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The Rio Chama Basin: A Social-Ecological History Linking Culture and Nature

Sam Markwell, José A. Rivera, Moises Gonzales, and J. Jarrett García
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Abstract

This monograph of the Rio Chama basin in northern New Mexico resulted from a larger project awarded to New Mexico State University by the National Science Foundation, Dynamics of Coupled Natural-Human Systems Program. The project was titled: *Acequia Water Systems Linking Culture and Nature—An Integrated Analysis of Community Resilience to Climate and Land Use Changes*. The NSF CNH grant was made to New Mexico State University with a sub-award to the Center for Regional Studies (CRS) at the University of New Mexico (UNM). As part of the multidisciplinary research team, the CRS investigators selected the Rio Chama watershed as a study area with the aim of mapping the social ecology and cultural evolution of the region during the early Puebloan societies of pre-1540, the period of Spanish colonial and Mexican land grant settlements to 1846, the rapid changes of the territorial period under U.S. jurisdiction following the Treaty of Guadalupe Hidalgo in 1848, and concluding with the issues of growth and sustainability along the middle Rio Grande valley after New Mexico statehood in 1912. The goal was to profile how different human actions have altered the landscape of the Rio Chama, a major tributary of the Rio Grande, in terms of water, grazing areas, forested uplands, and other natural resources. The study focused on the complexity of human-natural systems interactions, specifically the dynamics of change on temporal and spatial scales in a multi-cultural regional geography characterized by episodic cleavages and conflicts over the use of natural resources. In particular the monograph examined the Rio Chama basin as a contested eco-cultural terrain that continues under stress into the modern era as population growth and economic development in the urbanized counties along the middle Rio Grande increase the demand for water. Much of the water supply delivered to urban consumers originates in the mountains of the rural counties of north central New Mexico and southern Colorado including water imported from the Colorado River system. The final chapter of the monograph recommends a water policy future based on a perspective that water is a public environmental commons for sharing by Rio Grande stakeholders across watershed boundaries and political jurisdictions. For research implications, the study concludes that the use of social-ecological history is not as an end account of research, but as the beginning of a variety of new studies that open up questions about the dynamics of human-natural relations and how past couplings have legacy effects that can help stakeholders better understand present conditions and examine alternatives for the future.

Author Bios

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Acknowledgments

The purpose of this monograph is to narrate the social and environmental history of the Rio Chama basin from pre-Columbian to modern times. As such, the goal was not to produce any new evidence of ecological change, but more simply, to synthesize research conducted by archeologists, historians, and social science scholars associated with each historical period. For this reason, we acknowledge the multitude of sources we have cited in the References. Any errors in our presentation of facts, or omissions of data, are entirely our own. Research funding for the project was provided by a National Science Foundation award to New Mexico State University (Grant No. 101516) with a sub-award to the Center for Regional Studies (CRS) at the University of New Mexico. At UNM we thank the CRS Director, Tobías Durán, for sponsoring the NSF CNH project and also for his many years of financial support to other land and water research initiatives. The UNM sub-award budget was administered by Marina Cadena, CRS Unit Administrator. We thank Marina for processing the accounting documents and other paperwork needed to implement the Rio Chama study. We also acknowledge all the UNM graduate students who conducted research during the five-year NSF CNH award: Sam Markwell, J. Jarrett García, Marcos A. Roybal, Sophia Thompson, and Roberto H. Valdez. Assistant Professor Moises Gonzales, Director of the Resource Center for Raza Planning at the UNM School of Architecture and Planning, served as a collaborator and along with many of his graduate students provided mapping and other technical support to the research team.

Table of Contents

Introduction	4
Chapter 1: Pre-Columbian Puebloan Development	8
Paleo-Indian, Archaic and Classic Chaco Periods 10,000 B.C. to 1200 A.D.	8
Upland Migration and Riverine Periods 1200 A.D. to 1540 A.D.	10
Environmental Adaptation and Resilience	14
Chapter 2: Spanish Colonial Eco-Cultural Encounters and Land Grant Settlements 1540-1820	16
Convergence of Systems: Contested Terrain	17
Socio-Ecological Transformations	19
The Pueblo Revolt and Aftermath	21
Chapter 3: Agricultural and Mercantile Expansion 1820-1912	27
Mexico and Early U.S. Transition	28
Railroads, Regulation and the Road to Statehood	31
Mercantile Economy and the Environment	33
Chapter 4: A Century of U.S. Statehood, People and Water 1912-2012	35
Partido Sharecropping in the Regional Economy	36
Flooding in the Rio Abajo and the Middle Rio Grande Valley	38
Urban Growth and Effects of World War II	42
The San Juan-Chama Project	43
Chapter 5: Water Policy Future	44
A Conceptual Framework for Action	46
Linking Stakeholders Toward a Rio Grande Commons	48
Appendix 1: The Riverine Pueblos	51
Appendix 2: The Jicarilla Apache	54
References	56
Maps & Figures	64

Introduction

The Rio Chama watershed drains roughly 3,160 square miles, from the San Juan Mountains on the Colorado-New Mexico border in the north, to the confluence with the Rio Grande in the south, and is bounded by the Continental Divide and the Tusas mountains and Black Mesa on the west and east, respectively. The watershed is located in a bio-geographical transition zone, encompassing the edge of the Colorado Plateau and its associated shrub and steppe biome on the northwest, the southern reach of the Rocky Mountain region with pine forests on the northeast, the Jemez Mountains on its southwest boundary and the Rio Grande Rift valley on the southeast. Most of the watershed is located in Rio Arriba County and covers more than half of the land area of the county (Rio Chama Regional Water Plan 2006). (Figure 1A: Rio Arriba County and Rio Chama Watershed)

The Rio Chama begins at 9,320 feet above sea level and flows south and east, dropping 3,700 feet in elevation to the confluence with the Rio Grande at 5,620 feet just north of Española. The watershed's highest points are located on the ridge of 10,000-14,000 foot San Juan peaks that form its northern border in Colorado, and Brazos peak at 11,410 feet in Rio Arriba County of New Mexico. The total land area includes about 2,020,480 acres or 1,944,530 acres within New Mexico. Control and ownership is divided as follows: almost 50% of the watershed is managed by the U. S. Forest Service, with 28% under private ownership, 11% in Pueblo and Tribal reservations, and the remaining 11% under the jurisdiction of the Bureau of Land Management (BLM) and the State of New Mexico. The Chama Canyon stretch of 24.6 miles was designated by the U.S. Congress as a Wild and Scenic River in 1988, and it is co-managed by the BLM and the Forest Service. The 30,000 acres of irrigated land in the watershed, all along the alluvial valley bottoms, represent only 5.4% of the privately held land. This "ribbon of green [supports] virtually all the settlement in the region" (Rio Chama Regional Water Plan 2006: 1-11). (Figure 1B: Rio Arriba County Federal and Tribal Lands)

The Rio Chama is only 130 miles in length but nonetheless is one of the major tributaries of the Rio Grande, and itself is fed by numerous creeks, streams and arroyos. Due to semi-arid conditions in the landscape, most of these tributaries are diverted for small-scale irrigated agriculture in the valley bottomlands: Cañones Creek and Rio Brazos on the northern stretch, followed by the Rito de Tierra Amarilla, Rio Nutrias, Rio Cebolla, Rio Gallina, Rio Puerco de Chama, Canjilón Creek, Cañones and Polvadera Creek, Abiquiú Creek, El Rito Creek, Rio del Oso, and on the southern end, the Rio Ojo Caliente formed by the Rios Tusas and Vallecitos. The watershed is maintained by a bimodal regime, with precipitation coming from winter snow and late summer monsoon rainfall. The majority of the precipitation comes from winter snowfall, which accumulates in the higher elevations and drains into the Rio Chama during spring melting and runoff. Winter snow is supplemented by the summer monsoons, which deliver sporadic, localized and intense bursts of rainfall from July to September. The annual amount of precipitation in the mountain ranges of the Rio Chama basin average approximately thirty-five inches. The village of Chama in the north receives approximately twenty inches, and the least precipitation falls on Española, the southernmost point, with approximately 9.5 inches annually. The watershed's average yearly precipitation amounts to approximately 3,265,398 acre-ft/yr— of which 436,979 acre-feet constitutes the estimated evapotranspiration (Rio Chama Regional Water Plan 2006: Tables 4-5 and 4-7)

The vegetation in the watershed is distributed through a variety of ecotones, from Montane grasslands and Spruce-Fir forest at the highest elevations, down through mixed conifer forest, aspen stands, and into piñon-juniper woodlands and high desert shrub and grasslands at the lower elevations, and the river itself is surrounded by a riparian zone that contains the densest vegetation and most fertile soils. This riparian zone has been altered by Hispanic *acequias* (earthen irrigation canals) since around 1600 and prior to that by pre-Columbian water control technologies dating to the riverine Pueblos of 1200 A.D. The process of mixing human labor with the land over time has created a bountiful hydro-ecosystem mosaic of agricultural and uncultivated vegetation dependent on precipitation, and, in modern times amplified by aquifer pumping, hydrologic modification, and human trans-basin engineering that imports water from the Colorado River to the Rio Chama and from there channeled downstream to urban centers along the Rio Grande. (Figure 2A: Rio Chama Terrain Model; Figure 2B: Rio Chama Below Abiquiu Dam)

The chapters of this monograph narrate the social-ecological history of the Rio Chama basin, surveying the breadth of human-nature interactions that have shaped the region over centuries of occupation. This timeline spans the pre-Columbian period of ancestral indigenous peoples to the post-contact Puebloan societies; the concessions for land grant settlements during the Spanish colonial and Mexican periods; the U.S. territorial era of rural industrialization with the introduction of railroad transportation; and the opening of public lands for homesteads at the turn of the twentieth century just prior to the Great Depression. The study concludes with an analysis of post-World War II rural outmigration with the attendant issues of growth and sustainability in Albuquerque and other urban centers along the middle Rio Grande. At the end, the monograph proposes a water policy future based on a perspective that Rio Grande water is a public environmental commons for sharing by stakeholders across planning regions. (Figure 3: Northern Rio Grande Basin).

The impetus for this project arises from the concerns and conflicts around land and water use in the basin, as indigenous and traditional rural communities increasingly are incorporated into broader regional, urban, national and global resource networks. Although these communities are partially autonomous, especially in relation to Pueblos, the local acequia irrigation associations, and the Jicarilla Apache Nation, over the course of centuries they have been integrated into larger legal, political, and economic institutions. With the transition to U.S. rule in 1846-1848, roughly 70% of the lands in the Rio Chama basin were transferred from communal ownership and use to Federal, State, and Tribal control while much of the remaining land was partitioned and privatized. Additional and more dramatic changes occurred during the twentieth century when the hydrology of the Rio Chama was reengineered by the construction of three reservoirs and an inter-basin tunnel. The first dam, El Vado, was built by the Middle Rio Grande Conservancy District (MRGCD) in the 1930s in order to provide flow regulation for the irrigation district that stretches from Cochiti Pueblo to San Marcial. The second dam, Abiquiú, was built north of Abiquiú village on the lower Chama for flood and sediment control in the early 1960s, and in 1971 it was joined by Heron reservoir when both were designated to hold San Juan-Chama Project water imported from Colorado (Flanigan and Haas 2008; Glaser n.d.)

The San Juan-Chama Project was constructed by the Bureau of Reclamation during the late 1960s and completed in the early 1970s. The project diverts water from three upper

tributaries of the San Juan River (Rio Blanco, the Navajo River, and the Little Navajo River) in the Colorado River system to the Rio Chama through a tunnel carved beneath the Continental Divide (Flanigan and Haas 2008). The water from the project enters Heron reservoir through Willow Creek near Chama, New Mexico, and then passes through the Rio Chama for utilization by a number of entities downstream, with the bulk of water contracted for municipal uses in the City of Española, the County of Los Alamos, the City and County of Santa Fe, the Albuquerque-Bernalillo County Water Utility Authority, and for agricultural purposes, the Middle Rio Grande Conservancy District. Tribes and acequia communities that also benefit from project water include the Jicarilla Apache Nation, the Pueblo of Ohkay Owingeh, and the Pojoaque Valley Irrigation District (Flanigan and Haas 2008; Thomson 2012). The acequia irrigators on the main stem of the Rio Chama, however, divert only native water from snowpack and precipitation that originates in the Rio Chama basin itself, and even though they hold water rights more senior than downstream municipalities, the acequias do not receive an allocation of the waters imported and stored by the San Juan-Chama Project.

Once the San Juan-Chama Project was completed and became operational, the magnitude of the trans-basin diversion greatly altered the physical and governmental complexity of the Rio Chama watershed as it meshed into a relationship of urban water demand on the Colorado River, a system that has experienced periods of drought for the last sixteen years pitting agricultural water rights against urban water uses. The flow of the Colorado River was divided in two when the Colorado River compact was established in 1922 with appropriations to upper and lower basin states. The Upper Colorado River Compact was signed in 1948 when New Mexico was appropriated 11.25% of the flow (Flanigan and Haas 2008), second to last when compared to California, Colorado, Arizona and Utah, and Wyoming, states in descending order of the largest shares. Only Nevada ranks lower than New Mexico. Currently, much of the Colorado River water is pumped into a number of modern projects of desert plumbing to satisfy the needs of farmers as well as urban demand emanating from the regional metropolises of Las Vegas, Los Angeles, Phoenix, Tucson and other cities. Likewise, the municipal drinking water systems for Santa Fe and Albuquerque, coupled with the middle Rio Grande irrigators, receive the bulk of New Mexico's Colorado River water delivered from Heron reservoir for these downstream uses by way of the Rio Chama as a transport channel. Within the Rio Chama basin, the watershed yield amounts to about 418,000 acre-feet of native water, but 90% of this amount flows downstream into the Rio Grande for uses outside of the region and only 6.4% of total yield is depleted by Rio Chama communities (Rio Chama Regional Water Plan 2006).

This monograph describes the social ecology and cultural evolution of the Rio Chama basin as context for establishing common ground across the myriad of upper Rio Grande stakeholders as they plan for a new water future under conditions of scarcity compounded by the effects of climate change. For methodology the researchers utilized a mix of qualitative research and visualization methodologies to synthesize cultural forms of knowledge production into a narrative of transformations in the social and material life of the people residing within the Rio Chama basin. Sources of information included historical archives, archeological surveys, geographic mapping, governmental publications, ethnographic studies and sociological reports, along with the use of the emerging multidisciplinary research into linked physical-social-ecological systems (Berkes et al. 2003; Fernald et al. 2012). When we examine culture, key elements in this study include: social organization, material production, resource use and

management, political regimes, relationships, diversity, production technologies, ritual, labor, spatial constructions, and sustainable practices. The study centers on questions about changing historical forms of social ecology, cultural analysis and connectivity along the Rio Chama watershed:

- (1) What are the human relations to physical systems and the natural environment across the diverse population groups that have inhabited the region? When first established, how did these local societies organize themselves to extract natural resources essential to survival?
- (2) What forms of technology were utilized? What were the means and materials of production? What have been the necessary mental conceptions and fields of knowledge?
- (3) And finally, are there any lessons to be learned in terms of the contemporary water policy arena where stakeholders, water planners, and resource managers can potentially collaborate and make decisions toward a common and sustainable future?

Scholars whose concerns bridge the humanities, social sciences and natural sciences have described systems of social and natural organization as “ecocultural regimes” (Masco 2006) and “cosmopolitics” (Latour 1999) to grasp the intricate connections between the “human” and the “natural” more adequately than is possible from within the framework of a single disciplinary analysis. Of particular interest in this study is the nexus between society and the natural ecosystems at the scale of human settlements with a focus on social organization. We utilize the term “social-ecological,” which shares with these other terms the intention to convey the concept that all productive practices and social relations across historical periods and eras have seen contestations over the general social order and the relation to nature. We also do not presume an absolute incompatibility between practices located in the opposed categories of the “traditional,” and the “modern” out of a concern that such an opposition often confuses the perceived “traditional” or “modern” status of a social system or practice with legitimacy in the present, which can take the form of either a modernist progressivism or a primitivist romanticism.

Instead of following the well-trodden paths of such a binary approach, the concept of ecocultural regimes helps to convey the ways that social organization and material production throughout history have always been embedded in cultural logics of a more-than-human world, a proposition made evident by Ortiz’s work on the Tewa worldview (Ortiz 1969). For the Rio Chama study, this allows us to understand the evolution of social organization and material techniques in terms that do not privilege the most recent manifestations of social-ecological order as the optimal arrangement of social and natural relations. Important implications follow from such an approach. These implications will help us clarify the terms of comparison of social organization and material techniques across historical periods and political regimes, and how the legacy of past practices can inform current discussions about adaptive water policy and management.

Additionally, we can say that the material techniques of production that emerge in different periods can be compared for their long term sustainability and ability to produce human

and non-human diversity and well-being, as well as their short-term efficiency and profitability for humans. This approach does not discount practices that have become marginalized (such as dry farming, flood irrigation farming, and local exchange and subsistence farming), but opens up a discussion of how such practices can be configured alongside new technologies to promote sustainable long-term economic development in the indigenous Pueblo, Tribal and Hispano communities along the Rio Chama and the upper Rio Grande basin as a whole. In other words, acequias and solar panels can be complementary technologies that are the material basis of sustainable practices of living in the world and not artifacts from different eras. The diverse material techniques and social formations in the Rio Chama watershed are a rich repertoire for community-based development and planning. This document hopefully will be of some help toward collaborative strategies across stakeholders, and we recognize and advocate that indigenous Pueblos, Tribes and Hispanic acequia communities should be at the center of planning processes alongside municipalities, industry, commercial agriculture, and citizen groups that advocate for the protection of the environment and natural resources.

Chapter 1: Pre-Columbian Puebloan Development

Paleo-Indian, Archaic and Classic Chaco Periods 10,000 B.C. to 1200 A.D.

In distant geological time the Rio Chama was not a watershed. It has only become what it is today through millions of years of complex planetary processes. These processes created the material culture and landscape of the Rio Chama watershed that humans sought out and inhabited for millennia. Within the region, the site with the longest known utilization by indigenous Amerindian peoples is the Piedra Lumbre, or “Shining Rock,” located to the west of present Abiquiú Dam. The Piedra Lumbre mesa, as historian Poling-Kempes wrote, “has been the stage for a busy, complex, sometimes violent, always interesting multicultural human drama for several thousands of years” (1997: 3). The Piedra Lumbre is the site of *Tsee p'in* (Tewa) or *Cerro Pedernal* (Spanish), a peak that contains large and easily accessible deposits of chert, a natural material that can be made into stone scraping, cutting and piercing tools. Lance-heads made from chert are among some of the earliest artifacts found in the region, dating back to 9500-5500 B.C., when Paleo-Indian populations were living and hunting not only in the Llano Estacado as once thought, but scattered throughout New Mexico (Stuart 1986). Archeologists have found evidence of camps within the present location of the Jicarilla Apache Reservation and in the Gallegos Wash region of the Navajo Reservation, sites associated with the Clovis, Folsom and Midland periods (Stuart 1986). Since these ancient dates, the Rio Chama basin has been increasingly traversed, inhabited, cultivated, harvested, and engineered for its varied and abundant natural resources. Increased human land use occurred during the subsequent Archaic Period (5500 B.C.-A.D. 900). Archaeological evidence suggests a dispersed population of hunter-gatherers especially in the middle and later years of the Archaic Period at locations such as the Rio Chama watershed, the Santa Fe area and at the piñon-juniper uplands of the Pajarito Plateau where wild plants and animal resources were accessed seasonally moving between high and low-elevations (Duwe 2011).

In addition to the chert found on Cerro Pedernal, the area around El Rechuelos, located just north of the Valles Caldera, was a primary source of obsidian for the indigenous peoples that dwelled in the San Juan and Rio Grande watersheds. While there is little archeological evidence of permanent or semi-permanent living structures in the Rio Chama drainage prior to the thirteenth century, artifacts manufactured from the materials of these geologic and volcanic formations are found throughout west-central North America (Snow 1983; Ortman 2010). These artifacts, primarily arrow and spear points, were part of a broader set of tools and symbolic materials traded and utilized by the inhabitants of the region stretching across northern and western Mexican deserts, the Colorado Plateau, Great Basin, Great Plains and the Pacific Coast (Wilcox 1996). While it is difficult to access the cultural meanings that imbued the trade, ritual, and labor relationships in which these artifacts were utilized, their presence is widespread and are especially prevalent in structures and villages associated with the large and complex dwellings located at Chaco Canyon and Mesa Verde.

Both Chaco Canyon and Mesa Verde were sites of increasing complexity and scale with horticultural and architectural technologies that enabled the aggregation of large populations around “Great House” structures for the three centuries preceding the migration of ancestral Pueblo people to the northern Rio Grande in the thirteenth century. Variations of the pithouse, a dwelling dug two feet into the ground and covered by a thatched wood and stick roof sealed with mud and clay, became widespread during the first millennium A.D. These pithouses were relatively simple to build and maintain, and they were the most efficient dwelling unit built by the early Puebloans. Pithouses suited the semi-nomadic Puebloan subsistence practices of hunting, harvesting wild plant products, and cultivating dispersed localized areas, while retaining potential for mobility given the linkages between climate fluctuations and the social conflicts and negotiations that shaped the chances for long-term human survival. Around 800 A.D., the western Anasazi, or early Puebloans of the Colorado Plateau, began to build above ground, connecting a number of mud and pole huts in semi-circles around pithouses, and by 1000 A.D. above ground masonry buildings were widespread throughout this region of the ancestral Puebloan landscape.

The new living units were centered around food storage bins and towers in conjunction with a public plaza that often contained a kiva, a modified pithouse construction used for communal gatherings and ritual activities. This development in architectural change coincided with the increasing prevalence and diversity of practices that involved animal domestication (turkeys and dogs) along with new horticultural techniques for the cultivation of corn, squash, melons and beans. New material techniques, coupled with a high degree of social and political coordination of production and exchange, allowed for a vast and complex socio-economic system to emerge in the San Juan basin, a drainage area to the west of the Rio Chama Valley (Gordon and Reiter 1965). According to archeologist David Stuart, “[an] estimated twenty thousand Chacoan farmsteads and nearly two hundred major ‘outlier’ trade-and-ritual great houses were linked in a huge trade-food-transportation-ceremonial network” (Stuart 2010: 69). During this period there is little archeological evidence of Puebloan dwellings in the Rio Chama drainage, but the highlands that border it to the west were home to groups on the eastern edge of the Chaco network. The Chaco phenomenon was one of the largest and most clearly defined regional economic, social, and political networks in North America that created a vast system of roadways in the northwestern quadrant of New Mexico and adjacent areas of Arizona, Utah and

Colorado, evidenced by ruins of more than 10,000 Anasazi structures, more than half of them built between the period 950 A.D. and 1100 A.D. (Stuart 1986).

Around 1150 A.D., after villages in the San Juan Basin reached their highest population levels, people from the farmsteads and pueblos in the Chaco region began to migrate en masse from the Great House centers to upland areas that surrounded the basin in all directions. While there has been substantial archeological inquiry into the causes, contours and dynamics of these migrations, forming a precise description remains problematic because of the complexity of such a retrospective undertaking. Perhaps these migrations were driven by a combination of climate-related social, religious, economic and political dynamics. Archeologists have concluded that the timeline of the migrations was characterized by a shakeup of the clan-kinship and sodality organizations that shaped inter- and intra-tribal relationships (Ware 2002; Fowles 2005; Ortman 2010). Many well-known hypotheses associate drought stress, deforestation and population growth with inequitable and unsustainable distributions of resources between elites and farmer laborers (Stuart 2010; Diamond 2005). These circumstances of conflict were negotiated differently across many groups and communities, resulting in changes of location and social organization by the peoples involved in the Chaco complex. Mesa Verde, located eighty miles northwest of Chaco, reached peak population during the out-migration from Chaco and itself began to disperse roughly a century after the depopulation of Chaco began.

Today, Chaco Canyon and Mesa Verde are home to national parks that are visited by tens of thousands of American and international tourists caught in the allure of antiquity. Contemporary indigenous people with ancestral, cultural and geographical ties to Chaco and Mesa Verde include the tribes of the Ute, Navajo, Hopi, Zuni, Tanoan, and the Keres. Again, it is difficult to know precisely the identities of the indigenous peoples that constructed these places or the complexity of social organization that they created and lived within. More certain are the many links between the material culture, origin stories, languages, ritual and ceremonial practices, epistemologies and oral history narratives of indigenous peoples that tie them to these ancestral sites. Whatever the reasons behind the migrations from these ancient sites, the cultural and material developments forged during this period provided the knowledge and techniques that were adapted selectively to new lands by migrant populations. For millennia the Rio Chama basin was traversed by ancestral Puebloans who made use of its chert and obsidian deposits, hunted game, and gathered wild plants. The thirteenth century A.D. marked the beginning of a significant quantitative and qualitative change in the human presence along the Rio Chama.

