state. The unhindered growth on the Front Range of the Rockies is fed by a well-greased system of water transfers. In Colorado, transfers are entirely controlled by the law of prior appropriation; no judge or administrator is authorized to apply public interest criteria. The result is a system driven by a single allocation strategy: the pressure to acquire more water rights.[45]

That pressure in Colorado is formidable. A booming Front Range metropolis is developing from Colorado Springs to Boulder. Sprawl is claiming land at record rates, demanding additional water to feed lawns, water golf courses, and wash cars. With access to new water rights smoothed by statutes favorable to water transfers, urban water conservation and efficiency are reduced to political rhetoric. A significant source of fuel for the sprawl of the Front Range is water transferred from the Arkansas River Valley in central and southeastern Colorado.

Growing Problems

Behind only Arizona and Nevada, Colorado had the third fastest-growing population in the country in the 1990s, expanding a remarkable 30.6%.[46] But land is being developed even faster. Sprawling development is consuming land at an average of three times the rate of the state's population growth. Between 1987 and 1997, 1.4 million acres of agricultural land and open space were converted to other land uses. Today, Colorado is losing 10 acres of agricultural land to development per hour.[47]

The environmental impacts of sprawl in Colorado are devastating. Animal habitat is gobbled up by development along the Front Range deep into the foothills. At the same time, air quality in Denver has worsened as low-density development encourages auto dependence. Between 1990 and 2000, the region's population grew by more than 2% per year, but vehicle miles driven grew by over 5% annually and freeway congestion increased by more than 28%.[48]

Colorado's Front Range from Boulder to Colorado Springs has experienced dramatic urban growth that has strained water supplies in the area.

Photo: Colorado Sprawl Action Center.

Sprawl also places pressure on the state's water supply. Sprawling development in Front Range cities uses water very inefficiently. In 1990, Colorado Springs was using 202 gpppd and Pueblo was using an astronomical 250 gpppd.[49]

Estimates show that over the next two decades, municipal water demand in Colorado could grow by more than 250,000 acre-feet per year (roughly the amount of water used by 1 million municipal residents).[50]

The Arkansas Valley Basin

Colorado's original post-war water acquisition policy was to look afar, usually to the west slope of the Rockies, to obtain unappropriated water. Though these sources were often difficult and expensive to obtain, they were often more politically feasible. Leaving local agricultural rights alone avoided political disputes and left local agricultural economies intact. Now that most of these more expensive sources are spoken for, Denver and the other booming Front Range cities are seeking water rights from local agricultural sources.[51]

The Arkansas River Basin is located in the central part of the state, running from the Continental Divide all the way to Kansas, a distance of almost 170 miles. Irrigation began in the late 1800s and fueled a bustling agricultural economy for much of the region

through the 1960s.[52] Sugar beets became the cash crop of the area.

Pueblo was the first of the Front Range cities to reach into the Arkansas River Basin when it acquired the Clear Creek Reservoir in 1955.[53] A major drought in 1967 aided the collapse of the local economy and spurred the first major sales of water rights to upstream urban interests.

Private investors who saw money to be made in water prospecting sped up the movement of water rights from the Arkansas Valley to the Front Range cities.

In Crowley County in the Arkansas River Basin, private investors swindled local farmers into selling their rights, convincing the farmers that the water would stay in the area. In 1968 an investment group called Crowley Land and Development Company (CLADCO) offered $380 an acre to farmers in Crowley County who held shares in the Twin Lakes Reservoir and Canal Company, a non-profit mutual ditch and reservoir company with extensive water rights holdings supplying area irrigators. The $380 included land, buildings, and water rights.[54] The group sent letters to Twin Lakes shareholders claiming that they intended to operate lettuce and Christmas tree farms.[55]

CLADCO then proceeded to scare Twin Lakes shareholders into selling their water rights. Company representatives told area irrigators that everyone else was selling their rights and if they did not sell their shares, they would not get their water anyway.[56] Farmers worried that once many area rights were gone, the quality and quantity of water left for irrigation would be diminished.

By 1972, CLADCO owned 55% of the stock in the Twin Lakes Reservoir and Canal Company. CLADCO eventually sold Twin Lakes water to Aurora, Colorado Springs, and Pueblo Springs for between $2,300 and $2,400 per acre-foot.[57] By 1980, Front Range cities owned 94% of all Twin Lakes shares and CLADCO no longer existed.[58]

The siphoning of Twin Lakes water led to the destruction of the local economy. In 1979, the last remaining sugar beet processing plant in the area closed down. The plant owners sold their land and water rights to private investors. In the mid-1980s Pueblo purchased additional stocks in other small ditch companies in the area. In 1986, Colorado Springs bought 17,500 acre-feet of water rights in the Arkansas River basin.[59] Also in 1986, Aurora finalized three major acquisitions of water rights in the basin, obtaining almost 17,000 acre-feet for prices between $2,500 and $3,500 per acre-foot.

Environmental Impacts

The Arkansas River is the saltiest river in the United States. Former agricultural land, thought to return to native vegetation once fallow, lies bare and dusty from the salinity passed into the soil by years of irrigation. Farmers and government agencies are working to restore these lands to a grazeable state, with only varied success.

Wildlife habitat that evolved as a result of irrigation is suffering. Cottonwood groves and wetlands that once depended on irrigated water are now dead. Raptors and other birds that depended on the cottonwood groves are dying out. Wetland ecosystems developed during years of irrigation have dried up, endangering local waterfowl.