Upland Migration and Riverine Periods 1200 A.D. to 1540 A.D.

During the thirteenth century, the northern and central Rio Grande became inhabited by numerous and diverse ancestral Puebloans migrating east and southeast from Chaco and Mesa Verde to upland areas of ponderosa and mixed piñon/juniper forest (Stuart 1986). The departures from Chaco and Mesa Verde, which are often explained in simplified environmental determinist terms, were not due to rapid collapses. Rather, they were complex contested negotiations and violent confrontations within and between communities at local and regional scales (Ortman 2010). While the dates associated with the final abandonment of ancestral sites correspond to drought events and climatic flux, archeologists propose that “stressful periods

(such as cold or dry spells) created contexts that were particularly amenable to changes, possibly instituted as a result of deliberate strategizing by knowledgeable agents” (Hegmon 2008: 230). The migration of ancestral Puebloan peoples from the Colorado Plateau to the Chama district was in reality a heterogeneous set of long-term processes. The multiple migrations that took place were shaped by the decisions and actions of different groups to adapt subsistence, trade, and habitation strategies to new lands and simultaneously modifying material technologies and social organization.

Archeological, linguistic, and ethnographic evidence shows that the migrations consisted of numerous groups, often speaking different languages or dialects, practicing different forms of social organization and utilizing different material technologies (Stuart 2010; Ortman 2010). Eventually the various migrant communities came into contact with one another and with other people already established in the northern Rio Grande. New social formations were forged as “migrant” and “indigenous” groups exchanged members, ideas, techniques and materials, creating new economic, kinship, and sodality (i.e. moiety or other intra and trans-tribal ritual group) relations. These relationships formed the basis for the production and transmission of what Anschuetz (1998) refers to as economic, social and ideational technologies. Anschuetz, drawing on his archeological research in the lower Chama basin and ethnographic research with Hopi Pueblo farmers, describes these technologies as not only instruments or artifacts, but as informed by spirituality and metaphorical descriptions of the relations between people, water, animals, plants and the land that constituted the ancestral Puebloan cultural landscape (Anschuetz 1998). The Puebloan farmers used tools such as stone axes and hoes to clear areas for cultivation and then developed a variety of bordering and terracing techniques to increase the capacity of the land to absorb rainfall and runoff. These technologies enabled the Puebloan communities to flourish and produce material abundance in a sparse high desert ecosystem. The design of these features and plant cultivation were combined with spiritual thought and practice, which imbued productive labor with obligations to an interconnected social, natural, and supernatural landscape (Anschuetz 1998; Ortiz 1969).

The Upland period (1150-1300) is marked by a transition from the Chaco cultural and economic complex to a trading network between communities living in upland piñon-juniper and ponderosa districts of eastern Arizona with partners in the Jemez area that “brought seed corn, pigments and exotics to the Pajarito Plateau” (Stuart 2010: 91). The archeological record documents that the transition period of the late 1100s and early 1200s was marked by the return to the widespread use of pithouses and small above-ground farmsteads constructed from brush and mud by highly mobile populations. The 1200s evidenced the proliferation of cobble bordered and gravel mulched plots modified for specific cultigens (corn, beans, squash, melons, tobacco, cotton, prickly pear cactus). The recent migrants to the area were integrated into a broad trade network between practitioners of a highly mixed cultivating, hunting, gathering and craft-making economy (ceremonial regalia, everyday clothing, blankets, ceramics, baskets, weapons, farming tools), that mitigated the risks associated with practicing agriculture where rainfall is variable and not annually reliable. This enabled farmers to harvest and store surpluses during good years while being able to rely on other food sources as well as on trade and reciprocal sharing relationships during years of mediocre or poor harvests. Anschuetz details ways that Puebloan farmers were adept at observing weather patterns and determining whether environmental conditions were amenable to producing an adequate harvest, and if not, going

without intensive planting and cultivating for a year and investing in other productive activities (Anschuetz 1998: chapters 1 and 2).

A number of additional large villages were built as the northern Rio Grande population grew. Stuart describes that new trade contours emerged during the late thirteenth and fourteenth centuries that “connected northerly areas with frigid winters, such as the Taos and Chama valleys, with warmer, southerly ones such as the middle Rio Grande and the chain of mesas that form the northern approach to the plains of San Augustin” (Stuart 2010: 100). He argues that this period was a time of increased efficiency and adaptation through the diversification of cultigens and farming techniques adapted to local climate and soil conditions “working with, rather than against, the forces and limitations of nature” (Stuart 2010: 103). Stuart also makes a distinction between the height of Chaco’s size and complexity, where massive labor investments were utilized to build great houses and roads, and the following centuries when labor was invested in “using and enhancing a new landscape’s capacity to feed people... [including] water control features, small reservoirs, low-cost irrigation, cobble grid gardens, pumice mulch, terraced hillsides, and a much more diverse repertoire of cultigens” (Stuart 2010: 103). There are examples of similar water modification technologies throughout west-central North American areas inhabited from 400-1200 AD, suggesting a high degree of interaction and mobility of people, ideas and technologies.

The complexity of interrelations of heterogeneous migrant and already established but also mobile groups makes it difficult to narrow down the precise origins of the people who inhabited the Chama district during the Upland Period. Ortman (2010) argues that the increasing population of the Chama basin was driven largely by immigration of large communities over many decades from the Mesa Verde region. The immigration to the northern Rio Grande and Chama basins took place throughout the 1200s, and by 1300 A.D. Mesa Verde was completely uninhabited. This timeline coincides with the Pindi phase (A.D. 1200-1300) of the Coalition period, a time when the first human settlements were established anywhere within the Rio Chama watershed (Duwe 2011). To migrants from the depopulated northern San Juan region, “the Rio Chama was an unoccupied ‘new world’ of sorts where multiple disparate people could settle and work out identities and cosmologies in the centuries that followed” (Duwe 2011: 252). In his exhaustive review of the archaeological record pertaining to the Rio Chama watershed, Duwe concludes that the Pindi phase was characterized by a number of “small-scale populations” that settled throughout the Tewa Basin and that the first sustained residential settlement in “the previously uninhabited Rio Chama watershed occurred in the mid-thirteenth century at the site of Tsama’uinge,” followed by other ancestral Tewa sites located in the Rio del Oso valley (Duwe 2011: 240, 252, 314).

Migration-driven population growth in the Chama basin resulted in a broader regional shift from almost exclusively upland dwellings to a mix of upland and lower valley inhabitation. In the Chama district, this spatial shift from 1280-1320 A.D., characterized by pithouse and above-ground thatched brush and jacal farmhouse construction, was followed by an increase in construction of large masonry (mud brick and stone) aggregate villages surrounded by smaller dispersed thatched and masonry farm pit-houses during the period 1320-1450 A.D. (Ortman 2010; Anschuetz 1998). Interestingly, the movement of a large population from the Mesa Verde region to the Chama-Rio Grande confluence area was not accompanied by the wholesale arrival

of a Mesa Verde material culture suite. While certain practices that were widespread at Mesa Verde, but previously absent from the northern Rio Grande, did appear (turkey husbandry), many other practices from the northern Rio Grande and other areas became part of the practices of the ancestral Puebloan tribes composed largely of Mesa Verde migrants (kiva architecture and pottery styles). Hegmon (2008) states that the agency of individuals and groups, such as the Mesa Verde migrants, is practiced within structures or contexts. For the migrants, these contexts were shaped both by the people, resources and events at the site of departure as well as those of the destination region of the Chama-Rio Grande confluence. Hegmon (2008) argues that the arrival of a large number of immigrants from the Mesa Verde region without the arrival of a distinctly Mesa Verde style suggests a situation “consonant with a body of thought known as Resilience Theory—that structural rigidity, which allows little room for variations in agency, may be more likely to lead to dramatic (and sometimes painful) transformations than structural flexibility” (Hegmon 2008: 227). The adaptations evidenced during this period suggest that migrant groups were innovatively coping with environmental and social changes in ways that improved intergroup cohesion and survival.

In his work Ortman (2010) concludes that the flexibility in architectural forms, subsistence practices and toolkits was due in part to social, political and religious conflicts in the Mesa Verde region. He points out that the alienation of certain disadvantaged groups from the dominant Mesa Verde groups, which led to early outmigration, put these groups in a position to re-establish practices they encountered in the northern Rio Grande, practices which were similar to those of their ancestors at Mesa Verde but different from those of contemporary Mesa Verde society which was becoming increasingly hierarchical and inequitable (Ortman 2010). Thus, migrants were able to convince Mesa Verde residents to join them in their new homelands where they had established an alternative society. For Ortman, this is most clearly evidenced in the:

...upheavals of revolution, including the breaking and burning of kivas and possessions, violence against opposing factions, the abandonment of villages, the long walk to the Tewa basin, the construction of a new society, and public surveillance [i.e. public plaza form] to ensure compliance with the new norms of behavior, would have encouraged the formation of strong bonds of solidarity and common commitment among the migrants (Ortman 2010: Vol. 2, 596).

This interpretation of the events concerning Mesa Verde out-migration and village aggregation in the Tewa basin (lower Chama and Rio Grande confluence) points to the ways that social organization was intentionally reconstituted to address social and material inequities, leading to the construction of new communities.

The construction of new communities was not a simple or straightforward process. As stated by Pauketat (2008: 244), “a projection or an instantiation of community is not the same as the materialization of a shared communal ideology,” and “given the Southwest’s evident social complexities and likely contested identities, any community project was politically charged.” Anschuetz (1998) maintains that the projects to build Pueblo communities undertaken by the ancestral Tewa tribes were facilitated by the ritual inscription of the landscape with sacred meaning through kivas and shrines. These sacred ritual practices were the means of creating and maintaining intragroup coherence based on reciprocal obligations, especially when it came to

distributing and sharing material abundance. Trade relations with external groups were also informed by ritual and constituted an alternative to violent intergroup encounters that were common during the Upland and Classic periods (Anschuetz 1998).

Alfonso Ortiz, renowned Tewa anthropologist, has detailed the social organization of the Tewa, which he argues is determined primarily by the dual moiety organization of “Summer people and Winter people” (Ortiz 1969: 16). He explains that this dual organization is a social mechanism of reconciling the antagonisms that can arise from an asymmetrical division of labor and ritual practices among group members. For instance, summer and winter moieties are not strictly determined by descent or residence; so their members integrate different groups within a village. Also, there are shifting duties of labor and ritual assigned to the members of the moieties, with the summer people taking on more agricultural labor and ritual, with winter people taking on more hunting and gathering labor and ritual (Ortiz 1969). This diversification can lead to an asymmetrical accumulation of resources, and the ritual and exchange relationships between groups can serve to naturalize or reconcile this asymmetry (Fowles 2005). Thus, we can say that social organization was closely tied to the material landscape through metaphorical, spiritual and technological practices.

Environmental Adaptation and Resilience

Before moving to conflicts that developed during the fifteenth and sixteenth century with the arrival of other migrating populations, let us summarize and recapitulate the narrative presented thus far in this chapter. The ancestral groups that inhabited and developed the Tewa pueblos of the Chama watershed built extensive agricultural field complexes and large villages throughout the three centuries preceding Spanish contact and colonization that began around 1540. Most of these features were built during the Riverine Period along the main stem of the Chama as well as on the major tributaries, especially El Rito, Ojo Caliente, Abiquiú Creek, and Rio del Oso (see case studies of riverine pueblos in Appendix 1). The variety of field types (runoff irrigation and other rainfall dependent strategies) with their associated mulches and water modification techniques were spread across the landscape to maximize the potential sources of food, given the climatic uncertainty. The pueblos and their associated field complexes were built up over time, and the flexibility and mobility of the local populations meant that these sites were being constantly left behind and re-inhabited over the centuries, with new phases of construction during re-inhabitation. (Figure 4: Riverine Pueblos)

The early villages (1275-1350) were built largely with an enclosed plaza containing one or two kivas. Later on (1350-1450), additional roomblocks were added around these enclosed plazas, and new plazas and kivas were constructed. Hegmon (2008) notes that people were actively adapting traditional architectural forms, in this instance the masonry village and the pithouse, into different communal and ceremonial architectural forms of villages and kivas. Typically, new kivas were built at large village sites, but as sites were inhabited, departed from, and re-inhabited, new kivas would be constructed on the kivas and pithouses that had been built centuries earlier (Hegmon 2008). Similar processes can be seen in the field complexes, as re-inhabitation and expansion of cultivated area over time was accompanied by the re-construction of shrines and the construction of entirely new shrines (Anschuetz 1998). It is difficult to narrow down how much of these agricultural and dwelling features were utilized at any given time, as

they were part of a flexible and mobile subsistence and ritual pattern. The flexible and mobile nature of communities in this period of Pueblo development was part of a strategy of adaptation to a context of variable environmental conditions (most importantly precipitation) and the uncertain dynamics of social alliance and conflict with other competing groups.

The lower Rio Chama watershed was the site of an increasingly complex synthesis of social organization and material techniques of environmental modification during the three centuries preceding the Spanish exploration and conquest of the sixteenth and seventeenth centuries. Incoming Tewa migrants encountered other migrant clans and tribes that had inhabited the northern Rio Grande watershed for centuries. This encounter of people and systems precipitated significant expansion and intensification of agricultural practices and watershed modification, new techniques of ceramic, stone, bone, and wood artifact production, new systems of social organization such as the moiety, and development of communal villages with large centralized roomblocks and plazas with dispersed farmhouses. These innovations enabled the Puebloans living in the Rio Chama and other northern Rio Grande watersheds to become part of an expanding trade network that linked indigenous peoples from the Colorado Plateau, Rocky Mountains, Great Plains, as well as the Chihuahuan and Sonoran deserts to the south. These trade networks fluctuated across space and time as different cultural, political and social communities (i.e. tribal nations, bands within these nations, sodality groups, and possibly other formations) came into contact, created and mediated relationships of both collaboration and conflict. This period of resilient negotiation and adaptation contributed to population growth in the Chama district population from approximately 500 people in 1275 to nearly 3,000 people in 1350, 6,500 in 1400, and reaching approximately 11,000 in 1450 when growth leveled off until the arrival of the Spanish during the Coronado expedition of 1540 and later years (Ortman 2010: Vol. 1, 134).

While the exact quantities are uncertain and a comprehensive study has not been conducted, the estimates put forward by Anschuetz (1998), Buge (1984) and Ortman (2010) suggest that during the time of peak population, around 1450, the amount of potentially cultivated land grew to an amount that probably has not been surpassed since. This is due to the open utilization of multiple resource terrains: valley bottoms, the mid-valley mesas, and the surrounding mountains and forested lands. In economic and spatial terms, the major difference between this Tewa mode of agricultural production and the acequia-based mode introduced by the Spaniards around 1600 is the flexible and selective utilization of a much larger expanse of different types of lands through numerous modifications (contour terracing, cobblestone grids, gravel mulching, check dams, small reservoirs) in the Tewa mode, compared to the regular and more intensive utilization of the valley bottomlands of the latter through acequia flood irrigation and grazing in the uplands by livestock introduced during the Spanish *entrada*.

Although the Spaniards classified the Tewa amongst the sedentary “Pueblo” Indians they encountered, in contrast to the more nomadic Athapascan tribes (i.e. Apaches, Ute, and Navajo), the Tewa before and after Spanish contact have maintained geographic networks centered in villages but sustained through mobility across the surrounding landscape. Sociologist Tessie Naranjo (2008) of Santa Clara Pueblo describes the significance of mobility in her chapter “Life as Movement” in the collection *The Social Construction of Communities: Agency, Structure, and Identity in the Prehispanic Southwest*. Naranjo states that Tewa metaphor, “life as movement”

gestures to both the “physical movement from one place to another, the movement that was so fundamental to the Pueblo people’s way of life in the past,” as well as “the movement that characterizes life itself, the constant movement of changing circumstances” (Naranjo 2008: 252). In contrast to a classification based on being sedentary, Naranjo (2008), along with Ortiz (1969), show how crucial “becoming” and the flexible movement in both spatial and social relations are to Tewa cosmology, which is both a material and a spiritual system. Severin M. Fowles (2009) notes that the discipline of archeology has shifted from earlier approaches that sought to understand pre-Columbian life in purely economic terms to one that considers the economy in light of “the phenomenological experience of dwelling within landscapes, the semiotic experience of attaching meaning and agency to mountains and springs, and the political experience of structuring space and human movement through it ”(Fowles 2009: 448). The shift described by these three authors opens up the possibility of understanding the Tewa couplings of human-nature systems as dynamic reconfigurations of social relations and relations to nature, and not as static systems of a permanently fixed order.

As this chapter has begun to demonstrate, the cycles of population growth, exchange and conflict that shape the coupling of human-nature systems are mediated by a diverse array of material, social and ritual processes and practices. In the fifteenth and early sixteenth century that followed, the arrival of Uto-Aztecan and Athapaskan people (Ute, Apache, Comanche, and Navajo) introduced new dynamics of exchange and conflict to the Chama valley. This period of change coincided with the beginning of Spanish exploration of the New World, heralding an era of colonialism and modernity that would bring about radical transformations in social organization and material technologies. The Rio Chama watershed was already a contested terrain before the arrival of the nomadic Uto-Aztecs and Athapaskans and later followed by the “*conquistadores*” of the Spanish empire. With this latter confluence of groups, the horizons of social alliance and conflict were shaped by new relations of identity and difference. The arrival of new indigenous people and European groups into the region set in motion significant changes in the human presence within the Tewa basin, including a slowly decreasing Tewa population through emigration and the ravages of conflict with both indigenous and colonial forces.

Chapter 2: Spanish Colonial Eco-Cultural Encounters and Land Grant Settlements 1540-1820

The effects of Spanish period colonialism disrupted and obscured much of the cultural and material landscape from the pre-Columbian world. On the other hand, colonialism also brought about ethnography, documentation, and mapping of the social and material landscape of the northern Rio Grande region that is now retained in archival records for use by historians and other scholars. What we do know is that the cultural world of the Puebloan, Ute, Navajo, and Apache tribes was vastly transformed through Spanish colonialism. Forms of social organization and material techniques of production from indigenous and Iberian cultural milieus mixed in an uneven encounter between military forces and sociopolitical systems. In this historical context of expansionist colonialism, the emergence of modern capitalism, and the transition from absolute to parliamentary monarchical regimes in Western Europe, newcomers to the region and indigenous peoples— for all their difference—still found precarious common ground.

During the mid-fifteenth century the Tewa population of the lower Chama valley peaked along with the extent of agricultural watershed modification and the construction of large house villages. There was a marked shift underway regarding the extent of Pueblo development and population of village and field complexes in the lower Chama basin during the period of first contact with Spanish explorers in the late sixteenth and early seventeenth centuries. The precise reasons for the end of the general trend of population growth, agricultural intensification and village aggregation that had prevailed in the region since the thirteenth century are not entirely known. It is also not clear how the relations and dynamics between Tewa and other tribes, particularly the Ute, Navajo, and Apache, were unfolding prior to Spanish colonization.

Most sources argue that Utes, Navajos, and Apaches arrived in the Rio Grande and San Juan basins during the half century period of 1450-1500, although it is possible that the ancestors of these tribes were part of the Chacoan system and had returned after migrating elsewhere. The Comanches arrived during the seventeenth century, but they remained connected to the Great Plains and did not take up permanent occupation in the northern Rio Grande region. There is difficulty mapping out the exact contours of the pre-Columbian and early Spanish colonial social and ecological systems, but the degree of overlap (including contestations) in territory and resources, along with the sharing or transfer of knowledge of practices and technologies that were used to sustain communities, are evident in agricultural practices and architectural materials used by both the Athapascan and the Puebloan peoples. The Spanish *entrada* introduced new cultigens, livestock and forms of human settlement different from the past but these too were melded and incorporated into strategies of mutually beneficial exchange once competition over resource use subsided. (For location of Ute, Nabajoo, and Comanche territories in the late eighteenth century, see Figures 5A and 5B: Miera y Pacheco Map 1778 and also Figure 5C: Provincia de Nabahoo in Miera y Pacheco Map 1778.)

Convergence of Systems: Contested Terrain

One of the most significant changes in human-nature relations during the period of contact was the convergence of indigenous concepts and practices of land tenure with Spanish practices. The new systems enforced by the Spanish extended from Catholic traditions of divine natural law in which God granted the earth to its inhabitants in common. The Spanish Crown controlled which individuals and communities were granted lands, a duty that was often delegated to provincial governors. Community grants were organized around a number of commons: the church lands and *camposanto* (cemetery), the village plaza, the acequias and riverine areas, and the grazing and timber resources of upland forests. Laid out in irregular boundaries of metes and bound, the grants followed the natural contours of the land and encompassed essential resources for the building of agro-pastoral communities: irrigable land adjacent to watercourses; meadows in the uplands for grazing by livestock; forested lands in the upper watershed mountains for timber, wood fuel, hunting, and gathering of medicinal plants. As a further incentive, each *poblador* (settler on the grant) was provided with a *solar de casa* or plot of ground used to build a house and an adjacent *suerte* or long lot parcel of land to irrigate crops for family subsistence and hay production as winter feed for livestock (Carlson 1990).

The boundaries of the San Joaquín del Río de Chama grant closely followed Spanish settlement policies. In 1808 when Alcalde del Pueblo de la Cañada, Manuel García de la Mora,

reported his ceremony of grant possession to then Governor Joaquín Rael Alencaster, he indicated that "two leagues of irrigable land surrounding the proposed settlement of San Joaquín was available as farm land" (Ebright 2008: 108). In keeping with the grant decree of 1806 issued by the Governor, the remaining lands extending from both banks of the Río Chama were set aside as "common lands [to be] used jointly by the settlers for grazing and watering their animals and for gathering wood, herbs, and other resources of the land" (Ebright 2008: 108). As to metes and bounds, Alcalde García de la Mora described the grant in terms of its location on a canyon of the river, naming it "el Cañon del Río de Chama." He called out the boundaries as: "*Al norte el Rito de la Cebolla, al sur el Capulín, al este el lindero de los Martínez, y al oeste la Cejita Blanca*" [Cebolla River on the north, Capulín Mountain on the south, the Martínez grant (Piedra Lumbré) on the east, and "the *cejita blanca* (little white ridge) on the west"] (Ebright 2008: 108). The area designated by García de la Mora (eventually surveyed at 472,736 acres) by intent enclosed sufficient resources of pastures and watering places not only for use by the initial group of *pobladores* at the 1808 San Joaquín settlement but also to accommodate the arrival of new colonizers and the expected increase in population by way of their descendants. By 1832 the Gallina settlement was established on the opposite side of the Río Chama at the confluence with the Río Gallina (Ebright 2008: map 117). (Figure 6: San Joaquín del Río de Chama Grant Boundaries).

At the San Joaquín settlement, as elsewhere, each landowner in the grant had access to the outlying communal resources to insure tenure rights for the subsistence economy in a manner that encouraged practices of sustained yield, a system that was highly adaptive to the local environment and that favored conservation (Van Ness 1987; MacCameron 1994). As noted by Carlson (1990), agrarian planning reflected strongly the environmental realities of the Río Arriba region, where rough terrain, aridity and high altitude limitations on the growing season necessitated an integrated approach to colonization. Spanish officials and the settler groups overcame these physical barriers by implementing policies that were ecologically guided from the outset as expressed in the instructions for the development and occupation of newly discovered lands, codified in the Laws of the Indies of 1573 (Rivera 1998). The enactment of a commons ethic grounded in natural law ordered social life and material production. This often took organizational shape in the form of customs that varied across villages, particularly the coordination of water distribution according to local hydrographic and geographic conditions, the ritual processions and community gatherings, *ayuda mutua* (mutual exchange relationships), and the *rescates* or trade fairs with Utes and other indigenous tribes.

The first phases of Pueblo-Spanish contact produced what environmental historian Robert MacCameron (1994) characterizes as a form of the Columbian Exchange, a process that introduced plants, animals, and disease--Old and New World--but that also resulted in an exchange of material culture with distinct values relating to economic and social organization. The Spanish introduced new seeds, wheat, vegetables and the tools to modify the environment more substantially than had been the case before the encounter, and when combined with the introduction of livestock, the ecology of the region changed forever. Metal tools made possible the clearing of dense vegetation and cutting of woodlands along the rivers and into the steeper slopes for the cutting and hauling of forest timbers as construction materials for roof beams and to build bridges. MacCameron (1994) also points out that the agro-pastoral system of Hispanic settlers evolved into a successful strategy that sustained many small communities for generations

to come. Significantly, he concludes that: “[I]t was not only after the arrival of the Anglo-Americans into the upper Rio Grande valley and the introduction of commercial agriculture that changes in the land occurred in any dramatic fashion” (MacCameron 1994: 19).

In recent times, historians James Brooks (2002) and Ned Blackhawk (2006) have provided a revisionist view of early Spanish colonial history. They approach the encounter between the Spanish colonists and the indigenous peoples of the Rio Grande and San Juan watersheds as one between empires. Their analysis brings out the concept of these spaces as borderlands and contested terrain to the foreground, and it helps us understand the cultural and material story of the land grants of the Rio Chama frontier. The arrival of the Spanish settlers introduced a new claim on land and resources, this time in the name of the Spanish Crown, complicating an already multi-polar territorial contest. The animals, cultigens, and agricultural techniques of the indigenous peoples of the Rio Grande valley were influenced by a new set of livestock, crops and agricultural techniques brought by Spanish settlers and communities. Metal shovels, axes, materials and other tools enabled more intensive agricultural production through the expansion of acequias and the addition of various livestock to the primary indigenous staple of turkey and other wild game. The Spanish horse allowed for wider ranging and faster mobility of nomadic and semi-nomadic indigenous clans and tribes whether for hunting, seasonal habitation, or to procure more distant resources. Along with the introduction of firearms, these new plants, animals and technologies created additional possibilities for exploitation, conflict, or raiding the resources of other groups but also for production, cooperation and mutually beneficial exchange.

In the earliest phase of colonization (1598-1680), the Spanish relied heavily on conscripted Pueblo Indian labor and knowledge of the region to establish Iberian methods of acequia agriculture and for procuring materials to build missions and villages. The introduction of draft animals and the colonial organization of indigenous labor enabled the Spanish to expand the acreage brought into cultivation by irrigation along valley floors. This period also introduced a new form of social organization, the *encomienda* system of forced, unpaid indigenous labor and payments of tributes on grants issued to the Spanish elites, which created highly inequitable economic relations. For indigenous governance, in 1620 the Crown issued a decree that established secular officials in each Pueblo. The positions included a governor, *alcaldes* (who assisted the governor in general affairs), *fiscales* who focused on community lands and irrigation ditches, and *sacrisantes* who staffed and managed the mission’s church (Frank 2000: 9). While these posts were supervised by the Spanish colonial officials, they were filled by Pueblos chosen through internal decision making, and especially following the Pueblo revolt, they were controlled largely by a traditional tribal socio-religious order that exercised a significant degree of autonomy from colonial control and supervision. The native socio-religious order included *caciques*, war captains, and clan and kiva-based spiritual leaders (Frank 2000: 9).

Socio-Ecological Transformations

During the first century of Spanish colonial rule, the amount of land controlled by the Pueblos and cultivated on the pre-Iberian irrigation system was greatly reduced. The riverine pueblos along the Rio Chama and tributaries had been or were eventually vacated, and Spanish efforts to establish new settlements in the area would not get underway until the middle of the

eighteenth century after threats from raids conducted by Utes and Comanches were reduced. The number of Pueblo villages, and the lands these villages had access to, also declined. This was in large part due to the Spanish policy of claiming all lands for the Crown and then selectively redistributing them through grants to Pueblo tribes, *genízaros* (Hispanized Indians), as well as to *pobladores* of Spanish-Mexican settlers who petitioned authorities for grants of land not yet occupied by the Pueblos (Gonzales 2014).

Settlement growth and expansion in the Rio Chama basin essentially followed sources of water in a northwesterly direction fanning out from the confluence of the Rio Grande and the Rio Chama either alongside the floodplain of the Rio Chama or into valley bottomlands of tributaries with permanent or intermittent flows (Figure 7: Historic Settlement Pattern Along the Rio Chama). Mostly, this dispersal pattern was one of multiplying, not enlarging, established places. Initially, settlements consisted of small discontinuing clusters of *parajes* (encampments) and *puestos* (outposts) with family groups in charge of their own subsistence and defense (Quintana 1991). New ranchos and plazas were dispersed in a leapfrogging pattern, even though this made for less defensible settlements, resulting in a cycle of abandonment due to raids by Ute, Navajo, Apache and Comanche bands followed by resettlement after the raids subsided (Wozniak 1992 citing Swadesh 1974). In many cases, settlers ignored the instructions of Governors and Alcaldes to build fortified and walled villages of a grid-plan design; the decentralized *placita* of ranchos remained the settlement of choice in nineteenth century as the population moved northward into the upper Rio Chama watershed and valleys (Quintana 1991).

Perhaps the most significant but unstudied socio-ecological effects of the transformation of the landscape during the period of Spanish colonization was the replacement of the Puebloan watershed modification techniques and the concomitant social organization of labor and the built environment of the village with the Spanish acequia system. The Puebloan system of irrigation involved dispersed field complexes that spanned the riverbed, the surrounding hills that led up to mesas and tablelands, and even the tops of mesas. The common technique was to divert natural water courses and channel water to planted terraces and other land modifications. In contrast, the Spanish irrigation system followed the “Iberian *acequia madre* hydrological model” (Ansuetz 1998: 170). This method of canal irrigation focused largely around expanding the cultivatable land in the floodplain surrounding the river and the lands just above the floodplain, but did not extend to higher elevations. For social organization, the Rio Grande Pueblos did not rely on central authority to regulate water-use as had been the case at Chaco, and instead water allocation was carried out by ritual and custom more or less self-regulating. According to Moore (2004: 134), the “structure and distribution of agricultural sites suggest that the basic cooperative unit was small, perhaps consisting of nuclear or extended families.” When Spanish colonists introduced canal irrigation by diverting major river and streams, a more complex social organization was required to construct, operate, and maintain these systems. At this scale, small “corporate villages” provided the organizational basis for production, control and management of land and water resources (Van Ness 1987).

The transition to a different form of agriculture and the introduction of grazing animals altered the composition of ecosystems on a watershed scale, although the precise dynamics in terms of shift of species, introduction of new species, etc., are relatively unstudied. Moving from the land-as-sponge techniques of Puebloan agriculture (Ansuetz 2001) to the flood irrigation

method in acequia agriculture did not lead directly to erosion, but the shift did mean that the structures built by the Pueblos to slow runoff and catch eroded sediments and nutrients would slowly cease to function. Later in the nineteenth and into the early twentieth century when grazing and timbering expanded, the absence of these structures allowed for significant environmental changes that would have unfolded differently had the Puebloan watershed modification continued on its pre-Columbian scale after Spanish colonization. Emlen Hall notes that this transition also meant that the Pueblos pre-Columbian water rights were recognized by Spain, but “in terms of its own law, and not Pueblo practices” (Hall 2012: 75). Protected water rights were those connected to lands granted to the Pueblos by the Spanish regime as in the example of water from flowing springs on Pueblo grants which they were entitled to access (Hall 2012). Restricted by the Spanish imposed pueblo league, Pueblo natives lost access to their outlying ancestral lands, a change that created or intensified “the need for systematic and consistent irrigation networks and their maintenance (and coordination with Spanish neighbors) to extract a maximum return from a now fixed land base” (Snow 1981: 368).

The Pueblo Revolt and Aftermath

By the 1670s, Pueblo Indians had suffered significant population loss and impoverishment due to the *encomienda* system coupled with episodic conflicts with Ute, Navajo, Comanche and Apache tribes, drought and famine conditions, and European diseases to which indigenous people had not developed immunities (Poling-Kempes 1997). The Puebloan population decreased from 60,000-80,000 at the beginning of the seventeenth century to roughly 20,000 at the time of the Pueblo revolt in 1680. This sharp decline was largely due to smallpox outbreaks and the effects of dispossession by both Spanish and indigenous forces (Poling-Kempes 1997). These effects galvanized solidarity among the Pueblos. They rebelled in 1670 and drove the Spanish out of the upper Rio Grande downstream to El Paso destroying their fields along the ranchos and towns near Santa Fe (Vlasich 2005).

Although the Spanish were gone, the tools and horses they had introduced had become part of the fabric of Pueblo Indian subsistence practices. Apache, Navajo, and Ute bands likewise came into possession of large numbers of horses. This led to a change in the structure of both subsistence and social organization, as a higher degree of mobility and dispersion resulted in an egalitarian restructuring of group relations that created new networks of nomadic subsistence and exchange (Isenberg 2001). Also, the advent of the horse increased the occasions for raids, initially to acquire them from Spanish settlements, but then to launch raids further out into areas peripheral to the Chama basin. During the post-revolt period of 1680-1692, the Chama Valley was an invasion route used by the Utes to conduct raids of Taos, Picuris and other Tewa villages between San Juan Pueblo and Santa Fe (Wozniak et al. 1992).

Along with the Utes, Comanches also acquired the horse, and they too expanded their nomadic territory that ranged from Canada into modern day Kansas, Oklahoma, Texas, Colorado and New Mexico. Formerly living in small camps in the Rocky Mountains as hunter-gatherers, they used their equestrian skills to control the southern plains for almost two centuries as they engaged in the raiding of Pueblos and Spanish settlements in northern New Mexico while also participating at annual trade fairs hosted by these same villages. In 1777 cartographer Bernardo Miera y Pacheco developed a "*Plano Geográfico*" of newly discovered lands to the north and

west of the *Nuevo México* Province as part of the Escalante and Dominguez expedition where he located natural features such as mountain ranges and rivers, along with territories held by the Nabahoo, Moqui, Yutas and other indigenous people. To the northeast the map is void of details except a notation that this vast plain was: "*Tierra Incognita que poseen los Cumanchis: Esta Nacion es muy belicoso, y feroz se han hechos duenos de todos los Campos de los Zivolos desde los Yamparicas hasta la Provincia de los Texas*" (Unknown lands occupied by the Comanches: This Nation is warlike, savage [and] they made themselves owners of all the buffalo range from the Yamparicas to the Province of Texas). (Figure 8A: Miera y Pacheco Map 1777; Figure 8B: Miera y Pacheco Map 1777 Indian Homelands and Provinces; also see Figure 5B Miera y Pacheco Map 1778 for two locations of the Cumanchis Yamparicas and three other Comanche bands to the east in Texas.)

For the raids into the Rio Arriba, the Comanches were led by the legendary war chief known to the Spanish militia as Cuerno Verde (Green Horn). He was a prime example of the formidable "lords of the plains," Comanches who "raided Spanish and Pueblo settlements at will, carrying off captives, animals, and whatever else they wanted" (Lamadrid 1994). It took an army of united forces to bring about his defeat. In August 1779 Governor (Lieutenant Colonel) Juan Bautista de Anza forged an alliance of Spanish soldiers, militiamen and Pueblo Indian auxiliaries totaling about six hundred who gathered at San Juan Pueblo to plan a final campaign against Cuerno Verde (Kessell 2013: 142). They were joined there by other Pueblo warriors from the *Alcaldía de los Queres* plus two hundred Utes and Jicarilla Apaches along the route northeast toward the Arkansas River headed to the main Comanche camp in the plains of southeastern Colorado.

De Anza knew Cuerno Verde was massing for another assault on New Mexico (Kessell 2013). In a surprise attack the Comanches were forced to abandon their camp, and Cuerno Verde was cut off in an arroyo and died fighting alongside his captains, high priest, and other headmen (Kessell 2013; Eidenbach 2012). More than two hundred years later, the pursuit and defeat of Cuerno Verde is commemorated in folk plays that are still performed outdoors on horseback in places such as Alcalde and Ranchos de Taos, New Mexico. In "a stirring speech that many older Hispanos in the north can still recite," the Chief exults his warriors to once again get ready for battle, "*Que suene el tambor y pito. ¡Al baile, y punto de guerra!*" [Sound the drum and flute. To the dance, and ready for war!] (See *Los Comanches*, collected by Aurelio M. Espinosa, in Lamadrid 1994: 22-23.)

In a new, revisionist history of "the Comanche Empire," the Numunu or the Comanche people, as they became known later, are described by Powell (2014: 46) as "skilled tacticians and diplomats capable of mustering thousands of warriors at one time to advance their political and economic interests." Citing newly discovered panels of rock art by Severin Fowles and a team of archaeologists at a Comanche encampment in the Rio Grande Gorge west of Taos, Powell (2014: 47) notes that the Comanche presence in Texas and New Mexico dominated the region in terms of both trading and raiding of resources to the point that these Spanish-Mexican provinces "were virtual satellite states of Comanchería, more tied politically and economically to a mobile Native confederacy than to the government in Mexico City." In addition to trading horses and buffalo meat, Comanche bands also took captives when they raided Spanish settlements and Indian Pueblos alike. Brooks (2002) and Blackhawk (2006) both argue that the political ecology

of early borderlands society revolved as much around raiding for and trading captives as it did around the labors performed by Indians and poor settlers (for example, labor for acequia construction, agriculture, mining, village construction, and craft-making). While the Pueblo Revolt put an end to the extreme forms of the *encomienda* system, post-revolt borderlands societies continued to practice a “political economy of captive exchange [that] was not an alternative to violence but an assimilation of violence into mutually productive exchange relations” (Brooks 2002: 17).

During the period of the Pueblo Revolt, the Spanish had retreated to El Paso, but in the 1690s Governor de Vargas mobilized a reconquest that re-established colonial occupation and rule in the New Mexico Province. The *encomienda* system was abandoned as it was responsible for the excessive coercion that had driven the Pueblos to revolt, but a “*repartimiento de efectos* or *repartimiento de mercancías*” (distribution of goods) was still in place, through which governors of the territory and local *alcaldes* were able to extract tribute from the Pueblos in the form of goods and labor (Frank 2000: 25). In addition to abuses by secular officials, religious conversion was still the dominant policy, and Pueblo natives were conscripted in order to build the mission complexes that the Spanish friars operated with the goal of assimilating and educating the Pueblos into the colonial order. Sixty years after the end of the Pueblo Revolt, Pueblo natives were still providing good and services to the friars such as the forced contributions of wheat and maize, plus assigning women to cook, men to haul wood, and boys to help the missionaries with services and attend to other needs of each mission (Frank 2000). In the area of commerce, local *alcaldes* mediated between merchants and Pueblo communities, often extracting a tribute of crops from the Pueblo side of the deal. In addition to the crop tribute, two groups of ten men in each group were forced to maintain sheep and cattle herds for the governor in Santa Fe on a rotating schedule weekly, with alternating turns by Pueblos from the Rio Arriba and Rio Abajo. Pueblos were also obligated to supply five men and five women to the governor’s residence each week to haul wood and grind wheat and corn respectively (Frank 2000).

Eventually, the economic institutions that exploited Pueblo labor came to an end during the third quarter of the eighteenth century. In his account of this period Frank concludes that the burdens on the native Pueblos were lessened when it became difficult to transport large quantities of New Mexico’s commercial goods to Mexico at a time that coincided with “the increasing hostility of the Plains Indian tribes” (Frank 2000: 28). The most frequent raids on Northern New Mexico pueblos and villages were conducted by the Utes, Comanches and Kiowas. In contrast to Comanches and Kiowas, the Utes on the Chama frontier were in closer proximity to Hispano settlements and were among the first indigenous groups to acquire the horse. Blackhawk describes how the Utes transformed their society “by adopting the new technologies initiated by Spanish colonization, eventually carving out profitable roles within the colonial world. They became courted, feared, and powerful actors along this edge of empire and soon dictated the pace and scale of colonial expansion to the northwest” (Blackhawk 2006: 26). While the Utes still dominated the upper Rio Chama into the late seventeenth century, the Spanish concentrated on establishing settlements in the lower part of the basin. These attempts were unsuccessful as were most of the attempts made during the first half of the eighteenth century. The present day sites at Chamita and Hernández (originally San José del Chama), established around 1600 and 1714 respectively, were the first Spanish colonies permanently

inhabited northwest of Santa Cruz de la Cañada, the administrative center of the Rio Arriba. The Villa de Santa Cruz itself was founded in 1695 as a major land grant by Governor De Vargas twenty miles to the north of Santa Fe mostly as homesites and farms for new settlers from Zacatecas who could not be accommodated in the capital city due to a growing population and limited resources (Rivera 1998).

Northwest of Santa Cruz, the land grants of El Rito, Vega de Lobato, Plaza Blanca, Plaza Colorado, Tierra Azul, La Puente, Plaza de la Capilla and San José del Barranco were originally part of a vast grazing grant that was established in the 1720s. The grant was used for livestock grazing and was not settled until decades later. Members of the extended Martín-Serrano family established the Santa Rosa de Lima (Abiquiú) and Ojo Caliente grants in 1734 and 1735 respectively. According to Wozniak (1992), the first nonlocal Indian settlers of the upper Chama Valley were families who returned with Governor De Vargas between 1692-1695. Many settlers from this period claimed ancestral lands in the Chama Valley, and those who settled in the area occupied small scattered ranches. Most of these settlers were *españoles mexicanos* descended from Mexican Indians who had been acculturated to Spanish customs for generations (Wozniak 1992: 118; Swadesh 1974).

The early grant settlers along the lower Chama were unable to establish amicable relations with the regional Utes and Navajos and the raiding Comanche tribes from the east, and as a result their settlements were often abandoned and some residents were killed or taken captive by nomadic bands. At Santa Rosa de Lima (Abiquiú), established in 1734, the raiders carried off twenty-three women and children, forcing abandonment of the village until 1754. Ojo Caliente, north of Abiquiú, “also suffered captive raids and temporary abandonment” (Brooks 2002: 64). The Ute bands that had taken on a horse-enabled nomadic lifestyle were remarkably wealthy in comparison to other native and settler groups due to their use of their territories to graze and raise horses for trade and their ability to move across the Great Basin between the *Californio* settlements to the west and the *Nuevo Mexico* villages along the Rio Grande and tributaries. The bulk of trade was channeled through Abiquiú, where kinship and cultural networks unique to genízaro communities enabled trade and a tenuous mutual benefit between the Utes and Navajos and the Spanish and Pueblos during the mid-eighteenth to mid-nineteenth centuries (Brooks 2002). Genízaros were more successful at both fending off raiding parties of Utes and Comanches, and also at establishing trade relations, since they shared an indigenous background with these and other tribes such as the Navaho, Kiowa, and Apache. Most genízaros had been captured as children during intertribal warfare and subsequently “traded or sold to Hispanic settlers” where they often worked as servants, shepherds, or laborers and after conversion to Christianity, they learned the language and acquired Spanish surnames (Wroth 2004: 1).

It was not until the Spanish-Ute alliance of 1752 was established that the lower Rio Chama land grant communities became continuously inhabited. The alliance was negotiated at San Juan Pueblo, near the confluence of the Chama and Rio Grande, between Governor Tomás Vélez de Cachupín (who became the Spanish governor in 1749) and chiefs Don Thomas of the Ute, Chiquito of the Muachis and Barrigon of the Chaguagua (Blackhawk 2006). As described by Blackhawk (2006: 63-64), “[t]he 1752 accord brought immediate relief to northern New Mexico. Peace with Utes enabled Cachupín to repopulate the Chama Valley settlements of

Abiquiú, Ojo Caliente, Embudo, and Quemado” and also helped to jump-start many village economies by the resumption of Ute trade.

The Abiquiú grant was established by Governor Tomás Vélez Cachupín in 1754 as a genízaro settlement for 34 families and became known as the Pueblo de Abiquiú in reference to its historical connection to the Hopi genízaro Pueblo Indians of Tewa descent (Gonzales 2014). Poling-Kempes (1997) traces the movement of the Asa, a group of Tewa who headed west from the Rio Chama basin in the 1500s and established a new community on Hopi mesa. A group of the Asa also moved in with Navajo clans. In the early 1700s Franciscan missionaries convinced three hundred of the Asa Tewa from Hopi and Navajo tribes to move into missions at Jemez and Isleta pueblos, and it was from these groups that many of the genízaro settlers of the Abiquiú and Ojo Caliente land grants were drawn in the 1750s. “From 1752 until the end of the Spanish empire in North America, Utes and New Mexicans carved out a peaceful coexistence,” exchanging captives, chamois, buffalo skins, and items they had plundered elsewhere such as horses, muskets, shotguns, munitions, knives, meat, and other supplies (Blackhawk 2006: 71).

Abiquiú was a crucial outpost for Ute and Spanish survival, as both groups mutually benefited from trade in captives and resources. Blackhawk’s research has shown that, “[e]ventually such human exchanges enmeshed Ute and New Mexican societies to such an extent that linguistic and intercultural fluency blurred distinctions between ‘Indian’ and ‘New Mexican’.... linking the two into a common social landscape” (Blackhawk 2006: 71). The heterogeneous intercultural mixing, the preponderance of local custom, and “unruly” regional trade circuits emerged in the borderlands, a situation where the colonial centers in Spain, Mexico, and Santa Fe were relatively powerless to control the actions of the Crown’s subjects. Genízaros were key to the success of these settlements, many of whom often shared spiritual, kinship and exchange relationships with equestrian and Puebloan indigenous communities (Blackhawk 2006; Brooks 2002).

As described by Wozniak (1992): “[w]hat we have, then, is a culture whereby the concepts of time and space are an unavoidable accretion of Spanish, Tewa, Towa, Tiwa, Athapascan, Keres, and Kiowa, and many more people. While the informants speak Spanish, it should never be assumed that their entire cultural baggage is based solely on underlying Spanish roots” (115). The social relations of the borderlands was also a borderlands of systems of production, with trade fairs, such as those at Abiquiú, becoming a hub of mutually beneficial exchange between equestrian hunters and settled farmers. The customs that ordered social and material life would have varied greatly within and between communities. As the historian E.P. Thompson (1991: 97, 102) wrote in *Customs in Common*, “At the interface between law and agrarian practice we find custom. Custom itself is the interface, since it may be considered both as praxis and as law.... Agrarian custom was never fact. It was ambience.”

Despite the particularities of custom, the period from the early eighteenth to the late nineteenth century witnessed the expansion of a borderlands economy that resulted in two general trends. First, there were egalitarian developments in the social relations of production and distribution, as concluded by Isenberg’s study of tribes that invented their own forms of equestrian nomadic economic production and exchange. Specifically, Isenberg (2001) suggests that goods were shared more evenly throughout the tribes even as their wealth increased, with

property being held and redistributed in common so that no individuals became significantly wealthier than the rest. During this time, however, social inequalities were hardened between colonial elites, poor settlers, and Pueblo Indians. While most communities were living on a subsistence basis, there was a class of landowners who did not directly produce any goods through their own labor but gained wealth through exploitative labor relations with poor settlers and Pueblo Indians. Modernization initiatives which culminated in the Bourbon Reforms during the second half of the eighteenth century were implemented by colonial officials. The reforms targeted both land grant settlers and Pueblo Indians in efforts to bring existing trade, which occurred mostly in the form of barter of products, into the sphere of monetary circulation. This proved difficult as Spanish soldiers were the only persons compensated for their labor in money, while the vast majority of the regions inhabitants were engaged in subsistence practices. Farmers, craftspeople, and others were able to maintain some of their own products, often bartering these goods with others as opposed to selling their products as commodities and using money to purchase goods. The governor and alcaldes who held surplus goods often operated systems of credit for soldiers, settlers, and Pueblo Indians, who could pay their accounts in subsistence goods, labor or a combination of both.

Expeditions and plans were formulated in order to expand trade circuits and facilitate the connection of New Mexico to markets where money would be exchanged for goods in northern New Spain, opening routes from New Mexico to California and Louisiana. Ross Frank (2000: 120) writes that the late eighteenth century colonial economy in New Mexico “operated as a vast system for extracting foodstuffs and commercial goods for export,” and he quotes an 1803 economic report by then Governor Fernando de Chacón at length:

The internal commerce is carried out by twelve or fourteen merchants who are neither licensed, nor are they very intelligent in this department. Of these, only two or three do business with their own capital. All that the rest handle or introduce into the province is signed for [on credit], and in the same vein they distribute or sell [the goods] from one year to the other. This results in not paying back the money more than once a year, and with much loss and arrears in the collection of the credit accounts because they normally distribute [the goods] among the poorest people and at excessive prices. [This is] making more difficult the lack of money in circulation that has begun to be known for the last three years in the province. This situation still exists to a large degree, and in particular [among] the [Pueblo] Indians who do not value anything in money. (Frank 2000 citing the Governor Chacón report of 1803 at 120; brackets are in Frank’s excerpt.)

Frank notes that the end of the highly exploitative and inequitable *encomienda* system gave rise to a new system of mercantilism which in turn opened up “new economic opportunities brought by expanding production and a receptive market outside [and this] meant that enterprising New Mexicans could take up commercial practices previously reserved for the governor and alcaldes mayores” (Frank 2000: 121).