Fish species in the Arkansas River are suffering. With much of the water diverted to cities and the remaining water released only periodically to meet the needs of the few remaining agricultural uses, stream flows are inadequate for local fish populations. The Arkansas River has lost much of its trout population in the last few decades.

Economic Impacts

In total the Arkansas River valley lost almost 50,000 acre-feet of water rights to Front Range cities between 1955 and the early 1990s. According to the study by Charles Howe from the University of Colorado at

Boulder, this translates to a loss of 80 non-agricultural jobs in the area, as well as countless agricultural jobs, a loss of $2.65 million in state net income, and a loss of $250,000 in annual local government revenue.

Crowley County shows signs of depression after having lost huge quantities of water. The number of irrigated farms declined from 390 in 1950 to 101 in 1987.[60] Of the money made from sales of water rights to urban interests, 60% to 75% went to taxes and debt repayment.[61] Businesses are closing around the county and many farmers are choosing, against their will, to sell their water rights rather than foreclose. Some farms still remain, using water leased from the Front Range cities which hold rights in excess of their present need. As these leases expire in the coming years, towns in the basin will decline even further. Few irrigators remain who own shares of Twin Lakes water. Orville Tomky, an alfalfa farmer in his seventies, irrigates 320 acres of land in Crowley County. He has been farming his land since 1947 and was one of the few who resisted selling. Today he estimates his rights in the Twin Lakes Company are worth more than $1 million.

Reno and the Truckee/ Carson River Basin

Reno, "the biggest little city in the world," is not that little anymore. While the infamous growth of Las Vegas has brought national attention to the state, the Reno-Sparks area of Washoe County in northern Nevada is sprawling to the north, relatively unnoticed. The growth is typical of Western cities in recent years: the pace is furious and the result is subdivisions, highways, and strip malls.

The City of Reno sits in a mountain valley in the arid Truckee-Carson Basin surrounded by federal lands. Due to competition with tribal interests and lack of access to federal reservoirs, Reno and nearby Sparks have no secure water supplies. With growth continuing off the chart and new homes continuing to take over the hillsides of Reno, the city is scrambling to find the water for new development. In the last decade, Washoe County has been looking toward Storey and Churchill counties, 50 miles east of Reno, for its water rights.

Sprawling Expansion

Nevada, one of the driest states in the nation, has been the nation's fastest-growing state in every decade since the 1960s. Due in large part to the growth of the gambling industry, the state has grown a whopping 66% in the past decade.[62] Washoe County's population jumped 25.6% to 339,486 over the same period. The last census put the state's population at about 2 million.[63]

Photo: Nevada Division of State Lands.

The burgeoning cities of Reno and Sparks are looking to purchase water rights from communities along the Carson River (left). Loss of water rights has already led to dropping water tables and ecological damage in Nevada.

Low-density, car-dependent development has made Reno a city with one of the highest percentages of land devoted to public infrastructure, including roads. 51% of the land in the city of Reno is devoted to infrastructure. This is considerably more than in cities of similar size, such as Albuquerque with 23% and Tucson with 35%.[64]

This sprawling, low-density growth has consumed agricultural land at an alarming rate in the Reno area. The unchecked growth of Reno and Sparks has resulted in the loss of 75% of the agricultural activity to the west of Reno.[65]

Sprawling growth in the Reno-Sparks region also consumes water inefficiently. The

Reno area uses 299 gpppd, an astronomical amount compared to the national average of 184 gpppd.

Water for Growth

The cities are looking to the east to the marginal farmland of Carson Valley in Storey and Churchill Counties as a new source of water rights. The Truckee Meadows cities have already purchased over $2 million in water rights, the majority in Churchill County. The cities are expected to purchase up to 24,000 acre-feet of water rights from these counties, which lie downstream along the Truckee River.[66]

Under the 1996 Water Quality Agreement, Reno and Sparks must "reserve a portion of their water rights to ensure quality and flow of water in the Truckee River." The point of the water quality law is to force the cities to leave a certain number of acre-feet of their allocated water to flow downstream untreated and unused. This water is meant to dilute the millions of gallons of treated wastewater that is released into the water by the cities, preserving water quality for downstream users and the ecological health of the river.

Instead of implementing conservation programs to comply with the law, Reno and Sparks officials are buying up additional water rights in downstream Storey and Churchill counties, water that is destined for those counties anyway. In doing so the city is putting the environment and downstream communities at risk.

Other Impacts

Residents of Storey and Churchill counties in the Carson River Valley report that the loss of water rights is taking a toll: the water table has dropped in Churchill County, and ground cover and cottonwood stands are dying. The true economic and social consequences of these transfers may not be known for months, or even years.

Nevada communities have little means to protect themselves from urban "water ranching." They have no voice in the process, no matter how large the proposed transfer. The water transfer process in Nevada only addresses the concerns of the individual buyer and individual seller.

According to State Engineer Hugh Ricci, "Any water rights can be purchased. Buying and selling is between those parties (who are directly involved in the sale)." Churchill County Manager Bjorn Selinder points out that once one rancher or irrigator sells his rights it makes it more difficult for his neighbor to divert water. Ranchers often share the cost of maintaining diversion ditches; with fewer ranchers diverting the cost increases. With less total water being diverted in a given area, the quality of water also decreases.

New Mexico on the Brink

New Mexico's water situation is similar to the aforementioned examples from around the West. The same pressures driving change throughout the West are evident in New Mexico. What makes our state different is that we possess the knowledge and ability to manage growth before it's too late.

The trend is clear in New Mexico: access to relatively inexpensive "new" water sources enables development around New Mexico's major cities. While these sources are available and cheap, cities have little incentive to enact strict water conservation and growth management measures, even in the desert. Our largest city, Albuquerque, is the most inefficient water user of any comparably sized city in the Southwest.

The New Mexico case studies in this report look at both the potential impacts of one single water transfer and the broader trends of water rights transfers from agriculture to urban interests. The case study of Albuquerque focuses on the availability of agricultural water rights to support inefficient sprawling development. The case study of Santa Fe County's application to transfer water from a northern New Mexican farm explores the tension between urban and rural interests. This single transfer, if approved, has the potential to allow easy access to large quantities of rural water to swelling cities to the detriment of northern New Mexico's rural areas.

The "new" source of water for our urban areas in most cases is the transfer of water rights from irrigated agriculture. Such transfers compromise the environment, the economy, and the survival of our ancient rural communities and their culture.

Albuquerque and the Rio Grande

Albuquerque is growing fast and inefficiently. While the population has grown moderately in past decades, the physical size of the city has ballooned exponentially. The Albuquerque area has grown from 61 square miles in 1960 to over 187 square miles today.[67] With new subdivisions, golf courses, green lawns, and strip malls there is increased pressure to find "new" water. Albuquerque's decisions on growth management and water supply today will determine whether the city follows a path toward sustainable growth or continues to sprawl inefficiently.

Albuquerque's sprawling development is fueled by the availability of cheap "new" water sources. Similar to the situation of Reno-Sparks, the primary "new" source of water is downstream agricultural water rights from Bernalillo, Valencia, and Socorro counties. In addition, the city proposes to switch from reliance on water pumped from the aquifer to surface water from the San Juan-Chama diversion project delivered by way of the Rio Grande. But the San Juan/Chama diversion would only be a short-term solution and is riddled with flaws in its present form.

Sprawl has pushed development farther and farther from the center of Albuquerque and has increased demand for scarce water resources.

The transfer of additional agricultural water rights to the city of Albuquerque in the coming years would have a cost. Transfers would facilitate further inefficient sprawl growth, and the loss of farmland and water rights in downstream counties would bring a host of environmental, social, and economic problems.

Albuquerque has made steady progress on water conservation in recent years, but it is still one of the least efficient cities in the area. Albuquerque cannot solve its water and

growth problems by relying on an ever-growing water supply, either from downstream agricultural rights or the San Juan/Chama Project. The city must vastly expand its efforts at water conservation and growth efficiency via better planning practices.

Sprawling Growth

The trend in development in Albuquerque is to build on the fringe, leaving large areas of undeveloped land within city limits. The SprawlWatch Clearinghouse, a national organization, ranked U.S. cities according to density in 1990 and again in 1999, with highest ranking equaling highest density and lowest sprawl. Albuquerque's ranking declined from 49th to 195th over 10 years.[68]

With this pattern of sprawling growth, Albuquerque has seen many alterations in its landscape, environment, and social structures.

Before 1960, the city boasted a beautiful downtown with a bustling financial district, hotels, and theatres. The Alvarado and Franciscan Hotels and many of the Victorian office buildings of the past have given way to parking structures and vacant lots. The city's transportation, once made up of a diverse array of modes including trolleys and bicycles, has given way almost entirely to the automobile.

Albuquerque's sprawling growth in the last fifty years has resulted in considerable degradation of the environment. Air quality is the most visible problem. Frequent winter inversions, when cold air is trapped in the valley with a layer of warm air above, result in high concentrations of air pollutants near the Earth's surface. Carbon monoxide levels from automobile engines are already very high in the area due to its mile-high elevation. Increasing population along with the new sprawling landscape result in many more miles being driven, further degrading local air quality. Cars and trucks were responsible for Albuquerque's failure to attain compliance with federal carbon monoxide standards from 1978 to 1996.[69]

Other ecological consequences stem from the changing landscape and loss of natural habitat. Several local species have suffered due to loss of valuable habitat. Black hawks, prairie dogs, black-footed ferrets, and burrowing owls are among the animals with severely reduced populations due to destruction of their habitats.

Development First, Water Second

In New Mexico, the third most arid state in the nation, common sense dictates the consideration of water supply availability before the approval of additional development. But Albuquerque and Bernalillo County continue to approve major new developments at the fringe of the city without ensuring that water supplies are available. For example, the proposed west-side subdivision called Quail Ranch would be home to more than 55,000 people on 6,700 acres. The developers have provided inadequate assurances to elected officials that they have the water rights that they need to accommodate the new users.

Albuquerque has recently made significant progress toward water conservation. Under the city's landscaping restrictions, for example, green lawns no longer accompany every new home. A number of reuse and other conjunctive use projects reduce overall water demand. But there is still much need for improvement, with per capita water use rates among the highest in the area. Long range plans must have strict limits on water use, and all new development should be consistent with those limits.

Water for Growth

Today Albuquerque's water supply system relies solely on the aquifer beneath it for all of its water. Wells pull water from the aquifer, and the aquifer is naturally recharged by water from the Rio Grande. The more water pulled from the aquifer, the bigger the strain on the Rio Grande to provide enough water to recharge the aquifer.