The Spanish colonization of the region had devastating effects on the Puebloan population. Already reduced to 20,000 in the late seventeenth century, by the end of the eighteenth century only 10,000 members of Pueblos were counted. The meager Hispanic population of less than 5,000 during the first half of the eighteenth century increased to nearly

20,000 during the second half of the century. This was due to both continuous immigration from the Iberian Peninsula and other parts of New Spain (Mexican Provinces) as well as the steady detribalization and Hispanicization of indigenous peoples as was the case with *genízaros*. The census efforts conducted by the Spaniards demonstrate the slipperiness of social categories as the same populations would be referred to variously as *colores quebrados*, *castas*, *coyotes*, *morisco*, *genizaro*, *mestizo*, *criollo* in different reports (Ebright 2005). Classifications were blurred by the relations that crisscrossed different ethnic and racial groups as part of the broader changes that were taking place in the contestations over territory and trade.

As the eighteenth century came to a close, changes in Europe and in the colonies disrupted Spanish control of the Rio Arriba. During this time the colonial system exercised less control over the frontier regions such as the Rio Chama. In places such as Abiquiú, where indigenous Pueblo, *genizaro* and Spanish settler communities were gathered on the edges of the territorial core of northern New Spain, Hispanos established mutually beneficial trade relations with different nomadic tribes. This is not to say that there was no longer any conflict and contestation over spatial and social boundaries, or that the Spanish colonial government did not seek to regulate and minimize these relations. The prevalence of customary arrangements upheld both exploitative relationships as well as new more egalitarian exchanges in both indigenous and settler communities, and sometimes between them. The events that led to the Mexican revolution in the early nineteenth century would not immediately impact life on the Rio Chama, but the political and economic changes under Mexico and the imposing presence of the U.S. under a policy of "manifest destiny" would soon bring major social, ecological and economic transformations to the region (Phillips 2011: chapter IV).

Chapter 3: Agricultural and Mercantile Expansion 1820-1912

The Spanish Empire's precarious hold on the province of New Mexico began to slip away during the first two decades of the nineteenth century. In 1821 Mexico achieved independence from Spain through armed revolution, and a new national constitution and policies were adopted in the decades that followed. These changes in governmental control were focused mostly in central Mexico, and the livelihoods of indigenous pueblos and land grant settlers in New Mexico remained largely unchanged. In contrast to the gradual agricultural expansion on the Rio Chama frontier, rapid transformations of metropolitan centers and their hinterlands elsewhere across the globe were resulting from the processes of production that would come to be known as industrial capitalism. While many of these transformations (automobiles, highways, electricity, and urbanization) would not reach the Rio Chama basin until the early twentieth century, they were already beginning to ripple through the fabric of social, human and natural systems in ways that we are still coming to terms with today.

Among the most significant innovations of the nineteenth century (most of which did not become widespread in northern New Mexico until early Statehood in 1912) were the exploitation of fossil fuels and the development of steam and combustion engines that ran on these fuels. Until this point the vast majority energy used to maintain the existence and expansion of human populations was driven by renewable sources fueled by the sun. Solar energy was transformed into grains and other crops that enabled humans to expend their labor power producing basic

goods. Likewise, animals were fed on pasturage and their labor power, meat, and dairy products (milk and eggs) were vital sources of energy for humans. With the advent of fossil fuel exploration, humans began to utilize the concentrated energy of terrestrial and marine life forms laid down in the earth between 150 and 350 million years ago. After the life forms (mostly peat bog forests and plankton in the oceans) died, they were preserved in oxygen-deprived environments and were transformed by geological processes into coal and oil.

Mexico and Early U.S. Transition

As to transformations in the Rio Chama basin, the period after 1821 began a gradual extension of settled territory now under the jurisdiction of the Republic of Mexico. Like Spain before it, Mexico continued the process of receiving petitions for land grants from its subjects. Abiquiú and surrounding villages had steadily grown in population, and many families began to utilize lands further upstream in order to relieve stress on the lands surrounding Abiquiú. Initially the uplands of Tierra Amarilla in the northern Rio Chama watershed were used for summer grazing and occasional timbering. Eventually Hispano settlers were attracted to the idea of creating permanent settlements in what was still territory for roaming Ute bands. Sheep grazing in these uplands had encroached on the Utes' winter hunting grounds since the eighteenth century, an intrusion not ignored by the Utes when they occasionally raided some of the sheep camps in retaliation. These actions served to increase tensions resulting in an outbreak of hostilities when exacerbated by incidents of exploitive trading practices by some Hispanic traders (Wozniak et al. 1992).

In 1821 and 1824 The Mexican government made explicit changes to land tenure arrangements, and in villages such as Abiquiú, this meant that individuals could alienate or dispose of their plots as they saw fit, while common property arrangements for the surrounding lands and irrigation water remained in force (Polling-Kempes 1997). Another liberal reform enacted by the Mexican government was to relax trade regulations with the United States. The trade with American merchants increased the use of cash that the Spanish Bourbon reforms were unable to bring about, but bartering continued to play a prominent role in the exchange of goods. In 1823, in response to the end of Spanish prohibitions on trade with the U.S. and other colonial powers, a flood of fur trappers and merchants from the east entered the northern Rio Grande region. Beaver and river otter furs were prized commodities among the increasing ranks of wealthy Americans and Europeans in urban centers. Dan Scurlock writes, "the large number of beaver methodically taken by the trappers caused a severe reduction or extirpation of local populations, as well as the river otter. Most regional streams have never recovered in terms of beaver populations reaching pre-1820 levels" (Scurlock 1998: 119-121). Scurlock states that in the mid-nineteenth century most game animal species (apart from buffalo) were still at the population levels that existed in the 1500s, but with the pull of Anglo markets, numbers would begin to decline from overhunting (Scurlock 1998). Large herds of livestock owned by wealthy Spanish and Mexican elites had led to overgrazing in the close vicinity of settlements in the Galisteo basin near Santa Fe, and forests were logged more intensively in these areas, but widespread overgrazing had not occurred, and the Rio Chama basin had not yet suffered any major environmental degradations.

Abiquiú, the largest village of the Rio Chama, grew in population from approximately 1,700 in 1789 to 3,500 in 1821 (Quintana 1991). In 1814, 1820, and again in 1824 settlers from Abiquiú made requests for a communal land grant in Tierra Amarilla, all three of which were rejected. While the claims made by the poor settlers of the village met with little or no recognition, Manuel Martínez, a wealthy Hispano elite with familial and class ties to government officials, was dignified with a positive response. Martínez had studied the property-granting regulations enacted by the Mexican government in the 1820s, and in the spring of 1832 he submitted a request to Governor Santiago Abreau for a private grant of the Tierra Amarilla lands. Abreau consulted the *Corporación de Abiquiú* which was the elected representative body of the frontier village. Correia (2013) points out that the *Corporación* supported the creation of a new settlement but only on the condition that it not approved as a private grant and that other landless petitioners should be included in the arrangement.

Martínez argued against having to give up his claim to private ownership, but the grant was eventually made for Martínez and other heads of households. The petitioners were issued private tracts along the lowlands while the rest of the surrounding natural resources were granted in common. Although the details of the grant made no mention of the fact that these lands were unavailable due to the Ute presence, this was certainly taken into consideration by the alcalde of Abiquiú, who chose not to travel to Tierra Amarilla to perform the rites of possession because of heightened conflict between Mexican militias and Ute bands. Settler groups off and on traveled to Tierra Amarilla to establish residence, but would be quickly driven back south due to their inability to overpower the Utes or to endure the harsh winters.

Hispanos continued to make unsuccessful attempts to establish permanent settlements in Tierra Amarilla throughout the 1830s. Even though the Petaca grant northwest of Ojo Caliente in the eastern stretch of the Rio Chama watershed created similar antagonisms in the years following attempts at Tierra Amarilla, the grant to the Petaca settlers was made in 1836. To secure the Chama frontier, the Mexican government continued to send settlers north, provoking hostilities through abrogating previous treaties and quasi-formal recognitions of indigenous possession of these territories. The rise in tensions and conflicting property claims was inevitable. The aim of the Utes and other nomadic tribes was clear: protect their borders, return to their seasonal camps as customary, and procure other resources found in their traditional homeland. Spanish-Mexican *pobladores* believed they too held valid claims on the land based on legal authority vested in provincial governors to distribute land not already occupied by Pueblos or other native people. Guided by these settlement policies, their goal was to acquire private property, a commons space for the benefit of all *vecinos* (citizen neighbors), and water resources to support crop agriculture and livestock production. Correia (2013) states that the 1830s was a period of a “ferocious war” between Mexico and Ute-Navajo bands who were conducting constant raids to prevent any further expansion of land grant settlements. In 1836 a Mexican militia responded with violence of its own by pursuing a Navajo party, killing twenty Navajo, and seizing more than five thousand sheep suspected of having been taken during a raid. Hostilities continued both ways into the next decade. “After Ute aggression against Mexican settlement accelerated in 1844, Mexican settlers abandoned every land grant village north of Abiquiú and west of Taos” (Correia 2013: 26-27).

Eventually, Mexico succeeded in resettlement of the once abandoned land grants, adding to those established under the Spanish colonial period. In the Rio Arriba and greater Chama district, dozens of grants were approved early in the colonial period and many others later during Mexican rule: Pueblo of San Juan, c. 1689, Santa Cruz de la Cañada 1694/1695, Pueblo of Santa Clara c. 1699, Bartolomé Sánchez 1707/1711, Sebastián Martín 1703/1712, Antonio de Salazar 1714, Town of Chamita 1724, Cristobal de Torres (1724), Bartolomé Trujillo 1724/1752, Juan Estevan García de Noriega 1735, Antonio de Ulibarri (Pueblo Colorado) 1735, La Barranca 1735, Plaza Blanca 1739, Plaza Colorada 1739, Juan José Lovato 1740, Town of Abiquiú 1754, Polvadera 1766, Ojo Caliente 1768/1793, Town of El Rito c. 1780, Piedra Lumbre (Pedro Martín Serrano) 1766/1806, Cañon de Chama (San Joaquín del Río de Chama) 1806, Juan Bautista Valdez 1807, Town of Vallecitos de Lovato 1824, Tierra Amarilla 1832, Petaca 1836, and Río del Oso (José Antonio Valdez) 1840 (compiled by Robert Torrez and Trapp 2010: 56-58).

The 1840s would bring increased military conflicts between Mexico, indigenous nations, and the United States, and settlers were unable to maintain permanent settlements on the land grants on the upper Rio Chama tributaries. The U.S. Army invaded and defeated Mexico in 1846, and General William Kearny declared that all property of Mexican citizens in the annexed territories such as New Mexico would be inviolably respected. Charles Bent, a former fur trader in the region, was installed as territorial Governor of New Mexico, but in 1847 an alliance between Pueblo and *Mexicano* leaders during the Taos Revolt unseated the Governor by removing his head, making clear the dissatisfaction of local people with the regime change. The 1847 revolt was violently suppressed, and in 1848, after lengthy debate, the Treaty of Guadalupe-Hidalgo was enacted officially ceding the vast northern territories of Mexico (now New Mexico and other southwestern states) to the United States.

Governmental restructuring of human-nature relations—largely through struggles over land-tenure—occurred slowly. The New Mexico territorial assemblies of the early 1850s reiterated that customary arrangements of land tenure, watercourses, taxation and trade developed under previous sovereigns would remain in force. The U.S. Office of the Surveyor General was established in 1854 to confirm property rights that were initially recognized in the Treaty of Guadalupe-Hidalgo, beginning a process of legal contestation over land that continues to this day. The U.S. wars on Ute, Navajo, Apache and Comanche tribes in the 1850s and 1860s enlisted militias of *Nuevomexicano* settlers enticed with the possibility of permanently controlling frontier grants such as Tierra Amarilla and Petaca. But these grants quickly faced another threat as wealthy Anglo land speculators, land and cattle companies, powerful lawyers, and politicians began taking ownership of land through a variety of political, legal, and economic shenanigans (see Correia 2013 for an update on the land grant wars of New Mexico and the violence that erupted at Tierra Amarilla during the 1960s).

One of the principal duties of the Office of the Surveyor General was to adjudicate ownership of property and regulate the flow of settlers onto lands with overlapping and contested claims. During this period, Anglo settlers as well as Hispanos who established their claims prior to U.S. occupation were engaged primarily in a subsistence farming economy. The more wealthy Hispanos farmed and herded on lands they owned themselves while most made a livelihood from the common property resources of land grants; others practiced sharecropping on lands owned by wealthy merchants, lawyers, land speculators and politicians. During the middle

and late nineteenth century, the population steadily increased in the Rio Chama region as it did throughout New Mexico due to the expansion of already existing settlements and the creation of new settlements under the Homestead Act of 1862. While the general practices of production remained largely the same as those of previous centuries, the intensification of grazing, logging, hunting, irrigated and dryland farming introduced unprecedented pressures on the resource base. The Homestead Act of 1862 provided a mechanism for increased Anglo settlement, and *Nuevomexicanos* themselves began to apply for homestead lots. The Act allowed settlers to gain access to 160 acres of land, and if they could “improve” the land over the course of five years (which was extremely difficult), they gained title to the land. In addition to homesteading, newcomers acquired land through purchase or exchange of services, the latter being common practice among lawyer-politicians who built substantial landholdings. Sometimes wealthy investors would pursue both routes, buying land and acquiring more than the legal amount of homesteading tracts, building what historian T. H. Watkins (1879) referred to as “fiefdoms the size of European countries.”

Railroads, Regulation and the Road to Statehood

With the arrival of the railroads in the late 1870s and early 1880s, pressures on land and other resources of the Rio Chama basin continued to build. The railroads entered the territory from the north and east, connecting small-scale agropastoral production to mercantilist networks, linking local products to regional markets, and bringing goods from across North America to the New Mexico Territory. The new possibilities for trade were controlled mostly by a few powerful merchants alongside ranching corporations that were developing monopolies on grazing lands especially around the lush environments of the Tierra Amarilla land grant. (Figure 9: Tierra Amarilla and other Land Grants in Rio Arriba County)

Frank Bond, one of the region’s dominant entrepreneurs, centered his mercantile and sheep-dealing “fiefdom” in Española starting in the late nineteenth century when New Mexico was still a frontier territory. Bond controlled the majority of grazing lands in the Rio Chama district, which had been significantly reduced due to Forest Service grazing limitations. Bond employed many local villagers as contracted *partidarios*, a situation in which he controlled access to land and doled out sheep to individuals who once indebted to him, often remained indebted for the rest of their lives. As the *patrón* in this *partido* production, a system dating to fourteenth century Spain, a large sheep owner would rent ewes on credit to local sheepherders, the *partidarios*, who then built up small flocks of their own by splitting the new born lambs and any surplus wool yearly in accordance with an agreement that most of the time benefited the original sheep owner (Correia 2013). The *partidarios*, on the other hand, assumed the inevitable risks of sheep mortality resulting from predation or disease, and when they were not able to meet the terms of their contracts due to losses, they were still obliged to pay off their debts to the *patrón* “by entering into contracts with increasingly more onerous terms” (Correia 2013: 61). Bond continued his *partido* sharecropping enterprise into the 1930s. In 1935, a government study funded by the Land Program of the Federal Emergency Relief Administration concluded: “[a]pparently it is essential that the renter remain in debt to the company; otherwise the mechanism of control is impaired” (Tewa Basin Study 1935: Vol. III, 147). In the face of rampant and severe exploitation, many villagers began to migrate to surrounding agricultural and industrial centers to join the growing ranks of the wage-labor force.

The intensification of grazing and timbering operations began to impact land-health, and the burgeoning fields of forestry and watershed management became increasingly focused on environmental problems. Environmental degradation was a matter of concern for early figures of the conservation movement. In 1864, George Perkins Marsh published *Man and Nature*, one of the most extensive studies of human-nature interactions attuned to the possibilities for degradation inherent in dominant modes of development. Marsh's work was influential, as it drew attention to a potential Achilles heel of Manifest Destiny. By the late-nineteenth century, a conservation movement had emerged, and impetus was put on creating a national platform to support but also regulate increasing settlement of the Western states and territories.

During the first decade of the twentieth century, governmental institutions concerned with managing human-nature relations began to take shape and exert a formative influence nationally. A number of organizations responded to the call for conservation, and a National Irrigation Congress (NIC) was created to advocate for settlement and reclamation projects. In 1895 the second session of the NIC was held in Albuquerque. By 1902 the NIC had succeeded in passing the Reclamation Act through the U.S. Congress. The Reclamation Service, the Forest Service, and a variety of university-based programs set out to address the problems that had arisen from exploitation of natural resources. The Rio Chama basin and surrounding lands were no exception. Steady population increases were sustained during the late-nineteenth century, which continued into the first decade of the twentieth century. With statehood for the New Mexico Territory looming on the horizon, population growth was encouraged in hopes of ushering in the next stage of political and economic development that would profoundly alter human-nature relations throughout the region.

Reclamation Service work had prompted initiatives to establish comprehensive water laws throughout Western states and territories. The land grant acequia communities of the upper Rio Grande watershed had maintained customary practices of *repartimiento*, or communal water sharing agreements under U.S. rule, but increasing claims on water led to competition, shortages, and conflict. At a train stop in Deming on May 6, 1901, President William McKinley advised New Mexicans that they would have to wait for statehood. New Mexico would need "more water and people" if the territory were to be worthy of incorporation into the Union (Holtby 2012: 72). But for many *Nuevomexicanos*, the influx of new settlers in the second half of the nineteenth centuries had already caused duress due to the passage of territorial laws that favored large-scale irrigation projects aimed at growth and development that endangered water rights of Hispanos and Pueblos (Baxter 1997). For instance, in the late 1890s Hispano and Pueblo farmers were named as defendants in a lawsuit brought into territorial court by the newly formed Albuquerque Land and Irrigation Company. According to Baxter (1997), the company intended to construct a system of reservoirs, canals, ditches and pipelines to provide water supply for irrigation and colonization on undeveloped lands following the passage of the Incorporation Act of 1887, but the company had not yet acquired any water rights on the fully appropriated Rio Grande. The main canal would run some thirty-five miles from just below San Felipe Pueblo to near the Pueblo of Isleta, a route that would require condemnation of property owned by scores of Pueblo and Hispano farmers. Hispano irrigators and their Pueblo neighbors at Sandia and San Felipe forcibly ejected the company surveyors "at gunpoint" when they began plotting the route for the canal (Baxter 1997: 94). Attorneys for the company filed two lawsuits seeking

injunctions in district court to prevent any further interference with the survey work in progress. The injunction against the defendants was granted, and upon appeal to the territorial Supreme Court, the ruling was reaffirmed (Baxter 1997).

From 1848 to 1912 New Mexico's inhabitants had remained under territorial control of the United States Congress, without representative democracy or full rights of citizenship, at a time when other Western territories were admitted into statehood without as much delay. The arrival of the railroad in 1879 spurred the entrance of U.S.-Anglo finance and industrial capital in New Mexico. Despite assurances from the United States government that the 1848 Treaty of Guadalupe Hidalgo would protect the property rights of former Mexican citizens, Anglo-American law often exploited the Hispano farmers as stockmen from west Texas encroached on the land grants to expand their own livestock and ranching enterprises. Land grant communities were widely dispossessed by unscrupulous newcomers who filed land claims in compliance with United States property rights written in English that descendants of the original settlers knew little about and did not understand (Rivera 2010). Land speculators, lawyers, judges, politicians and bankers formed alliances and acquired large portions of the Spanish and Mexican land grants by paying nominal sums or other land-grab schemes of questionable legality. This practice increased during the 1880s, when Anglo ranchers sought additional land and water resources for the grazing of their cattle. Hispanos with small flocks of sheep competed with Anglo land and cattle companies for the pastures in the high mountains such as in the Chama watershed, resulting in conflicts that at times escalated into violence. Some Hispano sheep growers eventually lost their flocks to repay debts and subsequently became sheepherders for the larger ranchers in the region or migrated to other ranches in Colorado and Wyoming (Rivera 2010).

Mercantile Economy and the Environment

In 1891 the Court of Private Land Claims was established to resolve the lingering property disputes that had not been resolved by the Surveyor General. But by the end of the first decade of the twentieth century, land grant communities retained only a fraction of the land initially granted under Spain and Mexico. The common lands of the Rio Arriba land grants were acquired by land speculators such as Thomas Catron and Thomas Burns (Correia 2013: chapter 2). The ascending mode of mercantilist commercial production began to incorporate and displace the modes of production practiced by Hispano land grant settlers and Pueblo Indians alike as encroachment restricted their land base and access to former commons in the forests. The Forest Reserve Act of 1891 withdrew large portions of the public domain from community land grants to create the Santa Fe National Forest in 1892 and the Carson National Forest in 1904; millions of acres were granted to the New Mexico Territory for the support of public education (Rivera 2010). With land losses throughout the region but the availability of jobs in new industries, the native population became a significant part of the low-wage working class. The American cash economy necessitated their entrance as migrant and seasonal workers into the labor markets in mining, ranching, railroad construction, commercial agriculture and resource extraction operations in the region. This seasonal labor was paired with what limited farming, grazing, and timbering that Hispanos could conduct on their own remaining lands. Some workers migrated farther out to the more productive mines of Cripple Creek west of Colorado Springs, the sugar beet refineries in Grand Junction and Fort Collins to the north, and later the mining camps of Bingham Canyon in Utah (Rivera 2010).

The intensified exploitation of natural resources under this new regime of production led to environmental degradation through the clear-cutting of forests, overhunting of keystone species such as the beaver, and overgrazing of grasslands and forest meadows. Together these practices created conditions in which erosion reached unprecedented scales, washing nutrient rich soils out of the steeper uplands and creating aggradation and flooding in the lowlands. The threat of environmental degradation and the loss of commercial profits increased the role of the federal government in regulating resource exploitation in New Mexico. In the first decade of the twentieth century a number of agencies were formed to carry out these resource management tasks. The United States Forest Service (USFS) was created in 1905, and the Carson National Forest absorbed much of the common timber lands of Rio Arriba communities. In 1908 Gifford Pinchot oriented Forest Service policy towards “sustained yield,” which meant the greatest possible harvest over the long term achieved through “scientific forestry” (Kosek 2006: 78-79). Initial activities of the USFS included making more detailed maps, surveying potential yield, and trail cutting. Although commercial access to the forest was regulated by the USFS, agency policies largely excluded subsistence access by land grant communities, which ultimately led to the preponderance of large-scale commercial activity over subsistence harvesting (Figures 10A: Denver and Rio Grande Railway 1873 and 10 B: DRGR 1873 Abundant and Heavy Timber).

In addition to timbering, public domain lands on the national forests were also opened to homesteaders with passage of the Forest Homestead Act of 1906 by the U.S. Congress. The Act was based on the prior U.S. Homestead Act of 1862, but in this case Forest Service lands deemed chiefly valuable for agricultural purposes would be made available through the U.S. General Land Office to prospective homesteaders (Valdez 2016). Applicants were a mixed group of Hispanic and non-Hispanic settlers and included Hispanos who formerly had occupied land grant properties prior to the transfer of those lands to the public domain. For these individuals, they shifted from a communal village economy based on mutuality to the Anglo-American value that promoted rugged individualism and a nuclear family structure. Homestead tracts were limited to not larger than 160 acres located on a grid map called the Section-Township Range system, a land subdivision different from the community land grants that were more expansive in order to include access to the grazing and timber resources of the commons. As featured in the Valdez (2016) map of the Santa Fe National Forest, hundreds of homestead claims were situated on the southwestern boundaries of the middle Rio Chama to include sites associated with Cañones, Youngsville, Coyote and Gallinas. (Figure 11: Santa Fe National Forest Homesteads, Act of 1906)

In the remaining period as a territory, the Office of the Territorial Engineer was established to regulate the distribution of water. In 1907, the first Water Code for New Mexico reconfigured the customary control of irrigation water within the Doctrine of Prior Appropriation (DPA). The DPA holds that first in time is first in right, and that in times of shortage, water is distributed to earlier claims while later claims are junior and go without. The important difference to traditional *repartimiento* is that the DPA operates based on individualized claims with equitability being a secondary concern, while acequias distribute based on communal arrangements to ensure equity and fairness (Rodríguez 2006). With admission to statehood in 1912, the Territorial Engineer became the State Engineer, and a comprehensive water code was established based on the DPA. The State Engineer consolidated all of the surveys of water use

that had been conducted and continued to document existing uses while approving new appropriations of surface water (groundwater was not incorporated into regulatory oversight until the 1950s).