The city is required to own water rights for the water used to offset the aquifer's depletion effect on the Rio Grande. The state engineer allows the city to purchase agricultural water rights downstream to offset depletion of Rio Grande water by the aquifer. If the city wants to increase its pumping of the aquifer, it must find water rights to account for the increase. The city looks for downstream farmers willing to sell their rights. Though the city must acquire rights to make up for all depletion, they are allowed to do so over time and presently deplete more Rio Grande water than they hold the rights to.

A proposal by the city to begin drawing San Juan/Chama Project water directly from the Rio Grande is being considered by the State Engineer, and could dramatically change Albuquerque's water supply system. Albuquerque owns rights to 47,000 acre-feet of San Juan/Chama Project water. The city has requested permission from the State Engineer to begin to divert twice that allotment, 94,000 acre-feet, much of which is native Rio Grande water independent of the San Juan/Chama Project. The city would return half to the river below Albuquerque as treated wastewater.

The ease and low cost of purchasing new downstream water rights and the availability of San Juan/Chama Project water allows the city to avoid making decisions on water conservation and growth management. Albuquerque is one of the most inefficient users of water of any city of comparable size, despite the scarcity of water. Only Phoenix and Denver use more water than Albuquerque's 209 gallons per person per day. In contrast, comparable municipalities, such as El Paso and Tucson, have achieved a per capita daily usage of 159 gpppd.[70]

Albuquerque's Water Rights Purchases: From Agriculture to Urban Sprawl

These transfers of downstream water rights are the main source of new water for Albuquerque's sprawling growth. An analysis of Albuquerque's modern water rights holdings and recent purchases shows a trend of water rights purchases and subsequent

Table 1. Acre-Feet of Water Rights Purchased by Albuquerque, by County of Origin[73]

County	Pre-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2002	Total
Bernalillo	726.6	39.3	1,111.5	217.3	307.8	27.4	2,429.9
Valencia		64.7	358.4	127.7	306.0	90.0	946.8
Sandoval			77.5	66.9	2.1		146.5
Socorro		247.0	781.5	111.4	562.1	81.4	1,783.3
Total	726.6	350.9	2,328.9	523.3	1,178.0	198.8	5,306.4

Table 2. Irrigated Acres Retired by Albuquerque Water Rights Purchases, by County[74]

County	Pre-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2002	Total
Bernalillo	166.0		522.6	103.5	141.5	3.5	937.1
Valencia		24.8	155.7	60.8	145.7	42.9	429.8
Sandoval			36.9	31.9	1.0		69.8
Socorro		117.6	372.1	53.0	267.7	38.8	849.2
Total	166.0	142.4	1,087.3	249.2	555.8	85.2	2,285.9

retiring of irrigated land south of Albuquerque.

During the Rio Grande Basin Declaration of 1956, the City of Albuquerque was assessed as having 17,875 acre-feet of vested water rights.[71] As the city boomed over subsequent decades, so did the depletion effect on the river from pumping water out of the aquifer. Starting around 1980, the city began buying up water rights to meet the demands of the city's growth and the corresponding increase in depletion effect on the Rio Grande.

The city today has a portfolio of 23,175 acre-feet of rights for surface water to make up for the depletion effect of aquifer pumping on the Rio Grande.[72] The 5,300 acre-feet of water rights purchased by the city since 1980 are overwhelmingly from agricultural uses; 90% of water rights purchased resulted in the retiring of irrigated lands, while only the remaining 10% came from other municipal and industrial uses.

Agricultural water purchases have resulted in the retiring of more than 2,200 acres of irrigated land in the last twenty years.

When Albuquerque needs more water, it turns to the agricultural uses directly downstream. Water rights purchased by the city since 1980 have come from only a few downstream counties. Initial purchases focused on agricultural rights within Bernalillo County. Starting in the mid 1990s, the trend shifted toward purchases in the counties south of Albuquerque, including Socorro, Valencia, and Sandoval counties.

Albuquerque's future sprawling growth will continue at the expense of downstream communities. If Albuquerque continues to rely solely on the aquifer for water and purchase water rights from downstream farmers accordingly, the city will require 61,000 acre-feet of new rights by 2040.[75] (See Table 3.) Moving this water to Albuquerque will require retiring over 30,000 acres of farmland, an area 1/3 of the size of the city itself. The city's trends in purchasing indicate that Socorro, Valencia, and Sandoval counties will be the most likely targets. These counties will face the brunt of the impacts of these transfers.

Environmental Impacts

There are several environmental concerns with Albuquerque's water future. The movement of water rights from downstream agricultural areas will mean retiring additional irrigated land. Retiring irrigated lands will result in erosion problems, dust and air quality issues, and destruction of irrigation dependent ecosystems. Transferring water rights will affect in-stream flows in the Rio Grande. Approval of the San Juan/Chama diversion project would also deplete flows. The already over-extended river could dry up in long stretches and critical wildlife habitat could be destroyed.

Economic Impacts

The impacts of future water transfers could include loss of income and tax revenue for state, county, and local governments, as well

Table 3. Albuquerque's Future Demand for Water Rights (acre-feet)[76]

	2010	2040
Total pumped from aquifer:	120,000	170,000
Rio Grande water used to recharge aquifer (50%):	60,000	85,000
Aquifer water not recharged by the river:	60,000	85,000
Water rights owned:	23,554	23,554
Additional water rights required:	**36,446**	**61,446**
Irrigated land retired (acres):	17,355	29,260

as a loss of jobs that are both directly and indirectly related to agriculture.

The loss of water rights will compromise the social stability of downstream agricultural communities by curtailing their ability to control their future. Corresponding loss of employment options may result in the emigration of young people to the larger cities, depressing populations in rural communities.

Albuquerque's Proposed Diversion

The San Juan/Chama Project diversion is another potential new source of water for Albuquerque. But the proposed diversion would allow Albuquerque to continue to grow inefficiently, use water inefficiently, and delay making important decisions regarding the coordination of growth and water management planning.

In 1963, city leaders made a major investment in water for the future, spending $40 million to buy perpetual water rights to 47,000 acre-feet of water each year from the San Juan/Chama diversion project, which tunnels water from the Colorado River Basin through the Continental Divide to the Rio Grande.

For the last forty years, Albuquerque has not used any of the water from the San Juan/Chama Project directly. A large portion of the water is held in reservoirs on the Chama River. The rest of the water is released into the Rio Grande, where some is leased to farmers in the Middle Grand Conservancy District, some is kept in the river to help protect ecosystems and habitat, and the remainder is used to help replenish the aquifer that Albuquerque has been actively draining. Since the completion of the San Juan/Chama transfer forty years ago, Albuquerque's water supply system has been fairly simple. The aquifer supplied the city with drinking water, the Rio Grande partially recharged the aquifer, and the San Juan/Chama Project resupplied the Rio Grande.

Albuquerque now wants to release all of its San Juan/Chama Project water from storage and divert 94,000 acre-feet per year of water from the Rio Grande. It would then release half of the water back into the river below the city as treated wastewater. This is twice the amount the city holds in water rights. Officials have proposed building an inflatable dam in the river north of Paseo del Norte that could be adjustable to collect or release water. An inflatable "bladder" would raise or lower the dam.

Albuquerque's desire to divert the San Juan/Chama Project water comes partly from concerns over the health and long-term sustainability of the aquifer. The aquifer itself cannot physically support the growing needs of Albuquerque. The aquifer is already showing signs of stress from over-pumping. The water level is dropping 3-5 feet per year, a trend that will eventually lead to a condition called land subsidence, in which the land above the aquifer collapses, damaging foundations, shearing pipes, and causing other kinds of structural damage.[77] Deteriorating water quality conditions are also a potential problem as water levels drop.

Until recently, city and state water officials believed that Albuquerque was sitting on a virtually limitless supply of clean, fresh groundwater. But in the early 1990s hydrologists learned that they had miscalculated; the aquifer was being depleted at a dangerous rate. Today the city's pumping of the aquifer is unsustainable and the aquifer cannot recharge fast enough to account for the effects of the pumping. The water level in some areas of the aquifer has dropped as much as 160 feet from its original levels.

The city has developed a new strategy to solve this problem: move from groundwater supplies to surface water supplies to allow the aquifer to recharge. The strategy is centered on using the San Juan/Chama Project water.

But the diversion will not solve Albuquerque's long-term water problem.

Albuquerque's solution to water problems is to look for more water sources. Adding water without addressing sprawl and water conservation will only relieve pressure in the immediate future. Over the long term the illusion of an endless water supply will spur new sprawl growth. The city needs to steer its policies toward decreasing pressure on supply by decreasing demand: stop sprawling growth and conserve the water the city already has.

The proposed diversion in its present form will have a number of serious negative impacts on the health of the river and local farming communities.

- The diversion provides Albuquerque with access to a large quantity of water without addressing the relationship between water and growth. The diversion is contrary to conservation and will lead to continued inefficient growth in the Albuquerque area.
- The proposed diversion and new dam could degrade fish habitat of species like the silvery minnow. The new dam will prevent the migration of fish species up and down the river and further fragment important fish habitat. Decreased stream flows will inhibit upstream migration and endanger fish eggs and larvae.
- Water quality would be impaired by the return of 47,000 acre-feet of treated wastewater to the river channel and the loss of natural flow through the Albuquerque reach to dilute the city's wastewater.
- The diversion will hurt the environment and economies of those communities in the Middle Rio Grande Conservancy district that are below Albuquerque but above the Elephant Butte Reservoir. If Albuquerque is permitted to divert 94,000 acre-feet of water from the Rio Grande, twice what they hold in water rights, and pump an additional 23,000 acre-feet of ground water for which it holds consumptive use rights, then water may not be available to downstream users in the quantities they need.

Top of the World Farms and Santa Fe

Santa Fe is booming. Young people, retirees, outdoor enthusiasts, and artists have flocked to the area in recent years, sparking development that has spread the City of Santa Fe and its suburbs across the northern New Mexican desert. Today, Santa Fe is one of the least dense cities of any of its size in the country.

Sprawling growth is eating up open space and using up Santa Fe's water supply. Development in recent years has increased pressure on the local water supply and spurred the city and county to begin to look for additional water sources.

Plans to transfer water from a farm in northern New Mexico down to Santa Fe County have sparked a debate that could shape the movement of water in New Mexico for years to come.

Several groups representing the interests of the environment, farmers, and acequias have formally protested the transfer with the State Engineer. A preliminary hearing on the subject is scheduled for August 2002.