Meanwhile, the regional cities of Española and Albuquerque began to grow at unprecedented rates. Modern day Española was established with the arrival of the railroad in 1880, located between older land grant and pueblo communities at the confluence of the Rio Chama and Rio Grande. The Denver and Rio Grande Railroad built a line of track from San Antonio Junction, Colorado into New Mexico to connect with railroad stations built at Tres Piedras, Embudo, and Española, resulting in the nickname “The Chile Line” (Rivera 2010). Eventually, the railroad linked Española, Santa Fe, Chama and other northern New Mexico towns with Colorado destinations such as Durango and Silverton to the northwest and Pueblo and Denver to the northeast (Figures 12A, 12B, 12C: Denver and Rio Grande Railway 1881 with Chile Line and Minerals). Roughly one hundred miles south of Española along the Rio Grande, new town Albuquerque was formed with the arrival of the railroad in 1880 a few miles east of the *Villa de Alburquerque*, now Old Town (which had been granted to settlers by the Spanish government in 1706). Aided by rail transportation, these cities in Colorado and New Mexico became major centers of regional commerce as resources passed from the rural areas to urban markets across the continent. Although Española was much closer to other Rio Arriba communities, population growth in Albuquerque would have just as significant effects on the distant Rio Chama watershed following the economic restructuring that took place after World War II.

Chapter 4: A Century of U.S. Statehood, People and Water 1912-2012

New Mexico was granted statehood in 1912, completing the official process set in motion by the Congressional Enabling Act of 1910. In his book on the *Forty-Seventh Star*, Holtby (2012) recounts the words of U.S. President William H. Taft as he signed New Mexico into the Union making it the forty-seventh State:

Early in the afternoon of Saturday, 6 January 1912 thirteen guests from New Mexico joined President William Howard Taft in his private office.... [A]t 1:35, when the president signed the proclamation approving New Mexico's entry into the Union....Taft spoke but two sentences: "Well it is all over [:] I am glad to give you life." Pausing to smile, he added: "I hope you will be healthy." (Holtby 2012: 259).

Taft's statement pointed to the widespread aspirations that statehood would bring about an increase in prosperity and well-being to a region that was relatively impoverished compared to most of the other states already in the union. Taft had been the last of fifteen presidents to preside over New Mexico as a territory under the United States, and finally, after six decades of political struggles, New Mexico had attained self-rule (Holtby 2012). The exclusion from national political processes had limited the ability of *Nuevomexicanos* to influence decisions made about natural resource use during more than a half century as a territory. With the transition to statehood, many of these limitations did not disappear, although they did shift.

The Constitution of the State of New Mexico contained a Bill of Rights and a number of articles that specifically concerned human-nature interactions. Article II, section five recognized the validity of the Treaty of Guadalupe-Hidalgo with Mexico, holding that the treaty rights and privileges, including those that guaranteed land and water rights, “shall be preserved inviolate.” Article IV, delineating legislative powers, contained section thirty-eight, “Monopolies,” which stated that the legislature “shall enact laws to prevent trusts, monopolies and combinations in restraint of trade.” Article XVI, “Irrigation and Water Rights,” recognized all existing water rights and determined that unappropriated waters were subject to appropriation under the conventions of the Doctrine of Prior Appropriation. Together these components of the Constitution seemed to outline the means by which the rights of traditional Hispano and Pueblo communities could protect their natural resources. Reality, however, is often much less tidy than the abstract legal rationalities designed to order it, and the law itself can be quite arcane.

Despite the protections implied in the New Mexico Constitution of 1912, the overarching power of federal agencies over the control of public lands, especially by the Forest Service, remained in force. The U.S. Supreme Court decision on the *U.S. v. Sandoval* case in 1897 had held that lands granted in common by Spain and Mexico were still the domain of the sovereign, now the United States as the successor government. As such, the court held that much of the common grazing and timber lands of land grant communities came under the Public Domain as a result of the U.S. Conquest. With the formation of the Forest Service, most of these lands fell under its jurisdiction and could be accessed through a public permitting process but not through traditional common rights of pasturage and harvesting of forest products. The effect of this decision and the rise of the Forest Service as a regulatory agency further excluded Pueblos and Hispanos from their traditional resource base and began to change the ways in which these villagers secured a livelihood. Migratory wage labor and the system of sheep sharecropping operated by regional mercantile and livestock companies soon became the predominant opportunities for work outside of the subsistence economy of communal land grants.

Partido Sharecropping in the Regional Economy

For many heads of households residing in the Rio Chama Valley, the Frank Bond Company, established in Española in the late nineteenth century, was the dominant source of employment and mediator of human-nature interactions during the early decades of the twentieth century. Sheep raising and wool production had been the mainstay of New Mexico’s economy throughout the territorial period and continued into the 1930s as did the practice of sharecropping under contracts with large companies (Holtby 2012). As noted by a group of authors who contributed to the Tewa Basin Study sponsored by the United State Soil Conservation Service in 1935:

We are accustomed to think of sharecropping as a consequence of slavery in the South, and economic system which needed slavery as its forerunner. This is a prevalent notion, and only a half truth. It might be more correctly considered that sharecropping was a logical result of the plantation system minus the formal relationship of slavery. In other words, it was not the previous existence of slavery that produced this particular form of economic organization but rather the circumstances of land monopoly plus the existence of an under-privileged group (Tewa Basin Study 1935: Vol. III, 141).

As a comparison to the post-slavery South, the authors also observed:

[W]e find a situation equally favorable to the development of a sharecropping system in the sheep industry in New Mexico. There is a virtual monopoly of grazing lands, and side-by-side with it a large under-privileged group—the Spanish-Americans (Tewa Basin Study, 1935: Vol. III, 141).

The Tewa Basin Study noted that the bulk of the land in New Mexico, specifically grazing and forest land, was held in public ownership. In theory these lands were open to public use, but the practical relations that existed were such that the vast majority of use-rights to these lands were granted to a few wealthy livestock barons. Among these barons, the Frank Bond Company was the largest grantee in the Tewa basin region where the Bond operated a sheep sharecropping system known as the *partido*. Despite the existing guidelines that limited the amount of sheep that could be sustainably grazed on national forest permit lands, the Bond Company and other monopoly firms enjoyed the fact that “permits have been allowed in the national forest in excess of the theoretical limit allowed any single sheep owner” (Tewa Basin Study 1935: Vol. III, 142).

By the 1930s the Frank Bond Company had strategically acquired grazing lands with access to streams, springs, and other water sources, creating a checkerboard of land throughout the Rio Chama-Rio Grande confluence region. This served, “[a]ccording to the statement of a well-informed sheepman—general manager for all of Bond & Nohl holdings—each actual purchase of land is designed to control an area approximately ten times as large, offering grazing rights without the cost of grazing fees or taxes” (Tewa Basin Study 1935: Vol. III, 145). By maintaining properties in this way, a few elites established control over lands that Pueblo and Hispano communities had depended on for their livelihoods. By taking control, the Bond Company allowed access to sheepherders, but on condition that they would deliver a set amount in pounds of lamb back to the company each year. This was typically done with sheepherders who already owned small flocks of sheep, which would serve as collateral to guarantee a return on the equivalent number of sheep the Bond Company would lease them.

In addition, the Bond Company owned a store that outfitted the small sheep operator on terms dictated by the company through extension of high interest credit that caused indebtedness to mount. At the time of the Tewa Basin Study, “all except three of Bond’s renters [were] heavily in debt to the company, so that at the end of each year they have gained nothing but a bare subsistence” (Tewa Basin Study 1935: Vol. III, 147). Remarking on the indebtedness perpetuated under this system of sharecropping, the Tewa Basin Study noted it did not take long for the sheepherders to “owe their labor for the rest of their lives for the privilege of a meager livelihood” (Tewa Basin Study 1935: Vol. III, 147). Although a few Hispanos with large sheep ranches in the Rio Abajo did profit from the system (Holtby 2012: 141), for most households with small landholdings in the Rio Arriba, sharecropping did not provide adequate economic support, a condition that led to outmigration from the rural communities along the Rio Chama in search of employment in the urban centers such as Pueblo and Denver in Colorado to the north and some to the downstream city of Albuquerque.

Flooding in the Rio Abajo and the Middle Rio Grande Valley

During the territorial period, the important towns in New Mexico had been concentrated in the Rio Arriba district at locations such as Santa Fe, Las Vegas, Española and Taos. The effects of the Great Depression and World War II, however, favored population growth along the wide floodplain of the Albuquerque Valley in the Rio Abajo (formerly the "*Alcaldía de la Villa de Alburquerque*" and now the Middle Rio Grande region) as the place to centralize economic development, build highway infrastructure, and make other investments in military and defense industries operated by the federal government. Similar to the northern Rio Grande, the ecosystem in Middle Rio Grande had been affected by human impacts over centuries of use by multiple societies in the pursuit of hunting, gathering, farming, ranching, logging and mining, and later, the impact of travel and tourism (Wozniak 1995). Unlike the benign economy of Pueblos and Hispanos based on subsistence farming and agro-pastoralism, however, Anglo-Americans introduced a new, commercial economy based on exploitation of minerals, grasslands and forests that "altered settlement systems, land use patterns, and the utilization of natural resources" (Wozniak 1995: 35). The arrival of the railroad in 1880 transformed Albuquerque and the surrounding area and made possible the start of commercial agriculture. As noted by Wozniak: "The emergence of large scale sheep and cattle herding had significant impacts on ecosystems of the Middle Rio Grande Basin, particularly on soils, native vegetation, and water resources" (1995: 35).

Increased production on extended irrigated acreages during the 1890s and subsequent decades brought about aggradation of the Rio Grande along with waterlogging of fields in low-lying portions of the valley (Wozniak 1995). During the early twentieth century, the Middle Rio Grande Valley was constantly subject to spring and summer floods. Flood events took two predominant forms corresponding to the watersheds bi-modal precipitation regime: the first being the result of snowmelt runoff in the spring, and the second being the result of monsoons rainstorms during the summer. For centuries the floodplain had been shaped and re-shaped by annual flooding, which was crucial to creating nutrient-rich silt, soil and riparian-floor compost deposits along the valley, and also vital to the regeneration of cottonwood forest. Between 1591 and 1942, eighty-two floods believed to have exceeded 10,000 cubic feet per second occurred on the Rio Grande (Scurlock 1998: 32). These floods were common enough that acequia farmers of the Middle Rio Grande Valley expected to have to rebuild diversion dams and other components of their acequia systems from year to year as the river washed out the dams or shifted course. Sometimes entire field complexes and ditches would have to be reconstructed after massive floods and streambed shifts.

Of the eighty-two recorded floods over the last four centuries, fifty of those floods, or roughly sixty percent, occurred during the ninety-three year stretch from 1849-1942. Flooding was becoming more common due to environmental pressures that were building across the Rio Grande watershed (Scurlock 1998: Table 17-Historic Rio Grande Floods 1591 to 1942, 33-38). Increased irrigation diversions from the headwaters of Rio Grande in the San Luis valley of Colorado lessened the capacity of the river to push sediments through the slower flowing stretches of the Rio Abajo. This was compounded by the increased erosion resulting from overgrazing and logging that had expanded following the arrival of the railroad and corporate resource extraction. Erosion increased the rate of riverbed aggradation, or increase of elevation

due to sedimentation. Floods also increased in frequency because the deterioration of grass and forest lands had reduced their capacity to slow runoff and absorb water. The threat of flooding made urban development difficult and farmers were often devastated by the transformation of once fertile land into swamps. These lands also suffered from alkalization due to the evaporation of water after flooding and swamping, which left the lands dry but at the same time left behind condensed alkali salts from the relatively saline river water (Phillips et al. 2011: chapter 5).

Throughout the early twentieth century, farmers from the Hispano land grant villages of the Middle Rio Grande Valley had to vacate their swamped and alkalized lands and find a means of subsistence or wages elsewhere. Meanwhile, a large array of city boosters, bankers and speculators, small and large farmers, engineers, and politicians began to create interest groups and organizations to address what commonly became known as the “flood menace.” One of these groups, the Rio Grande Drainage Association, organized in 1916, rallied around the motto “United we drain, Divided we drown.” The organization was composed of an Executive Board of landowners from Bernalillo, Sandoval, Valencia, and Socorro Counties, and they networked with other civic associations, college professors, representatives from the New Mexico State Engineer’s Office, the U.S. Department of Agriculture, and other government institutions. (See Middle Rio Grande Conservancy District Archives, Section 2, Row 3, Bin 5, Historical Correspondence)

Local political and economic elites gathered one hundred signatures in support of the Conservancy Act, which was passed into law during the 1923 session of the New Mexico State Legislature. The law created the Middle Rio Grande Conservancy District (MRGCD) which was tasked with draining swamped lands, providing flood protection for urban and rural areas, as well as the modernization of the acequia system which at the time was comprised of seventy-two community ditches in the two-hundred mile stretch between Cochiti pueblo in the north and the village of San Marcial in the south. The acequia diversion dams (mostly brush and rock structures) on the Rio Grande were removed in favor of a few modern structures to be controlled by engineers at a district office in Albuquerque. Although improvements in some form or another were desired by nearly all the valley’s residents, protests began immediately because small farmers had no representational means of ensuring that the MRGCD would be accountable to their concerns; yet, they were nonetheless subject to burdensome taxation (Phillips et al, 2011: chapter VII). For the new conservancy district to succeed, acequia water users had to relinquish control of their canals and submit to a centralized administrative authority and their “ditch riders.” These hired employees replaced the *mayordomos*, a central figure in the self-government of the centuries-old tradition of acequias. Management of the acequias, now incorporated as laterals of the conservancy district, shifted to MRGCD officials and their staff of engineers and other professionals (Rivera 1998).

Protests and negotiations between various interest groups, politicians, and MRGCD officials continued for decades, and the District began work at the onset of the Great Depression in 1930. One major project of the District was the construction of the El Vado reservoir on the Rio Chama a few miles southwest of the village of Tierra Amarilla. The reservoir was designed to store water during peak flows of spring runoff that would then be released to supplement flows during dry periods that regularly occurred in late summer. Construction of the dam was completed in 1935 with the help of New Deal funding. During the early 1940s, preliminary

plans were outlined for the creation of an inter-basin tunnel which would bring water allocated to New Mexico under the Colorado River compact that had been ratified in 1922. While there was serious consideration of using New Deal funding to create this enormous public works project, it would be decades before it actually got off the ground during the 1960s with construction of the Azotea Tunnel and Heron reservoir near the Town of Chama.

Together with the completion of the Elephant Butte reservoir in 1914, the establishment of the MRGCD and construction of El Vado dam in the early 1930s raised concerns from downstream users, especially in Texas and Mexico. Between 1928 and 1938 an interstate and international process of negotiation led to Congressional approval of the Rio Grande Compact in 1939 that divided its estimated flows between Colorado, New Mexico, Texas and Mexico. The Colorado River Compact had been signed by seven western states in 1922, and its waters were similarly allocated, creating the legal basis for the future diversion of New Mexico's share of the San Juan River into the Rio Chama.

In 1943, the University of New Mexico published *Man and Resources in the Middle Rio Grande Valley*, an interdisciplinary study (Harper et al. 1943) organized under New Deal agencies that were researching the economic conditions of the United States. The report sought to address and provide recommendations for resolving the varied problems identified as the central social and environmental ills affecting the Middle Rio Grande Valley, a region they located within the "mountain masses seen from four points on the river: Socorro, Albuquerque, Española and Taos" (Harper et al. 1943: 3). The report noted that despite the efforts of the Middle Rio Grande Conservancy District, aggradation of the riverbed had only increased during the 1930s. The authors pointed to overgrazing and the denuding of upper stretches of the watershed as the main drivers of aggradation, providing the following details about the Rio Chama as one of the principal tributaries of the Rio Grande in the Middle Valley:

Rio Chama Watershed: On the *high timbered areas*, vegetative depletion is less than twenty-five percent, with local areas suffering from overgrazing, fire and excessive logging. Nevertheless, little soil removal has occurred and surface run-off and silt production are low.

On the lower elevation of *woodland*, vegetative depletion is about thirty-five percent. Soil movement is high from soil structures formed from shales, sandstone, and limestone, and considerable silt and surface run-off are discharged over cultivated land adjacent to the Chama's stream channel.

On the still lower elevation of the *tablelands*, soil removal is proceeding at a high rate. Surface run-off and silt production are high.

Cultivated lands along the main stream are suffering from bank cutting and damage by the deposition of stones, gravel and silt by side drainages.

Additional details would extend but not change the picture of present conditions on the 3,117 square miles of the Rio Chama's watershed, which are producing erosion, soil removal, irregular stream flows, rapid run-off and a contribution of 3,700 acre-feet of silt to the Rio Grande every year (Harper et al. 1943: 44).

The authors pointed out that the area encompassing the Chama, Tewa-Taos and Jemez watersheds had an optimal carrying capacity of 44,000 "animal units year long," but presently,

stocking was estimated around 71,000 (Harper et al. 1943: 50). Another troubling aspect of the Chama's environmental health (or lack thereof) was the effect that post-1880 lumbering operations had on the region: "[t]he area was so clean cut that today it has the appearance of grassland, rather than of the Ponderosa pine area it once was" (Harper et al. 1943: 55).

The study also noted that the effects of the Great Depression in New Mexico were amplified through the deteriorating environmental and social conditions that existed prior to the 1930s. The authors identified the "principal forces" that they concluded had transformed life in the Rio Grande Valley north of Albuquerque: "American occupation of New Mexico—political, social, economic—introduced a new land policy, commercial agriculture (including dry-farming), commercial livestock operations, a trade and money economy, and a rapid, large-scale immigration of newcomers" (Harper et al. 1943: 59). These transformations created unemployment, impoverishment, and land degradation for the rural population, which had only been compounded by the Great Depression. Like the Tewa Basin Study, which was conducted earlier through New Deal programs, the authors of *Man and Resources* criticized the *partido* system of livestock sharecropping, through which the majority of small operators were "kept perpetually in debt to the commercial operators" to whom profits flowed while herders barely scraped by (Harper et al. 1943: 79). *Man and Nature* concluded that "[t]he problems which have arisen from man's efforts to exploit the natural resources of the Middle Rio Grande Valley for his economic benefit are incredibly difficult; worse still, these problems, so long as they remain unsolved, offer a critical menace to our American democracy. Yet the solutions of these problems is within reach of conscious and deliberate planning" (Harper et al. 1943: 118). Despite the progress made by the study to identify problems and propose solutions, the valley's social and environmental problems continued into the mid-twentieth century and later.

In early 1950 President Harry Truman issued an executive order that created the President's Water Resources Policy Commission to provide comprehensive expert knowledge regarding national and river basin water issues. Among other problems, the unresolved issue of flood control, especially in the Middle Rio Grande Conservancy District, was addressed by the Commission. The MRGCD had survived going bankrupt by giving over its financial obligations to the Bureau of Reclamation. Maintaining and operating the irrigation system continued to be carried out by the MRGCD with Federal support, but the Bureau of Reclamation and the Army Corps of Engineers took responsibility for flood control through the construction of a series of levees that channelized the river. The Rio Grande Project came into being during this period with the purpose of integrating the efforts of different agencies from local, state, and federal levels into a basin-wide plan for building flood control structures, reservoirs and improvement of the irrigation system.

The Commission's report noted that there were plans for new reservoirs in the works, including one on the Rio Chama. The authors stated, "[t]he problems in the Rio Grande Basin are so acute that a coordinated attack is necessary whereby all phases of water and related resources development are integrated into a program in which each phase complements and supplements the other," and they called for a comprehensive plan "that will consider the total resource management needs of the basin and under which all programs can be genuinely integrated" (President's Water Resource Policy Commission 1950: Vol. 2, 333). These mid-century diagnoses prompted the expansion of regulations that were carried out on multiple levels

of government, and from different agencies at each level. The Rio Chama, peripheral to much of the development activity of the early twentieth century, would soon become integrated into the watershed engineering efforts as a throughway for San Juan-Chama project water.

Urban Growth and Effects of World War II

As environmental and economic pressures mounted on the rural communities of the Rio Chama, more and more families found work in migratory wage-labor which they supplemented with subsistence activities such as acequia farming and grazing on what little land they still owned. World War II also provided a route for the rural poor to find work, and huge numbers of men left the region to join the armed services. This had the effect of not only providing jobs but also, through the G.I. Bill, increased access to the education and capital that were prerequisites of finding gainful employment and secure housing in an industrializing and urbanizing world.

World War II also brought the Keynesian military state economy into New Mexico through Los Alamos and Sandia National Laboratories, Kirtland Air Force Base in Albuquerque, and the mining and manufacturing industries which supplied these institutions with materials (Masco 2006). To Masco the Los Alamos National Laboratory (LANL) is the “most complex U.S. nuclear facility” with an expansive technoscientific mission located in the northern Rio Grande valley, a region that remains “one of the most internally contested cultural spaces in North America” (Masco 2006: 35). He reminds us that New Mexico invented the atomic bomb and that the majority of nuclear weapons in the post-Cold War era are Los Alamos designs, making LANL central to a “cradle-to-grave...lifetime support for each of its nuclear weapons designs” (Masco 2006: 36). Masco also notes that within the nuclear complex of the U.S. Department of Energy, LANL occupies the most rugged territorial space (forty-three sq. miles of mountainous terrain) and is surrounded by the most diverse populations anywhere. Masco attributes the high level of cultural diversity to the presence of multiple sovereign Pueblo nations and four-centuries old *Nuevomexicano* villages that are neighbors to the Los Alamos scientific community. Early in its history, the Lab became a place for locals to commute and earn wages daytime with ability to return home and continue to maintain their farms and ranches. Gradually, off-farm income surpassed what could be earned in the traditional subsistence economy resulting in rural outmigration to seek permanent employment in the post-World War II economy. “It is important to recognize that the Manhattan Project produced not only a transformation in scientific and international affairs; it initiated a conversion of northern New Mexico from a primarily rural, agrarian economy to a military-industrial state” (Masco 2006: 36).

LANL, along with Sandia Labs, Kirkland Air Force Base and other military-industrial installations brought many jobs and people into New Mexico, precipitating an explosion of urban growth. In addition, the 1940s brought electrification to the rural communities along the Rio Chama and its tributaries, mostly through extending electrical lines fueled by coal power plants. Coal was and still remains a major source of electrical power, and the widespread introduction of the automobiles, heavy machinery, and farm tractors introduced petroleum based energy into the region, enabling an intensity and scope of construction and land-modification that far exceeded manual human and animal labor capacities that had prevailed in earlier times under the more sustainable Pueblo and Hispano economic strategies. While these hydrocarbon fuels became more abundant in supply, water resources became increasingly scarce due to the growth of large-

scale agricultural and urban demands. In the 1940s New Mexico began to fall into debt to downstream states under the terms of the Rio Grande Compact.

Steve Reynolds, an accomplished academic engineer, was appointed as the State Engineer in 1955. Reynolds brought together his hydrological knowledge with his understanding of the legal issues surrounding water rights in New Mexico and the Compact obligations in order to establish new regulations on groundwater pumping. Albuquerque politicians and businessmen had projected the image of an abundant underground reservoir of water that would fuel urban growth indefinitely, but Reynolds and other hydrologists countered hypothetical projections of abundance with the cold hard facts of the limited nature of the hydrological system. To establish a legal system to work with this scarcity, in 1956 Steve Reynolds declared an underground basin in the Albuquerque region, and he developed guidelines for groundwater pumping that would require depletions to be offset through the purchase and retirement of existing surface water rights (see Phillips et al. 2011: chapter VIII).

The immediate effects of the declaration of the basin coincided with the slow growth of an informal water market network constructed mostly by water brokers and entrepreneurs, largely unregulated by the state or public institutions. Most transactions took place in the form of private contracts and were subject to minimal public scrutiny. Also, during the second half of the twentieth century, new dams and reservoirs were built in the Rio Chama drainage. Abiquiú reservoir was built in 1962 for flood and sediment control by the U.S. Army Corps of Engineers, and Heron reservoir was completed in 1971 to store water from the San Juan Chama project for municipal, industrial and agricultural purposes (Kelly and Urbina 2015). Both of these projects secured downstream urban growth in Albuquerque and the Middle Rio Grande Valley. During the time span when these projects were first planned in the 1940s to 2010, Albuquerque had grown from a city of 35,449 to a metropolitan area of 887,800. The State of New Mexico itself grew from 531,818 to 2,059,179 (U.S. Decennial Census, 2010).