Proposed water transfers could impact water quality on the Rio Grande. Santa Fe's proposed transfer of water rights from Top of the World Farms in northern New Mexico could set a dangerous precedent for allowing transfers of water rights from the northern Rio Grande basin to the middle basin.

Photo: Joanne McEntire

Growing Problems

At the base of the southern Sangre de Cristo Mountains, beautiful Santa Fe has become a symbol of Southwest living. The area has become a popular retirement spot for urban Californians and Easterners wanting to enjoy the Western lifestyle. Between 1982 and 1997, Santa Fe's population jumped 41.4%.[78]

Along with the population, the physical size of the city and its suburbs has expanded. The sprawling low-density development that has come to characterize Santa Fe's suburbs has gained attention as the city with the fifth lowest population density of any urban area in the nation.[79] The average lot in the city is over 1 acre; the suburbs, some of which extend onto county land, are filled with 2.5 and 5-acre lots. Large subdivisions spread across Santa Fe's southeastern and northern flanks while tracts of undeveloped land lie in the interior of the town, threatening the continuity of the city and the property values of adjacent neighborhoods.

Sprawling growth is driving the demand to find "new" sources of water. Low-density growth has increased the water consumption rates of Santa Fe residents. Larger lots normally have more extensive landscaping that requires large quantities of water. While most Santa Fe homes use xeriscaping or other less water-intensive landscaping, there is still a significant difference in water use between small and large lots. The average household in Santa Fe uses a quarter of an acre-foot per year; in contrast, homes in low-density developments such as the Sol y Lomas neighborhood use almost 30% more.[80] With all water in the region appropriated, finding "new" water sources means transferring it from an existing use.

Top of the World Farms

To quench the thirst of present and future sprawling growth, Santa Fe County has applied for a permit to purchase rights to 588 acre-feet of water per year from Top of the World Farms in the Upper Rio Grande Basin of northern New Mexico. The proposed transfer has sparked heated controversy.

Table 4. Santa Fe Residential Water Use[81]

Lot Size	Water Use (acre-feet/yr)
Less than 6,000 square feet	0.2
6,000 to 10,890 square feet	0.25
Larger than 10,890 square feet	0.32
Average single family dwelling	0.25

The application requests permission to make the water transfer to the county's water system via an infiltration gallery. The infiltration gallery, similar to a well, would pull water from under the Rio Grande. Although the rights transferred would be exercised via groundwater pumping, the wells are hydrologically connected with the Rio Grande.

The approval of this pending transfer would inevitably spur sprawl growth in Santa Fe and potentially in Albuquerque as well. First, the transfer would make available 588 acre-feet per year to fuel development. The transfer could also set a dangerous legal precedent for allowing transfers to happen between the northern Rio Grande basin and the middle Rio Grande basin. Establishing a legal precedent for the movement of water rights between these two basins could open the floodgates to allow rural water rights to flow to urban interests. This transfer would reduce Santa Fe's incentive to conserve water and manage growth.

Environmental Impacts

Northern New Mexico receives only 13 inches of rain a year, most of which comes during the summer monsoon season. In this parched climate, fallow lands take decades to return to their natural state, as plant succession is hindered by the lack of water. For years after irrigation stops these lands will be barren sources of dust, contributing to erosion.

The impacts to the groundwater around Santa Fe and the Rio Grande between Santa Fe and Albuquerque could also be troublesome. In some places below Santa Fe, the Rio Grande already dries to a trickle in parts in the summer. Because the Rio Grande and Santa Fe area aquifers are hydrologically connected, additional groundwater pumping will reduce already diminished Rio Grande flows. Reduced stream flows will put additional stress on threatened and endangered species that rely on the Rio Grande. Already, 11 of the 27 fish originally found in the river have disappeared.[82] Today, the Rio Grande silvery minnow is on the Endangered Species List and further reductions in stream flow could result in its extinction.

Economic Impacts

On a statewide economic level, the legal precedent set by the approval of this transfer could result in the loss of hundreds of thousands of acres of farmland. Thousands of jobs could be lost; millions of dollars in "state net income" and state and county taxes would disappear.

Northern New Mexico is home to thousands of small family farms. The loss of water rights would leave many with no economic option other than to head toward Santa Fe, Albuquerque, or Las Cruces to find jobs. The loss of agricultural production combined with many new low-wage workers seeking employment in urban centers could have serious effects on the statewide economy.

Societal Impacts

The impacts of loss of water would be focused on two distinct cultures of northern New Mexico: the acequias and Pueblo Indian communities.

Acequia communities in northern New Mexico number around 800.[83] They are responsible for irrigating approximately 160,000 acres on 12,000 farms, 70% of which are 20 acres or less.[84] In 1986, the per capita income in Rio Arriba and Taos counties was under $9,000 dollars. Incomes throughout northern New Mexico were comparable.[85]

Eighteen Pueblo Indian communities could also be impacted by water transfers out of northern New Mexico. The Pueblo and Anasazi Indians have been practicing irrigation in northern New Mexico since 1000 AD.

These irrigation systems, although centuries old, stand as modern-day models of community-managed, environmentally friendly, sustainable, small-scale, local food production. The potential loss of water rights is a serious threat to the acequia communities, to the subsistence-level agricultural practices of the Pueblo Indians, and to New Mexico as a whole.