The San Juan-Chama Project

The post-war expansion of public infrastructure works brought a renewed effort to bring Colorado River waters into the Rio Grande. The idea, present since the late 1930s and early 1940s, was to engineer a system of canals and tunnels that crossed the Continental Divide (Figures 13A, 13B, 13C: Middle Rio Grande Project Maps 1945 with Transmountain Diversion Site). The Divide is the line of highest elevation, mostly oriented along the Rocky Mountains, that marks the division between watersheds that drain to the West and empty into the Gulf of California or the Pacific (the Colorado River), and those that empty into the Gulf of Mexico or the Atlantic (the Rio Grande). New Mexico's Compact allocation of roughly eleven percent of the Colorado's flow was not fully allocated to existing uses, and the surplus was deemed necessary for a number of water users located in the urbanized counties downstream of the Rio Chama and primarily municipal uses in the Albuquerque metro area and irrigated agriculture along the Middle Rio Grande valley. Creating the physical structure necessary to fulfill this transfer of water flow amounted to a massive public works undertaking that led to the construction of Heron reservoir. Years of preliminary studies, congressional hearings, and planning deliberations provided the groundwork to get the project to the point of official congressional authorization during the summer of 1962.

Amassing the financing, equipment and intellectual and manual labor got underway almost immediately. Over the next decade, construction proceeded on the diversions from Rio Blanco, the Navajo River and the Little Navajo River, all tributaries of the San Juan draining the San Juan Mountains of southwest Colorado. By 1971 construction of the project had been completed, and new structures began to deliver “non-Native” Colorado water through diversion tunnels and storage reservoirs into the Rio Chama. The Azotea tunnel is the last in the series of tunnels and was carved underneath the continental divide. It delivers water into Willow Creek which then flows into Heron reservoir just before its confluence with the Rio Chama west of Tierra Amarilla. The legislation that authorized the San Juan Chama Project allows for a maximum diversion of 270,000 acre feet in any given year, and a maximum of 1,350,000 acre feet over any given ten year period, all conditional on available minimum flow in the tributary streams (Flanigan and Haas 2008). The Bureau of Reclamation has set the “firm yield” (the amount that can be reliably delivered during any given year) at 96,200 acre feet. This firm yield is contracted out to a number of entities: the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) has the largest allocation at 48,200 afy, followed by the Middle Rio Grande Conservancy District at 20,900 afy, and eleven municipalities, counties, the Jicarilla Apache, the Pojoaque Irrigation District, plus a few others together receive the remaining 27,100 afy (Flanigan and Haas 2008: 375; Thomson 2012: 32). (Figures 14A, 14B, 14C: Azotea Tunnel at Willow Creek with Heron and El Vado Reservoirs)

Chapter 5: Water Policy Future

As noted earlier, the Rio Chama is only 130 miles in length but functions as a major tributary of the Rio Grande, and itself is fed by numerous streams, creeks and arroyos. Most of the tributaries are diverted by local acequias for small-scale irrigated agriculture in the valley bottomlands. In the lower stretch below Abiquiú Dam, the mainstream Chama is diverted by eighteen community acequias for about twenty-eight miles before reaching the confluence with the Rio Grande at Chamita. Of importance is the fact that these acequias hold pre-1907 water rights, including the Acequia de Chamita as the most senior acequia in New Mexico dating to 1598-1599. The Jicarilla Apache Tribe is located on a reservation within the Chama basin and holds federally reserved water rights from the Rio Grande-Rio Chama watershed and is also entitled to contracted water from the San Juan-Chama Project. The Pueblos of Ohkay Owingeh and Santa Clara are located in Rio Arriba County at the confluence of the Rio Chama and the Rio Grande, and they both hold aboriginal water rights. In addition, the Rio Chama is a snowmelt-dominated river flowing into the Rio Grande north of the Otowi gauge, and this location makes it an important contributor to the Rio Grande index flow involved in water deliveries to the Middle and Lower Rio Grande of New Mexico as well as the interstate stream compact with Texas (New Mexico EPSCoR 2008).

The San Juan-Chama Project inextricably links three of the most vital water planning districts in the State of New Mexico: Region 14 for the Rio Chama basin where Heron, Vado and Abiquiú reservoirs are located, Region 3 for the Jemez y Sangre communities of Española, Los Alamos and Santa Fe, and Region 12 for the Middle Rio Grande urbanized metro area that includes Albuquerque and fast growing Rio Rancho (Figures 15A and 15B: NM Water Planning Regions 14, 3 and 12). In recent years, however, decreased snowpack in the San Juan Mountains

of Colorado have threatened the reliability of this imported water with curtailments on the horizon in response to dwindling reserves at Heron and El Vado alongside other pressures on the Colorado River basin where urban demands are rising and already exceed the supply (United States Bureau of Reclamation 2012). The City of Albuquerque relies on approximately sixty percent of its water supply from the San Juan-Chama Project due to a diminishing underground aquifer, and according to the Albuquerque Bernalillo County Water Utility Authority, this dependency could rise to ninety percent in future years when the perpetual rights of up to 48,200 acre feet will be needed annually (Albuquerque Bernalillo County Water Utility Authority 2011). (Figure 16: SJCP Adjustable Dam on Rio Grande at Alameda)

In the coming decades of increased water scarcity, and the likely effects of climate change, the contest over water resources in the upper Rio Grande basin could emerge as a battle of sprawl development in downstream cities, fueled by water, versus agricultural water uses that are susceptible to “retirement” by way of transfers in the market. Acequia farms in north central New Mexico, as well as commercial agriculture in the middle and lower Rio Grande, depend on the seasonal flows that originate in the sierras of northern New Mexico and southern Colorado. In times of scarcity, whether due to drought or climate change, pressures to sell agricultural water rights to “higher yield” uses for housing and economic development in Rio Grande cities will escalate.

The population differences are dramatic when comparing the Rio Chama watershed with the water demands linked to the downstream urban areas where growth is the most prevalent. Whereas Rio Arriba County is home to 39,777 residents, the total population in the urbanized counties of Santa Fe, Sandoval, Bernalillo and Valencia is about 1,036,844 (United States Census Bureau, April 2014). And unlike Santa Fe and Albuquerque, the acequia farmers of the Rio Chama do not have storage rights at Heron reservoir and can divert water into their headgates only from their share of native water or natural flow existent prior to the construction of the San Juan-Chama Project (Watermaster’s Report 2009). “Native water” is defined as water that originates in the Rio Grande watershed. Any native Rio Chama water that enters Heron is bypassed monthly and not held in the reservoir allowing that water to pass through the dam and flow downstream for use by acequias and other stakeholders (Kelly and Urbina 2015).

Under conditions of population growth in parts of the Rio Grande basin, water conservation is a necessary element of a new water policy for the future. The Puebloan technologies of water control along dispersed land areas to capture runoff, and the acequia diversions of surface water only when flows are sufficient, today can serve as models of sustainable practice for emulation by other stakeholders. Modifications by these traditional communities on the landscape left behind reduced levels of human impact, a basic premise of sustainability as measured by tools used to evaluate “ecological footprints” (Wackernagel and Rees 1996). In addition, the descendants of these people retain the ecological knowledge of their communities and regions, expressed by Arellano (2014) in his work on enduring acequias, as a deep attachment to place, “wisdom of the land and knowledge of the water.” Compared to the massive engineering projects that came after New Mexico statehood, water uses by Puebloans and Hispanos did not significantly alter the natural supply in the watershed since neither of these cultures set out to control and subjugate the upper Rio Grande and its tributaries (Phillips et al. 2012).

The traditional communities in the Rio Chama watershed share a connection to place, the land of the ancestors, and a belief system that water is sacred and must be managed with respect, “*el agua es vida*” (water is life). From the Tewa Pueblos who established riverine settlements on the tributaries of the lower Rio Chama, farmers and other stakeholders today can learn how to utilize grid gardening, gravel-mulched plots, and the polycropping of fields irrigated by runoff-fed canals, along with other lessons of water management and landscape ecology (Anschuetz 2001). The utilization of this flexible and diversified arrangement of agricultural practices was a common strategy at numerous sites excavated by noted archeologists (Buge 1981, 1984; Anschuetz 1998, 2001). In addition to water control irrigation in the bottomlands, the riverine pueblos also utilized dry-farming and terracing techniques on vast acreages of valley hillsides, highlands, and mesas at a scale that has not been replicated since that period. With the aid of modern science, such as remote sensing, perhaps these indigenous technologies can be scaled up and replicated. Crop and soil sciences too can add to the knowledge about the use of native seeds and crop varieties suited to the high desert environment of New Mexico. Seed exchanges between Pueblos and Hispano acequia farmers already takes place yearly and perhaps can be expanded to include urban gardeners and other groups that value organic produce grown from heirloom landraces.

Acequia communities too have important features that can be incorporated into water management plans within and across regions, for example, *repartimiento* (water sharing) in times of water scarcity, reliance only on surface flows with voluntary curtailments when run-off is low, and development of rules for water distribution that are flexible depending on hydrological conditions and that can re-negotiated if conditions change (Rodríguez 2006; Rivera 1998). Decision authority within each acequia is always local, a characteristic that permits adaptation at the start of every irrigation season and also at different intervals in the same season such as when spring run-offs decline. Water budgeting, now in currency among water planners, has long been a practice within each community acequia as well as principles of mutual help and social equity. For irrigation during spring run-off and the early summer months, the acequia hydrological model depends on an adequate accumulation of snow pack. Historically, the acequia users have relied solely on local knowledge to estimate run-off flows year to year, but with the advent of new technology such as snow telemetry (SNOTEL), the mayordomos and acequia officers will now be able to access data about snow depth and other water content indicators that are used to predict yearly water supplies in any given watershed. Current research into coupled natural and human systems too will help strengthen acequias as water management institutions confronted by the modern pressures of population growth, increased water demand, and climate change (Fernald, et al. 2012).

A Conceptual Framework for Action

The course of the twentieth century was shaped by the creation of new institutions that regulate human interaction with natural resources. The State Engineer, the Federal Bureau of Reclamation, the Army Corps of Engineers, state and federal courts, the U.S. Forest Service, and the Bureau of Indian Affairs have all played major roles in the livelihoods of the region’s land grant and Native American communities. For future policy directions, the current interest in coupled human-natural systems provides a basis on which the Rio Chama communities can take part in guiding and benefiting from these new models of research. The article “Earth

Stewardship: Science for Action to Sustain the Human-Earth System,” published in *Ecosphere*, outlines a research approach “to provide the scientific basis for actively shaping trajectories of social-ecological change to enhance ecosystem resilience and human well-being” (Chapin et al. 2011: 1). In this model, researchers are encouraged to integrate their own discipline “with other sources of knowledge and understanding to stimulate new interactions and collaborations that add to basic research and better guide the actions needed to shape a sustainable future” (Chapin et al. 2011: 2).

Similarly, the authors of “Complexity of Coupled Human and Natural Systems,” published in *Science* (Liu et al. 2007), argue for bringing together social and natural science methodologies to produce research that makes evident processes and linkages not necessarily accounted for in studies that are undertaken under a single disciplinary framework. Liu and co-authors conclude that interdisciplinary approaches can pick up on phenomena that “[v]ary across time, space, and organizational units,” and exhibit “nonlinear dynamics with thresholds, reciprocal feedback loops, time lags, resilience, heterogeneity, and surprises” (Liu et al. 2007: 1513). In a historical frame, these perspectives can pay attention to how “past couplings have legacy effects on present conditions and future possibilities” (Liu et al. 2007: 1513). In our study of the Rio Chama basin, we point to the use of social-ecological history not as an end account of research, but as the beginning of a variety of new studies that open up questions about the specific dynamics of human-natural relations both as past couplings and as a way to create a shared understanding about present conditions and then examine alternatives for the future collaboratively.

By engaging in interdisciplinary partnerships, human-nature systems research teams can be better equipped to develop concepts, goals and questions in conversation with the community of resource managers and water stakeholders. The retrospective possibilities of historical research are not always readily translated in the prescriptive modes of planning. The challenges faced by people and the ecosystems that sustain them across the world, however, force us to attend to framing the research questions of social-ecological histories in ways that can speak to contemporary problems. The restoration of riparian ecosystems back to sustainable conditions, for example, can benefit from the knowledge and understanding about the dynamic historical relationships between humans and the environment.

In one particular study, an interdisciplinary team of experts from archaeology, paleoecology, plant ecology, and geology (Periman 1999) developed tools that can model how prehistoric people and later cultures altered the ecological processes of the Rio del Oso Valley that through time created the landscapes we observe today. Various data sets were employed to reconstruct past vegetative structure and function in order to assess the cumulative influences of past human activity, and this information in turn was used to generate three dimensional simulations of environmental conditions through time. The study concluded that computer reconstructions and analysis of past landscapes as demonstrated at the Rio del Oso Valley site “will give land managers a greater range of information for use in planning, decision making, and restoration” (Periman 1999: 12). The Rio del Oso is a tributary of the Rio Chama downstream of Abiquiú reservoir.

Linking Stakeholders Toward a Rio Grande Commons

In addition to bringing together the methodologies of natural and social sciences, equally important is the need to design water governance projects that engage scientific scholars in the academy with the community of stakeholders. This present study of coupled natural and human systems in the Rio Chama basin hopefully will be of some help toward the development of collaborative strategies based on a view of water as a common pool resource for sharing by all water users across geographical, cultural, political and water planning boundaries. Especially critical is the need to establish new linkages of mutuality between urban consumers in downstream cities and rural people in the northern headwaters who are the first to divert water for human use.

Calthorpe and Fulton (2001: 17), point out that the modern "Regional City" today sets aside "outdated views of independent towns and suburbs" and instead links Economic Regions and Ecological Regions into one cohesive Social Region. The watershed is what links regional communities together. Upstream and downstream residents are connected by a common set of water drainages, and according to Calthorpe and Fulton (2001: 26) these constituencies "are bound together in a social compact with one another." Attachment to a given place brings with it a connection to the larger bioregion that should matter to people if they are concerned with sustainability into future generations. In his book on bioregionalism, Thayer (2003) argues convincingly that: "a mutually sustainable future for humans, other life-forms, and earthly systems can best be achieved by means of a spatial framework in which people live as rooted, active, participating members of a reasonably scaled, naturally bounded, ecologically defined territory, or *life place*" (Thayer 2003: 6).

Urban consumers along the middle Rio Grande and rural communities in the northern counties together have much to gain by working out solutions for the future that will protect the bioregional resources such as water to benefit all uses, whether for municipal supply, industry, irrigated agriculture, recreation, or ecosystem services. The acequia communities of New Mexico protect watershed health by recharging local aquifers; the seepage effects of groundwater recharge sustain riparian vegetation along the network of ditches, and these effects also produce a return flow to the stream for use downstream (Fernald et al. 2007). Ecosystem services in the acequia landscape include the preservation of cultural diversity as an inherent value to society as well as spiritual and religious values, educational values, recreation and ecotourism, esthetics, and the conservation of traditional ecological knowledge (Raheem et al. 2015: Table 4). These agroecosystems help to maintain traditional lifestyles in rural places while also protecting amenities that benefit urban residents such as recreational uses of the land, camping, fishing, rafting and other water based sports.

To develop a better decision process in water policy development for New Mexico, Gupta and his co-authors argue that there is a need to shift from an "individual conceptual model" to a "collective conceptual process" that brings together water managers, policy analysts and stakeholders to then model a policy that links the hydro-bio-human system for adaptive water management (Gupta et al. 2012: 11). In their view, water is among one of the critical elements in the "public environmental commons" and therefore should be managed flexibly where decisions about resource use "must be adjusted to respond to new facts as they are

acquired” (Gupta et al. 2012: 267). The single purpose solutions of the past inhibit flexibility and have not worked, and instead there is a need to develop a new and adaptive management scheme through a process of goal setting and continual reassessments conducted in public forums (Gupta et al. 2012: 267). For methodology they advocate the use of “coupled physical-social system modeling” to define a set of alternative scenarios that focus on the decision-making process based on shared data, better understanding, and consensus of stakeholder groups.

Gupta and his co-authors call for a more robust planning process at both the state and regional levels that will collect and continuously update the best scientific knowledge for use in alternative decision modeling that integrates hydrological, institutional, cultural and economic data. To this framework we add that visualization tools may help planning agents unpack and retranslate complexity of the system itself (Figure 17: Visualization Modeling Diagram). Data that is presented visually can reduce uncertainty about abstract ideas and help to level the playing field across stakeholder groups from different occupations and backgrounds. For the Rio Chama basin study we developed the socio-ecological narrative about coupled natural and human systems as presented here, and in parallel work, we have also illustrated human impacts on the resource base with the aid of visualization tools to model land use, built environment, geo-spatial, natural systems, and human settlement morphology (see Gonzales et al. 2013). Together, visualizations, modeling and simulation technologies help to share data in an understandable format and thus can open up new ways of immersing stakeholders in the planning process as they weigh options, analyze trade-offs, resolve differences and collaborate on solutions (Desouza and Smith 2015).

The diverse material techniques and social formations evident in the eco-cultural history of the Rio Chama watershed are a rich repertoire for community-based development and planning. Since the period of the Riverine Pueblos, the Rio Chama watershed has been the site of ongoing efforts to sustain human settlements in balance with the carrying capacity of the land and the limits of water resources in the region. For centuries, indigenous people and hispano land grant settlers attempted to maintain harmony with the environment while establishing mutually beneficial relationships of exchange despite initial differences and conflicts over resources use. Though different in world views, each society found a way to protect life sustaining resources such as water. That is a lesson that resonates today with increasing complexity in water allocation and increased populations that depend on the natural resources of the region. Indigenous people who continue to inhabit the region, the heirs of Spanish-Mexican land grants many of whom still clean out and use the acequia system, as well as urban newcomers who arrive and adopt the New Mexican landscape as their own, co-exist in modern times, and together these constituencies have an opportunity to establish new forms of water governance to share the limited supply of water in the commons. Collaborative planning at the basin scale and across regions appears to offer a pathway toward sustainable community and economic development for the mutual benefit of all upper Rio Grande stakeholders.

At one time or another, most settlements, towns, and cities of the desert Southwest were populated by newcomers who arrived in the “new world” in search of resources necessary to build communities. The conditions of climate long ago dictated where humans could survive and sustain a civilization, always dependent on water availability, whether found in intermittent flow arroyos, miniscule springs, or along creeks and perennial streams flowing down mountain

canyons (Anschuetz and Dean 1994). We end this monograph where we started. To the credit of the Pre-Columbian Pueblos, they have lived off the land for more than a millennium, and perhaps it would be wise to recognize, reflect, and take actions today in accordance with their world view that has withstood the test of time:

The heritage of the past is one of conscience and action. Adaptations of the farming techniques of pre-Columbian Pueblo Indians might once again sustain people with little adverse impact on the landscape, particularly if today's farmers were to see themselves as part of a greater whole. The future of humanity in the American desert does not lie in defying the elements. Advanced technology and its ability to make the desert perform according to cultural expectations is not the answer. The key to long term human survival is a recognition of our dependence on the land and its waters, and living accordingly (Anschuetz and Dean 1994: 127).

Appendix 1: The Riverine Pueblos

(Note: Except where indicated, the number of rooms at each pueblo site and dates of occupation are estimates compiled by Adler and Johnson 1996.)

Ojo Caliente

The Ojo Caliente stream drains the Tusas mountains and the easternmost area of the Chama watershed. There are numerous ancestral Tewa village sites near and along the Ojo Caliente, including Leafwater-Kap (1275-1400 A.D.) and Hupobi (1300-1550 A.D.). Leafwater-Kap was built upstream of the Ojo Caliente confluence on the Chama around 1275 but was never re-inhabited after the late fourteenth century. Hupobi was located on the Ojo Caliente mainstream just below the Rio Tusas and was joined by the villages of Posi (or Pose, Pose'ouinge) and Ponsipa-akeri around 1300 and Howiri a century later. These sites are built on terraces overlooking the floodplain and are surrounded by agricultural features and sources for micaceous clay and red ochre used for ceramics, and fibrolite, and also to make axes and hoes that were durable and tradable (Fowles 2009). Buge (1984) estimates that the Tewa population in the Ojo Caliente valley numbered between 2,000 and 5,000 around 1450 A.D., and he notes that the acreage utilized for agricultural production reached during this period has not been exceeded since. Specifically, he points to the fact that in addition to farming the limited irrigable valley bottomlands (which is the extent of most contemporary cultivation), Tewa farmers utilized dry-farming and terracing techniques on valley hillsides, highlands, and mesas (Buge 1984).

The utilization of this flexible and diversified arrangement of agricultural practices and cultigens was a common strategy in the region. The terraces were covered in small cobble bordered rectangular plots that ranged from 1-9 square meters. Less common were larger cobble bordered plots of up to ninety square meters that were built on gradual slopes. Most of these plots were cleared of rocks and pebbles and contained the silty clay soils that form the terraces. In addition there were gravel-mulched plots on the terraces and mesas. Mesa top gravel-mulched plots significantly expanded the growing season for crops, as the gravel provided added heat and the coolest air sinks off the mesas into the river valley below. In the floodplain and terraces, especially the secondary drainages, there were stone outlined waffle gardens. Shallow and wide stone-outlined channels directed arroyo runoff into these gardens. These agricultural features were accompanied by field houses, usually simple brush lean-tos, as well as depressions used to collect runoff water and topsoil. Buge notes that “[e]ven today they support vegetation with greater moisture requirements and were possibly used to grow special crops in the past” (Buge 1984: 32). Plots were often placed on west and north facing aspects, minimizing the solar radiation, and hence temperature and evaporation, that the plants would have to cope with.

Ponsipa-akeri, first built between 1250-1300 A.D., was a dwelling of fewer than 100 inhabitants. Within a few generations, the Santa Fe Wiyo phase component at this site “was burnt, torn down, and covered with fill before the later (Biscuit A-Biscuit B phase) pueblo was constructed...” (Buge 1981: 14). Over the next two centuries, illustrating the flexible abandonment and re-utilization of sites, Ponsipa-akeri would grow to more than 1500 rooms (Anschuetz 1998: 225), three plazas and seven kivas due to a series of three primary occupations and a clear “pattern of accretional growth and the aggregation of people into an existing Wiyo

phase pueblo” (Duwe 2011: 285). It is unlikely that all structures were ever inhabited at full capacity simultaneously, as room blocks and kivas would be left behind when they became weathered and their inhabitants moved to other sites, always maintaining the possibility of moving back and reconstructing earlier room blocks and kivas or building new ones. Posi was the site of the only great kiva in the cluster of Ojo Caliente villages, and it was located directly adjacent to the hot springs, which were and continue to be a sacred site for the Tewa people. It amassed more than 1000 rooms (Anschuetz 1998: 225), and ten kivas were spread around three plaza structures. Hupobi and Howiri, were built directly across the river from each other, relatively equal in size, and at peak occupation together they totaled roughly 3,000 rooms (Anschuetz 1998: 225) and fifteen kivas, and each had three plazas. These four villages were continually re-inhabited until the end of the seventeenth century, although never at the levels reached during the fourteenth and fifteenth centuries.

Evidence of Pueblo agriculture at Ojo Caliente prior to Spanish arrival can be found in stone-lined channels that diverted water from an intermittent drainage (Ebright 2014). Although an early Spanish grant was made around 1730, the farms and ranches at Ojo Caliente were temporarily abandoned due to raids by Utes and Comanches on Abiquiú area settlements in 1747 and other periods. A second land grant was issued in 1768 that included *genízaros* who were also provided with deeds to tracts of irrigable lands under a pueblo type of organization with a designated war captain as the lead officer (Ebright 2014). The raids continued, and a permanent settlement was not possible until after a peace accord with the Comanche and Ute tribes was signed in 1786. The formal and final grant for Ojo Caliente was approved in 1793 (Ebright 2014).

Cañones-Abiquiú-El Rito

Tsiping and Palisade were built around 1275 and 1312 A.D. respectively. Palisade, the furthest northwest of any Tewa or Puebloan village in the Chama basin, was abandoned by 1320 A.D. Following its abandonment, Riana was built further west in 1335 A.D. and was abandoned by 1350. Neither Palisade nor Riana grew larger than 100 rooms. Tsiping, in the Cañones drainage, reached about 400 rooms, fifteen kivas and four plazas but was abandoned by the end of the fourteenth century. Tsama, located on the terrace along the Chama-El Rito confluence, totaled 600 rooms, five kivas and two plazas. Villages that enjoyed more longevity were established during the middle to late fourteenth century around Poshu and Sapawe, near present day Abiquiú and El Rito respectively. Poshu would grow to about 1200 rooms (Anschuetz 1998: 225) with two kivas, one great kiva and two plazas.

Sapawe was built sometime after 1300 A.D. at around 1000 ground floor rooms and in a second phase during the mid-fifteenth century expanded to more than 2,500 rooms with eighteen small kivas, one great kiva, and seven plazas (Anschuetz 1994: 225). Near Sapawe there is archeological evidence of twenty four field houses, check dams, diversion walls, contoured terraces, two rectangular cobble-bordered fields, and twenty grids some associated with fieldhouses (Moore 2004). (Figures 18A: El Rito Valley and Sapawe and 18B: Sapawe Pueblo) Today Sapawe, also known as Pueblo Colorado, is still visible as a ruin located about two miles south of the village of El Rito, near the north end of the Cristobal Torres land grant. Colonial period settlements by Hispanic families included a number of ranchos along the Rito Colorado, and by 1846 the El Rito Valley consisted of five plazas: Plaza de Población (now El Rito),

Placita de los Espinosas, Plaza de la Casita, Plaza del Medio (now Placita), and Plaza de los Atencios (Quintana and Snow 1980: 45).

The Puebloan villages of the thirteenth and fourteenth centuries near Abiquiú were located for gathering and crafting chert and obsidian from Tsee p'in and El Rechuelos peaks, which would have served them well for trading. Although the agricultural features documented in this part of the basin did not reach the levels for the Ojo Caliente and Rio del Oso drainages, the “estimated 2,000 stone-outlined grids that cover the crest of Abiquiú Mesa in the Chama Valley represent one of the largest and best known examples of precipitation-dependent fields” (Anschuetz 1998: 148). One of the possible reasons for a less extensive agricultural investment in this area may be that the nomadic Utes, Apaches, and Navajos that entered the region during the fifteenth century incorporated the lower Chama basin into their territorial ambit. This could also explain the fact that permanent dwellings in this region were abandoned by the close of the fifteenth century and were not re-inhabited until the genízaro land grant of Abiquiú was settled in 1754 following approval by Governor Tomás Vélez Cachupín.

The colonial period settlement at Abiquiú consisted of Pueblo Indians from the Hopi region of Arizona who were brought to the mesa at Abiquiú by Fray Francisco Delgado initially in 1742, and by 1754 there were thirty four genízaro families that were granted the lands at the Pueblo de Abiquiú (Gonzales 2014 citing Wroth 2004: 590). An ethnographic study in the early 1900s, based on oral histories of elders from nearby Tewa pueblos, found that Abiquiú was a pueblo “whose inhabitants had the same culture and customs as the people of the Tewa villages” (Gonzales 2014 citing John Peabody Harrington 1916: 590-591). Church baptismal and marriage records for the Pueblo of Santo Tomás de Abiquiú, the name used by many residents today, indicate the presence of other genízaro tribes outside of the Tewa pueblos such as the Ute, Comanche, Kiowa, Navajo and Apache (Gonzales 2014).

Rio del Oso

The Rio del Oso is a tributary of the Rio Chama that drains the northern portion of the Jemez Mountains. Most of the watershed is now administered by the Santa Fe National Forest but had been traversed by a number of prehistoric people since the Archaic Period of hunters and gatherers ending around 600 A.D. Permanent human occupation, however, did not occur until after 1200 A.D. when Pueblo groups started to build dwellings and change the surrounding landscape by creating agricultural systems of land and water use (Periman 1999).

The earliest built pueblo in the Rio del Oso drainage, Te'ewi, sits at its confluence with the Chama. Built around 1250 A.D., this is one of the earliest Tewa sites in the Chama, and it grew to about 1090 rooms (Anschuetz 1998: 380) and housed eight kivas, one great kiva and two plazas. Ku, with 275-375 rooms (Anschuetz 1998: 380) creating a plaza surrounding three kivas, was built just south of Te'ewi in the mid-fourteenth century. At the same time as Ku, Pesedeuinge was built roughly three miles upstream on the Rio del Oso, with 280-550 rooms and no kivas (Anschuetz 1998: 380). Two smaller villages with 100-200 rooms, Maestas Pueblo, a multistoried housemound with two enclosed plazas, and site AR-03-10-06-1230, a linear pueblo with multiple pit structures, were built during the fourteenth century. These villages are located

near early fourteenth century sites of grids along alluvial deposits, which function similarly to gravel mulched plots for extending the growing season.

While many smaller structures are spread throughout the agricultural fields, the villages of Te'ewi, Ku, Pesedeuinge and Maestas sit on high hills and mesas that overlook the nearly 60,741 square meters "of durably constructed field space" (Anschuetz 1998: 389). Anschuetz has identified a number of shrines in the Rio del Oso that are still considered sacred to contemporary Tewa peoples from the pueblos of Ohkay Owingeh and Santa Clara. These shrines range in type from large boulders with petroglyph inscriptions, boulders with directional stone paths oriented towards cardinal directions and fields, shaped stone figurines, and rock rings marking sacred places. Anschuetz (1998) has also extensively documented a range of agricultural water modification features similar to those found in the Ojo Caliente drainage (see Buge 1984: maps and diagrams at 27-32). In his site plan for Maestas Pueblo, Anschuetz (1998: 370) locates a number of agricultural grids and a cobble-bordered and gravel-mulched plot next to the housemound.

Appendix 2: The Jicarilla Apache

At the time of sixteenth century Spanish expeditions into the Kingdom of New Mexico, the Rio del Norte (now Rio Grande) from El Paso north to Taos became the most feasible corridor in which to establish agricultural colonies along the *Camino Real de Tierra Adentro*. French cartographers who mapped *Nouveau Mexique* in 1650 (Nicolas Sanson) and again in 1722 (Guillaume de L'Isle) noted that this New Mexico floodplain was surrounded by *Apachería ou Pays des Apaches*: *Apaches Vaqueros* to the east, *Apaches de Navajo* to the north, and *Apaches de Xila* to the west (Guillaume de L'Isle 1722). Later, a map of 1768 (Alzate y Ramírez) locates the *Apaches Xicarrillas* northeast of Taos along with other Apache bands that extend into most of the eastern plains of Texas. (See Figures 19A, 19B, 19C, 19D, 19E, 19F: Apache Bands and Apaches Xicarrillas located in archival maps by cartographers)

The Jicarilla Apache are an Athabaskan people who migrated to the western Great Plains and southern Rocky Mountain region from the Canadian MacKenzie basin between the fourteenth and sixteenth centuries (Velarde-Tiller 1983). They arrived in the New Mexico province during the sixteenth century just before the first Spanish settlements on the Rio Chama and Rio Grande. Interacting with the Comanches and the Pueblos, the Jicarillas encountered compatible agricultural and ceremonial practices and material exchange (and sometimes warfare) between and among these groups before and after Spanish contact. During this time, the Jicarilla Apache homeland encompassed the upper Arkansas and Canadian rivers, ranging from the Rocky Mountains into the Great Plains. Most of their territory was "bordered by the Arkansas River in southeastern Colorado, the northeastern plains region drained by the tributaries of the Canadian River, the flatlands of the Pecos River Valley, and the area northwest to the Rio Grande in the Chama River Valley of New Mexico" (Velarde-Tiller 1983: 4). For material labor, the Jicarilla Apache's social structure was formed around a dual organization of "*Llaneros* (plains people), who lived in the plains of northeast New Mexico" and primarily engaged in bison hunting, and the "*Olleros* (mountain-valley people), who migrated annually to the Rio Grande Valley, along the Rio Chama and northwest into Tierra Amarilla" (Tórriz and Trapp

2010, 15). The *Llaneros* resided mainly in present day Colfax, Mora and San Miguel counties with the Cimarron Valley as their stronghold (Velarde-Tiller 1983: 13).

Under the Mexican Government, a number of land grants within the Jicarilla homeland on the eastern side of the Sangre de Cristo Mountains were issued to a handful of Hispano petitioners. The Jicarilla continued to use these lands because the grant-owners did not exercise control over them, but this arrangement changed after the American occupation and military control of the region in 1846-1848. The American government at first expected no difficulty with the introduction of “superior” institutions on Native American tribes of New Mexico in order to assimilate them into the U.S. “Euro-American” culture (Holtby 2012: 165). By 1850 six *Ollero* family-units were already living near El Rito, Abiquiú, and Ojo Caliente, partaking in trade with the local Pueblo, genízaro and Spanish villages during the winter and migrating to southern Colorado during the summer. The vast territory of the Jicarilla straddling northeastern New Mexico and Colorado, however, continued to be eroded by both Hispano and Anglo American homesteaders and other settlers during the period 1850-1870, causing the Jicarilla to rely on rations from the Indian agents in Cimarron and Abiquiú. During this time, the Jicarilla came into conflict with the new settlers and the U.S. army, and in 1854 warfare broke out when some of the Jicarilla resorted to raiding settlements and the taking of livestock (Torrez and Trapper 2010).

Starting in 1851 and continued again between 1872 and 1886, a series of negotiations ensued proposing locations for a permanent reservation, only to be withdrawn. After a prolonged period of broken promises, in 1887 the Congress passed the General Allocation Act, or the Dawes Act that would establish a reservation in a small portion of the Jicarilla homeland in north-central New Mexico on the Rio Chama watershed near the Tierra Amarilla Land Grant. The reservation, containing 416,000 acres, was created by an Executive Order on February 11, 1887, days after the passage of the Dawes Act. One effect of this Act was to establish a policy of individual allotments of reservation lands, a law which disrupted indigenous social organization and land tenure across the continental United States. Communal lands on Tribal reservations were divided to create individual farms. “Private ownership of land, the law postulated, bred good work habits and a thrifty, self-reliant farmer,” and “[c]apitalism, in short, would mold the Indians into American citizens” (Holtby 2012: 166).

At the Jicarilla reservation, additional lands were acquired in 1907 and 1908 to expand the reservation boundaries. This doubled the size of the homeland, and “all tribal members received allotments of 160 acres for agriculture and 640 acres for grazing” with timber resources held in common for their economic value (Holtby 2012: 167). Although the Jicarilla Apache had finally secured legal recognition of rights to land and resources after decades of being shuffled around New Mexico, the Dawes allotment policy and the encroachment by new settlers made it difficult for the Jicarilla to establish viable social and economic practices in accordance with their own customs, traditions and social structure. The limited arable land and unreliable irrigation at first convinced the Jicarilla that the new agricultural practices imposed by federal government agencies might help to improve conditions. The youth who attended boarding schools and learned how to plant and harvest crops in arid lands returned to the reservation with new techniques, but shortly after their return, they reverted to the traditional ways. After twenty five years, the mandate to assimilate the Jicarillas had failed (Holtby 2012).

Finally, in 1934 the federal government ended the Dawes Act, and the Jicarilla Apache received their lands as a tribal reservation with freedom to organize their society and resources. In the end, the traditional ways persisted alongside selective elements of modernity (Holtby 2012). Today the Jicarilla Apache continue to occupy the 1887 reservation with their headquarters in Dulce along the western border of Rio Arriba County. For social structure, they maintain their traditional lines of dual affiliation either as *llaneros* or *olleros*. Most of their economy is based on ranching, timber, oil and gas leases, issuing of permits for trophy elk hunting, and more recently, the building of a travel center with a gambling casino along the Cuba to Farmington highway. For water resources, the Jicarilla Tribe holds substantial water rights from the San Juan-Chama project that they can retain for reservation needs or lease out to other users as revenue flow.

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Maps & Figures

- Figure 1A: Rio Arriba County and Rio Chama Watershed
- Figure 1B: Rio Arriba County Federal and Tribal Lands
- Figure 2A: Rio Chama Terrain Model (Moises Gonzales)
- Figure 2B: Rio Chama Below Abiquiu Dam
- Figure 3: Northern Rio Grande Basin
- Figure 4: Riverine Pueblos (Adapted from Anschuetz 1998)
- Figure 5A: Miera y Pacheco 1778 Plano Geográfico de los Descubrimientos....
- Figure 5B: Miera y Pacheco 1778 Comanches and Utes
- Figure 5C: Miera y Pacheco 1778 Provincia de Nabahoo
- Figure 6: San Joaquín del Río de Chama Grant Boundaries (Roberto H. Valdez)
- Figure 7: Historic Settlement Pattern Along the Rio Chama
- Figure 8A: Miera y Pacheco 1777 Plano Geográfico del Nuevo México....
- Figure 8B: Miera y Pacheco 1777 Indian Camps and Provinces
- Figure 9: Tierra Amarilla and other Land Grants in Rio Arriba County
- Figure 10A: Denver and Rio Grande Railway 1873
- Figure 10B: Denver and Rio Grande Railway 1873 Abundant Heavy Timber
- Figure 11: Santa Fe National Forest Homesteads Act of 1906 (Roberto H. Valdez)
- Figure 12A: Denver and Rio Grande Railway 1881
- Figure 12B: Denver and Rio Grande Railway Chile Line 1881
- Figure 12C: Denver and Rio Grande Railway Chile Line and Minerals 1881
- Figure 13A: Middle Rio Grande Project NM-1945
- Figure 13B: Middle Rio Grande Project NM-1945 Rio Chama Sites
- Figure 13C: Middle Rio Grande Project NM-1945 Transmountain Diversion Site
- Figure 14A: Azotea Tunnel and Heron Reservoir
- Figure 14B: Azotea Tunnel and Willow Creek
- Figure 14C: Heron and El Vado Reservoirs
- Figure 15A: NM Water Planning Regions (NM Office of the State Engineer)
- Figure 15B: NM Water Planning Regions 14, 3 and 12 (NM Office of the State Engineer)
- Figure 16: SJCP Dam on Rio Grande at Alameda
- Figure 17: Visualization Modeling Diagram
- Figure 18A: El Rito Valley and Sapawe Pueblo
- Figure 18B: Sapawe Pueblo
- Figure 19A: Nicolas Sanson 1650. Ameriqve Septentrionale....
- Figure 19B: Nicolas Sanson 1650. Ameriqve Septentrionale....Apache Bands
- Figure 19C: Guillaume de L' Isle 1722. Carta du Mexique et de la Floride....
- Figure 19D: Guillaume de L' Isle 1722. Carta du Mexique et de la Floride....Apache Bands
- Figure 19E: Alzate y Ramírez 1768. Mapa Geographico (sic) de la América Septentrional....
- Figure 19F: Alzate y Ramírez 1768. Mapa Geographico (sic) de la América Septentrional....
Apaches Jicarillas

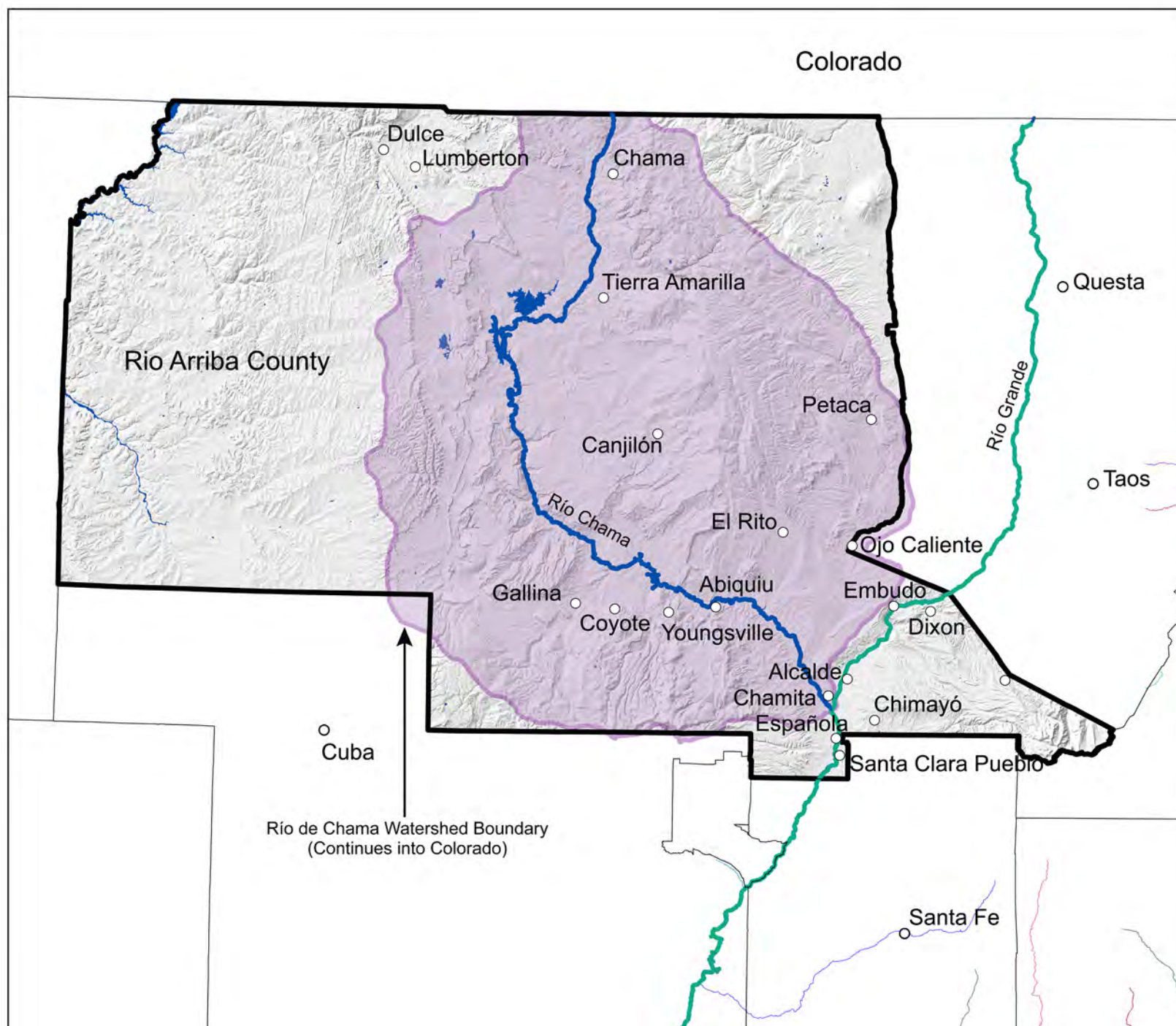


Figure 1A. Rio Arriba County and Rio Chama Watershed

Río Arriba County Federal and Tribal Lands

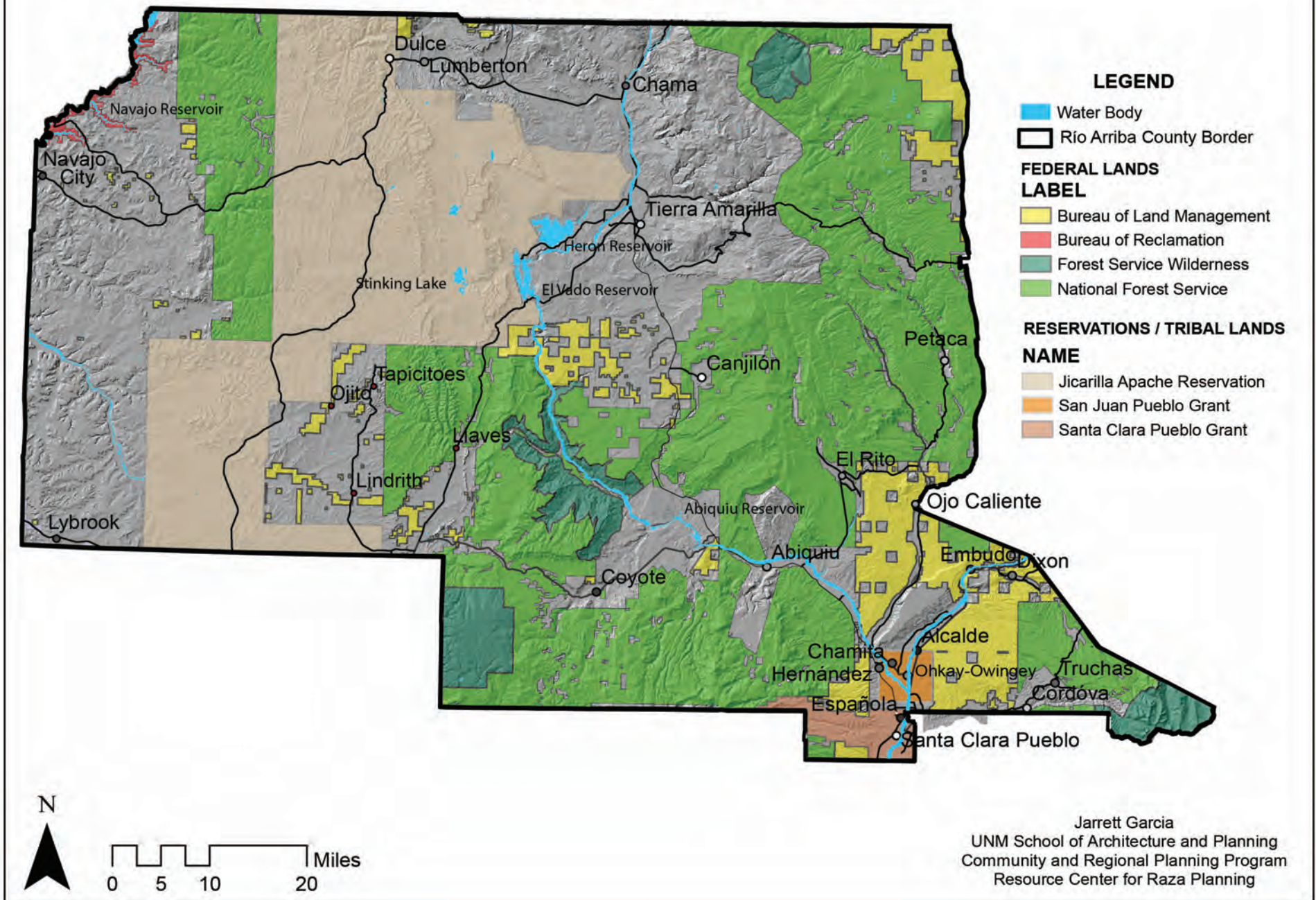


Figure 1B. Río Arriba County Federal and Tribal Lands

Land Use Conditions Rio Arriba County Rio Chama Basin

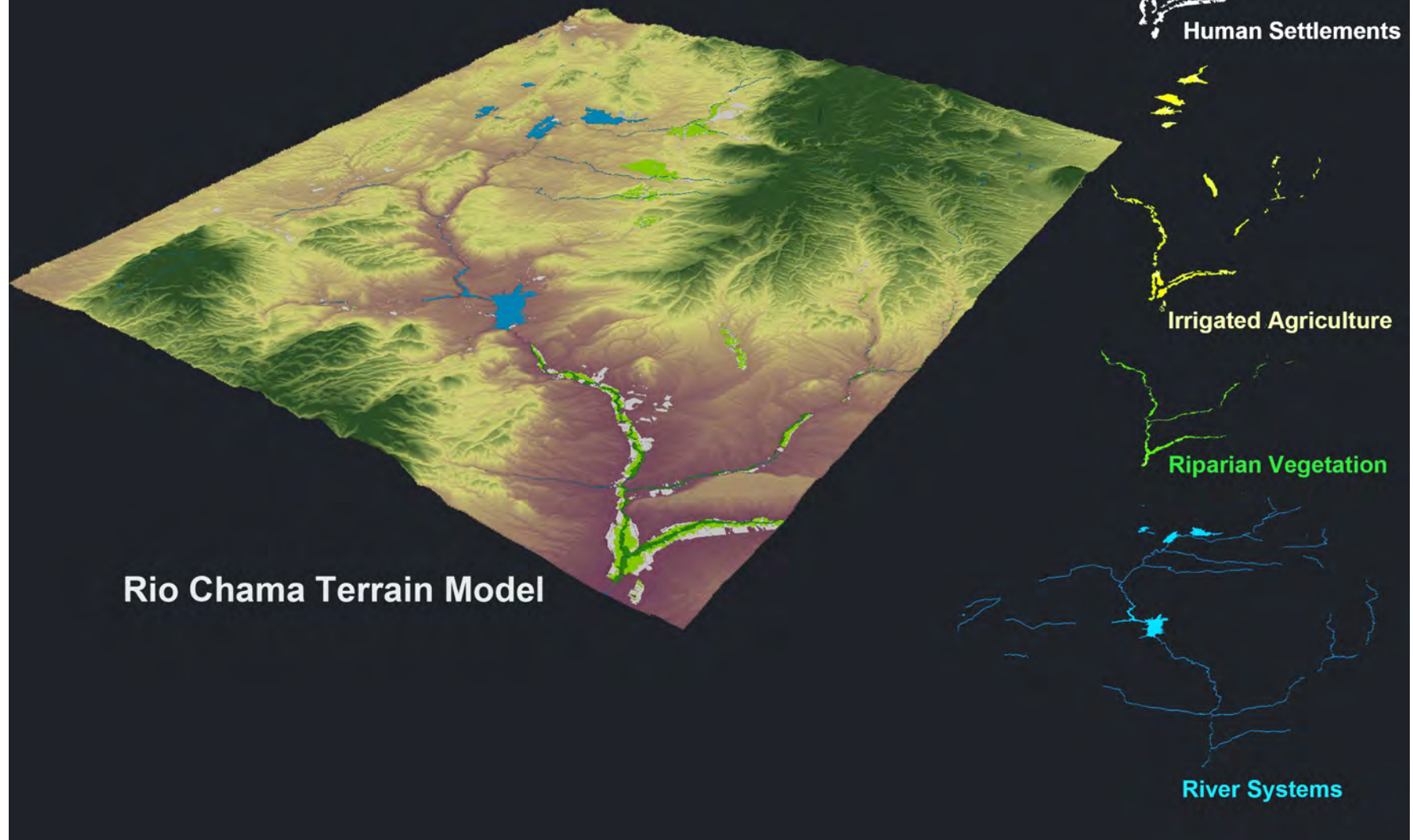


Figure 2A. Rio Chama Terrain Model (Moises Gonzales)