Loss of water to these communities means retiring irrigated lands. Loss of irrigated lands in any community decreases local revenue, cuts jobs, and has indirect effects on other local businesses. For the acequia and Indian communities of New Mexico, the loss of water rights will lead to clear economic and structural changes in the community, as well as the loss of a way of life. Many people will be forced to move to the cities to find low-wage employment.

SOLUTIONS FOR NEW MEXICO

Water and growth in New Mexico are inexorably linked. Growth cannot occur without water. Yet our cities are growing as though water were no obstacle. This cycle is unsustainable, and its effects are already apparent. Inefficient growth degrades our cities, while water transfers harm our rural communities and the environment.

Changes must be made to ensure the long-term livability of our cities, to safeguard the long-term sustainability of our water supply, and to protect the communities and ecological habitats that stand to lose in the face of the increased movement of water and water rights.

The following are three guiding principles for New Mexico's statewide growth and water management future:

Connect growth management planning and water planning.

The problems of inefficient sprawl development and dwindling water supply are linked but our planning process has yet to catch on. To guide efficient, responsible growth in New Mexico that will preserve our water supply for the future we must think about water first and growth second. Our planning process as it is approves huge new developments such as Quail Ranch to the west of Albuquerque without fully investigating their potential effects on water supply.

Make conservation the focus of urban water demand management to reduce the need for water transfers.

The cycle of water fueling growth can be slowed greatly by turning the focus of water management in our urban areas from finding new supplies to reducing demand. Cities in New Mexico are extremely inefficient users of water. The worst of these, Albuquerque, uses more than 205 gallons per person per day. The city should reduce its use to 150 gpppd. Reducing water demand greatly reduces the need for water transfers and hence the impacts on habitats and rural agricultural communities.

Developers and municipalities that purchase water rights should first be required to show proof of efficient water use with the water rights they already own. If the purchaser has existing supplies that are being wasted, then it should not be granted permission to purchase more. This will encourage conservation and efficiency in growth and water use, and will reduce the pressure on rural communities for water rights.

Work to mitigate the impacts of water transfers on third parties and make the transfer approval process more democratic.

Mitigating the impacts and costs of transferring water and water rights provides a two-fold benefit. First, policies to mitigate impacts benefit those third parties negatively affected by moving water. Second, such policies make it more likely that water will only be transferred when it is truly beneficial to the broader public interest.

Water rights do not give ownership of water to an individual, simply the right to divert and use a specific amount. Area-of-origin communities must have avenues to participation in the transfer approval process. Communities must be given the power to control their own fate, to protect their social and economic viability and the stability of their local ecosystems.

POLICY RECOMMENDATIONS

Policy recommendations are divided under the three guiding principles for New Mexico's statewide growth and water management.

Connect growth management planning and water planning.

- Regional water plans should be encouraged by the State Engineer as a way to promote planning and discussions between a variety of interests (urban, agricultural, environmental, recreational, etc.). Rural regions could prepare plans aimed at protecting their water sources that would then be honored by the State Engineer.
- Prepare realistic water budgets that balance supply with present and future demands. This will give communities the ability to decide whether new development is appropriate.
- Approve only those development projects which are compatible with the regional water budget and the city or county's land use and water planning.

Make conservation the focus of urban water demand management to reduce the need for water transfers.

- Require urban areas to achieve per-person-per-day usages of 150 gallons or less by 2010.
- Require purchasers of water rights to demonstrate efficient use of water for water rights they already own.

Work to prevent the impacts of water transfers on third parties, and make the transfer approval process more democratic.

- Provide communities with a voice in the transfer process. The water transfer approval process in New Mexico currently allows minimal participation from parties other than the individual buyers and sellers. A more democratic approach to the process of transfers will give communities the power to decide their own fate. New Mexico should adopt statutes similar to those in place in Arizona that require the consent of the governing body of either the irrigation district, agricultural improvement district, or water users' association before a transfer may take place.

  Arizona realized in the early 1990s, after the heavy "water ranching" of the mid-1980s, that the state was on the verge of losing its agricultural areas to feed inefficient sprawling growth in central Arizona. Allowing local irrigation districts to control the sale of water rights has given power back to rural communities to decide their fate and has slowed the movement of water rights to the cities.

  Some New Mexico districts already have this "right of first consent" authority in the specific statutes under which they were formed. This authority should be extended to acequias and all other districts.
- Encourage "win-win" situations for water transfer opportunities. Water transfers can occur with benefits for the buyer, the seller, and third parties. One possible "win-win" approach is to allow water rights purchasers to pay agricultural users the cost of upgrading the efficiency of their water use and then gain access to the water rights for the conserved water.

ENDNOTES

1. Ken Hughes, Department of Finance and Administration, Local Government Division, *Growth in New Mexico: Impacts and Options,* March 1997.

2. Center of the American West, University of Colorado, Boulder, *Western Futures*, downloaded from www.centerwest/futures, 5 May 2002.

3. EPA, HUD, *The Costs of Sprawl: Detailed Cost Analysis,* April 1974.

4. See note 1.

5. Ibid.

6. Peter White, *Water Rights Transfers Legal Research for the Northern New Mexico Legal Services*, 5 December 2000 (Unpublished).

7. U.S. Department of Agriculture, National Agricultural Statistics Service, *Farm and Land in Farms*, 1999.

8. Land and Water: Making the Connection, New Mexico environmental, public interest, and river groups, 2000.

9. See note 1.

10. Ibid.

11. See note 2.

12. Environmental Working Group, *Senate Approach Would Speed Payments to New Mexico Farmers for Farmland Conservation,* downloaded from www.ewg.org/farm, April 2002.

13. See note 1.

14. Adelheid Fischer, "Grass Is Not Always Greener: Reasons Not to Love Lawns," *Utne Reader,* September/October 1993.

15. Bruce Selcraig, "Greens Fees," *Sierra,* July/August 1993.

16. See note 3.

17. Miguel Navrot, "Survey Finds High Density Saves Water," *Albuquerque Journal,* 16 February 2001.

18. City of Albuquerque, "Albuquerque's Aquifer and How We Meet the Challenge," downloaded from www.cabq.gov/waterconservation/insert.html, 27 June 2002.

19. City of Santa Barbara Department of Public Works, "City of Santa Barbara Water," downloaded from www.santa-barbara.ca.us, April 2002.

20. Thomas Hylton, Urban Land Institute, *Save Our Lands, Save Our Towns: A Plan for Pennsylvania*, 1995.

21. See note 1.

22. New Mexico Office of the State Engineer, *Acequias*, July 1997.

23. Ibid.

24. Water rights are normally expressed in acre-feet per year. An acre-foot is the amount of water it takes to cover one acre one foot deep in water. A water right for one acre allows the holder to use one acre-foot per year.

25. City of Santa Fe Planning Division, *Water Use Table*, 2001.

26. City of Albuquerque Public Works Department, "Now's the Time," downloaded from www.cabq.gov/waterconservation, April 2002.

27. City of Albuquerque, "Albuquerque's Aquifer and How We Meet the Challenge," downloaded from www.cabq.gov/waterconservation/insert.html, 27 June 2002; Rio Grande Restoration, downloaded from www.riograndерestoration.org, April 2002.

28. National Research Council, *Water Transfers in the West: Efficiency, Equity, and the Environment*, (National Academy Press: Washington, D.C. , 1992).

29. Ibid.

30. Ibid.

31. Ibid.

32. Heim, Carol, "Leapfrogging, Urban Sprawl, and Growth Management: Phoenix 1950-2000," *American Journal of Economics and Sociology,* 1 January 2001.

33. Ibid.

34. Ibid.

35. Robert Lindsey, "Arid Farmers Grow Apprehensive," *New York Times,* 16 August 1987.

36. See note 32.

37. Ibid.

38. Steve Schmidt, "Population Grows Under Desert Sun," *Copley News Service,* 26 November 2001.

39. See note 28.

40. Jeremy Manier, "Urban Thirst May Parch the Rural Southwest," *Environmental News Network,* 26 March 2001.

41. Lawrence J. MacDonnell, Natural Resources Law Center, *From Reclamation to Sustainability: Water, Agriculture, and the Environment in the American West*, University Press of Colorado, 1999.

42. See note 28.

43. Ibid.

44. See note 6.

45. See note 28.

46. U.S. Census Bureau, "States Ranked by Percent Population Change: 1990 to 2000," 2 April 2001.

47. Colorado Public Interest Research Group, "Colorado's Loss of Open Space," downloaded from www.copirg.org, 25 June 2002.

48. Ibid.

49. See note 19.

50. Bob Berwyn, "Water Allocation Rules Outmoded: Report Pushes for Flexibility as Needs Rise," *Denver Post*, 11 December 2001.

51. See note 28.

52. Ibid.

53. See note 41.

54. Ibid.

55. Ibid.

56. Ibid.

57. See note 28.

58. See note 41.

59. See note 28.

60. See note 41.

61. See note 28.

62. See note 32.

63. Associated Press, *Study Ranks Reno Fourth Densest Metro Area in Nation*, 13 July 2001.

64. William Riebsame, Department of Geography, University of Colorado, Boulder, *Western Land Use Trends and Policy: Implications for Water Policy*, September 1997.

65. See note 28.

66. Associated Press, *Washoe County Squeezing Water from Storey, Churchill Counties*, 24 July 2000.

67. City of Albuquerque Planning Department, *Annexations, 1885 – Present*, dowloaded from www.cabq.gov/planning/statistics/annex.pdf, 28 June 2002.

68. Frank Zoretich, "New Study Links Suburban Sprawl to Poor Health," *Albuquerque Tribune*, 2 November 2001.

69. City of Albuquerque, Vehicle Pollution Management Division History, downloaded from www.cabq.gov/aircare/history.html, April 2002.

70. See note 27.

71. City of Albuquerque, *Cumulative Water Rights*, January 2002.

72. Data compiled by NMPIRG from analysis of R-G 960 water transfer files of the State Engineer of New Mexico, March 2002

73. Ibid.

74. Ibid.

75. Ibid.

76. Ibid.

77. Ollie Reed, Jr., "Terms Reached on City Water Treatment Site," *Albuquerque Tribune*, 30 October 2001.

78. Mark Oswald, "City's Population Density Rated Low," Albuquerque Journal, 25 July 2001.

79. Ibid.

80. City of Santa Fe Planning Division, *Water Use Table*, 1999.

81. Ibid.

82. Water in the West, "Encyclopedia of Water in the West," downloaded from www.waterinthewest.org, April 2002.

83. New Mexico Office of the State Engineer, *Acequias*, July 1997.

84. See note 28.

85. Ibid.