Figure 2B. Rio Chama Below Abiquiu Dam

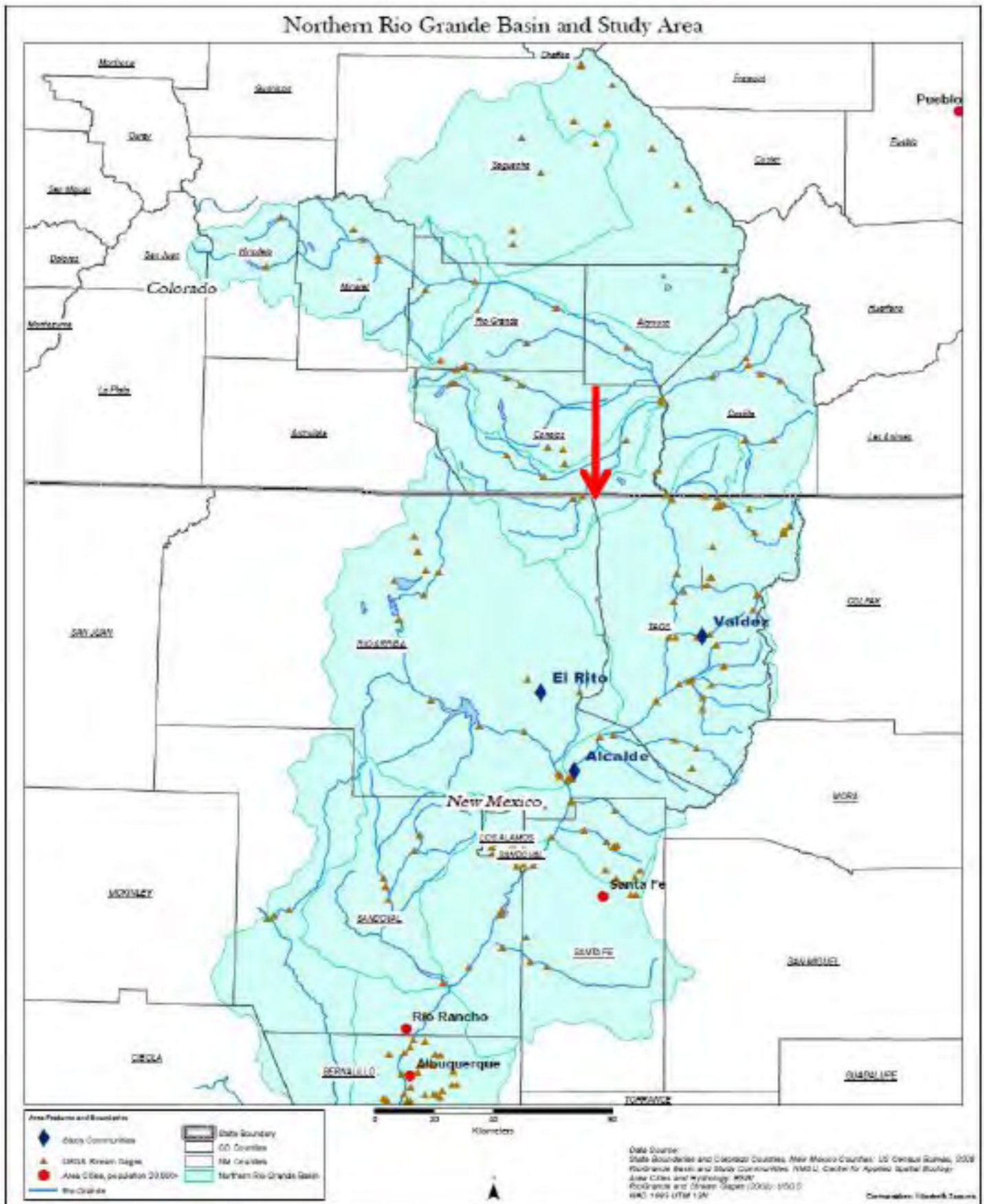


Figure 3. Northern Rio Grande Basin

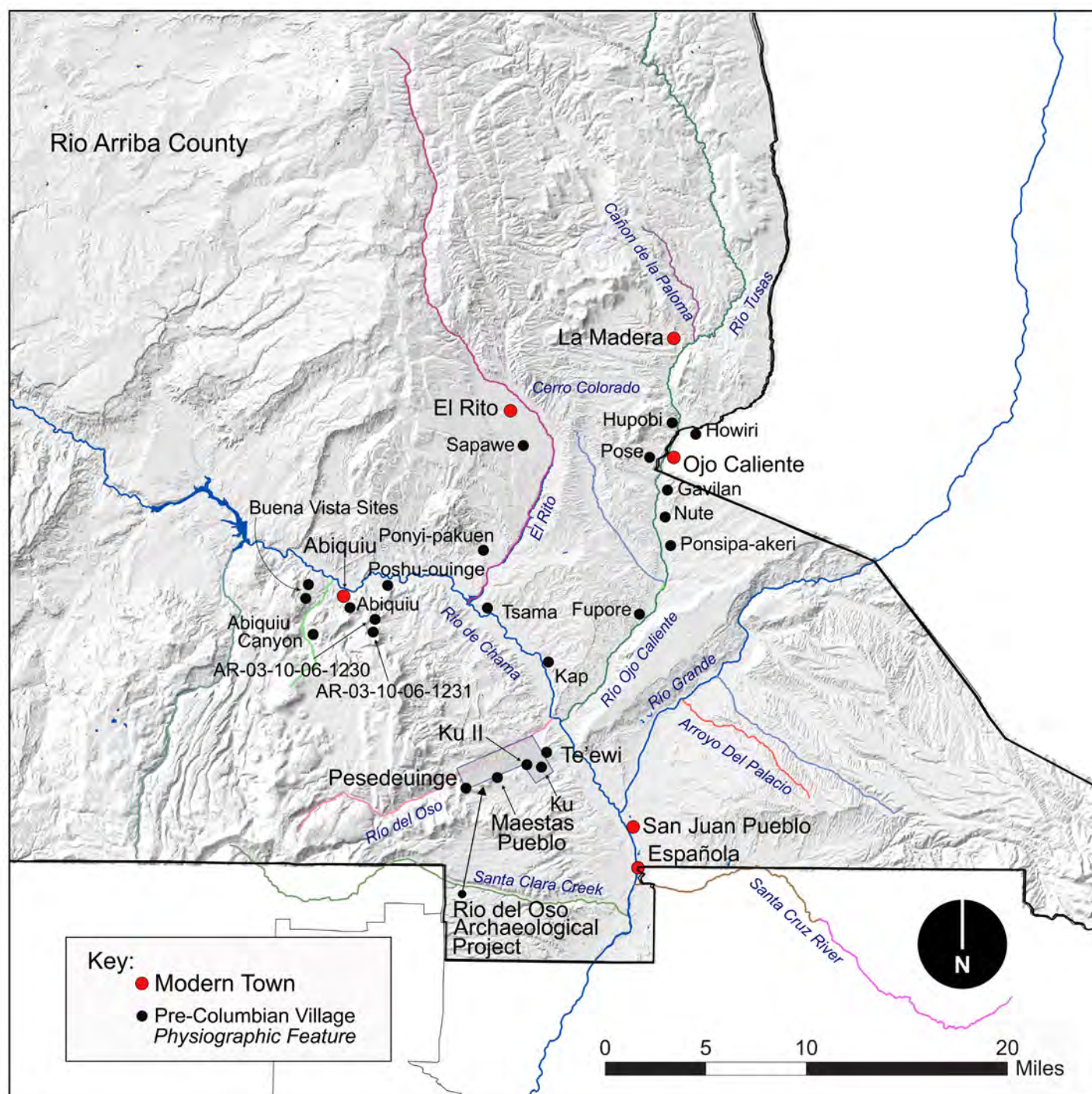


Figure 4. Riverine Pueblos (Adapted from Anschuetz 1998)

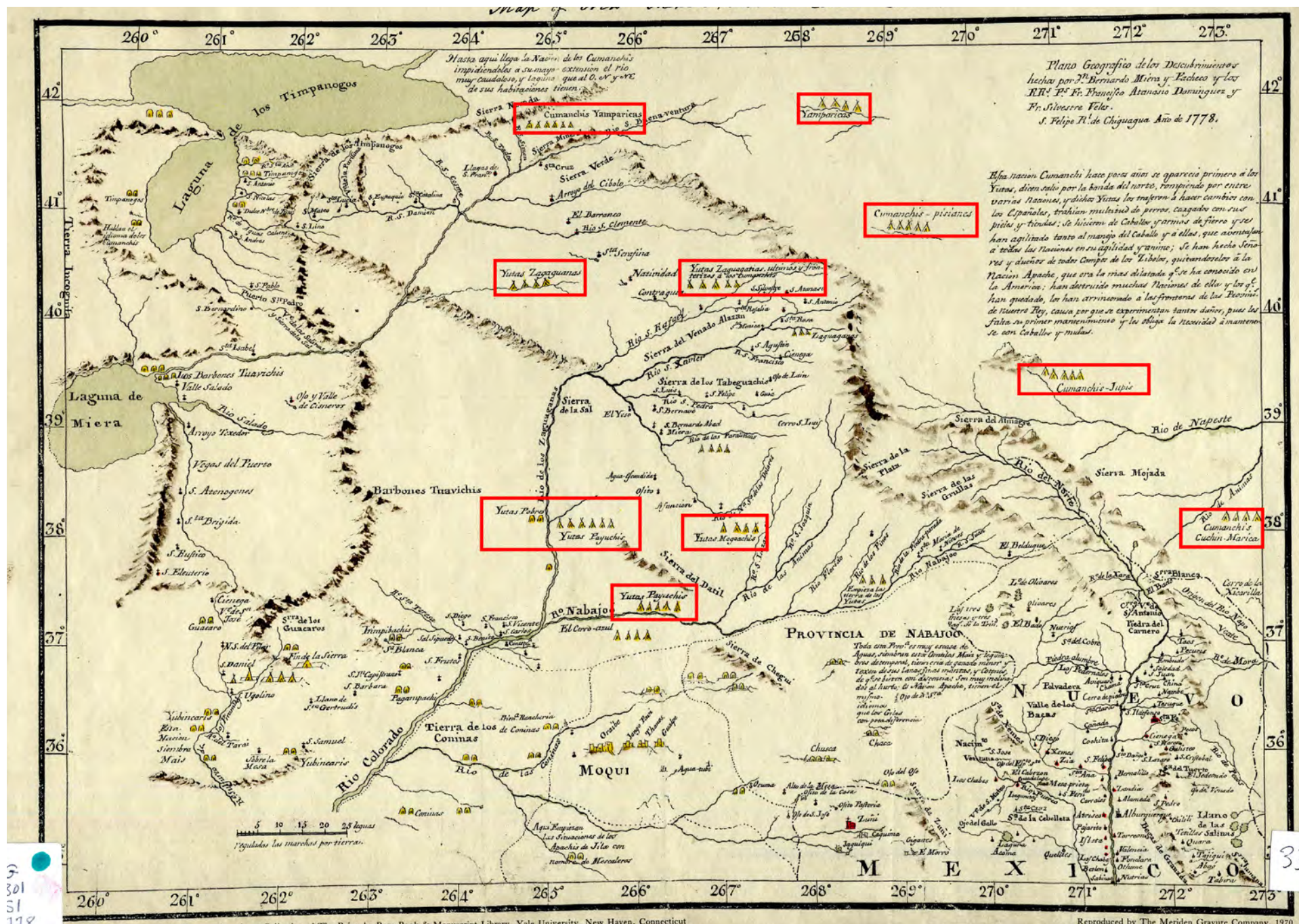


Figure 5B. Mierra y Pacheco Map 1778 Comanches and Utes



Figure 5C. Miera y Pacheco Map 1778 Provincia de Nabahoo

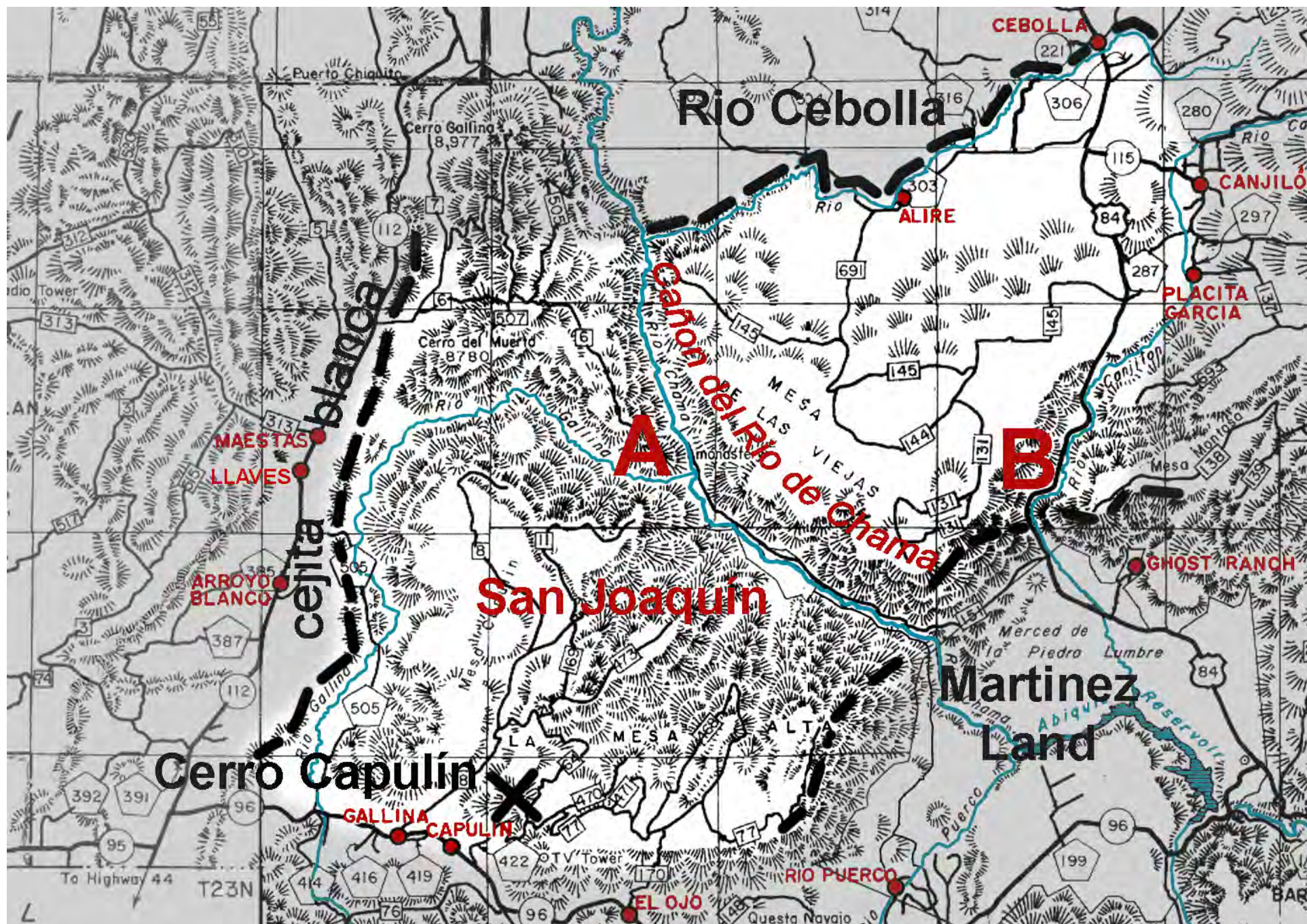


Figure 6. San Joaquín del Río de Chama Grant Boundaries (Roberto Valdez)

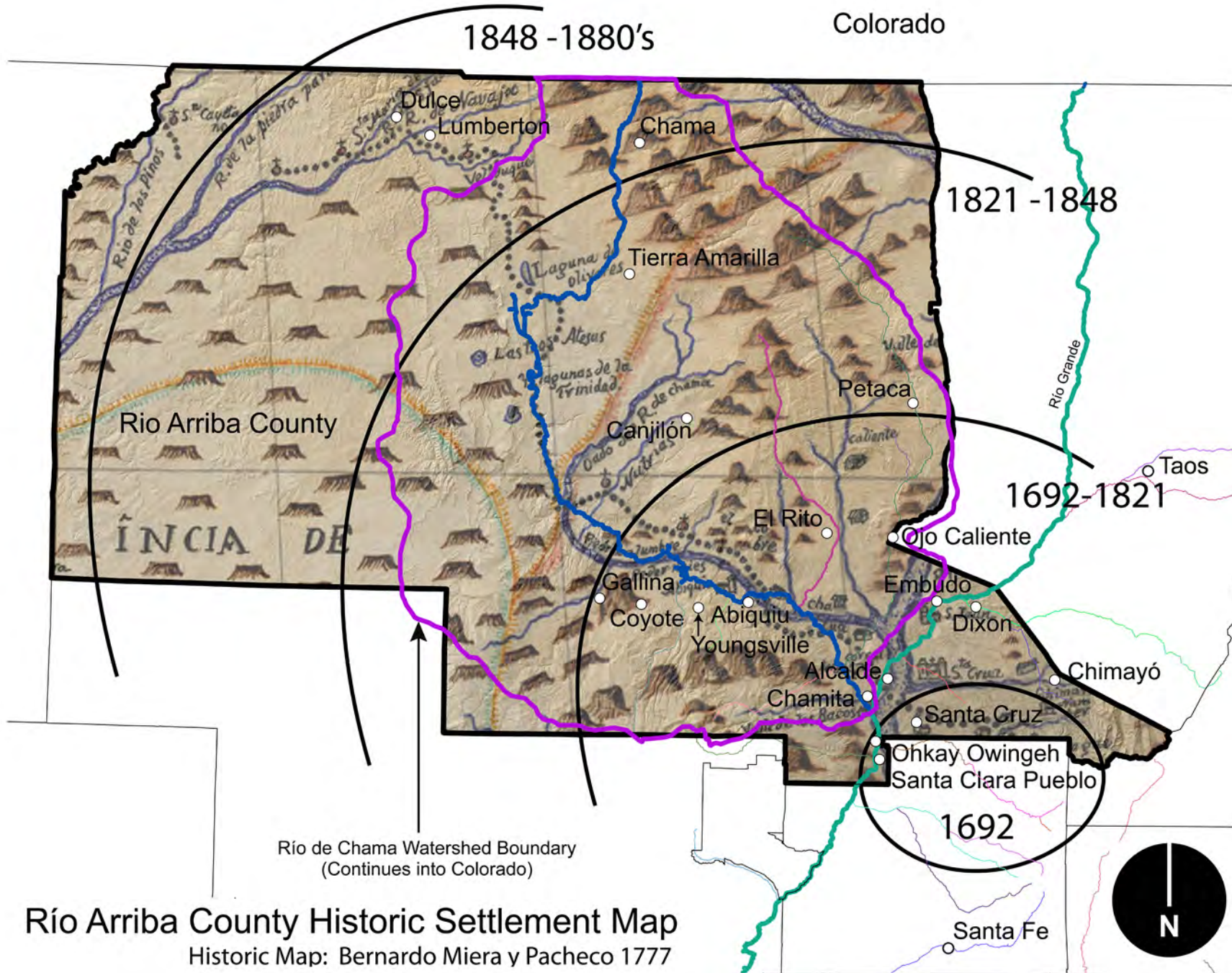


Figure 7. Historic Settlement Pattern Along the Río Chama



Figure 8A. Miera y Pacheco Map 1777 Plano Geográfico del Nuevo México



Figure 8B. Miera y Pacheco Map 1777 Indian Homelands and Provinces

11 Selected Land Grants: Rio Arriba County

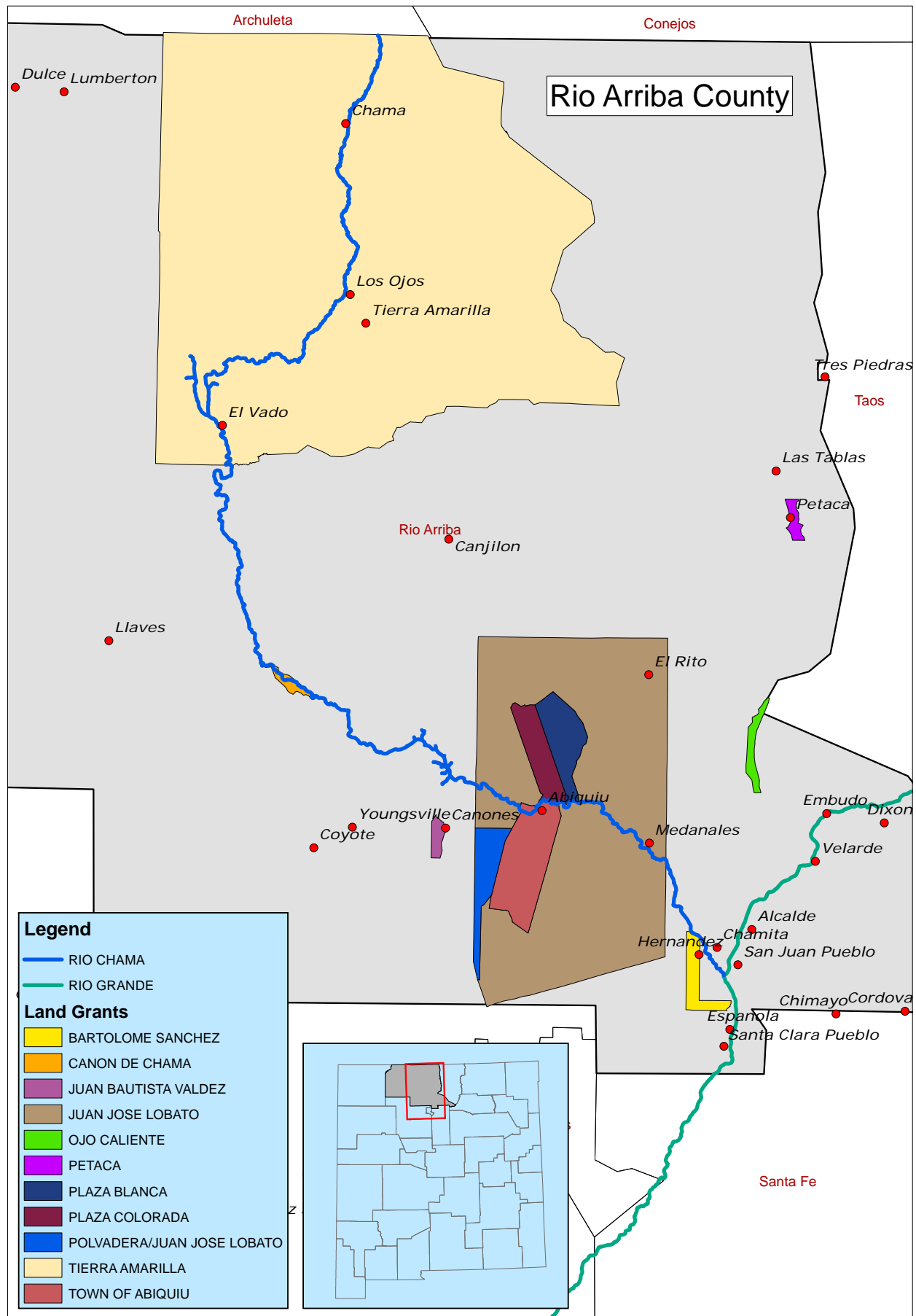


Figure 9. Tierra Amarilla and Other Land Grants in Rio Arriba County

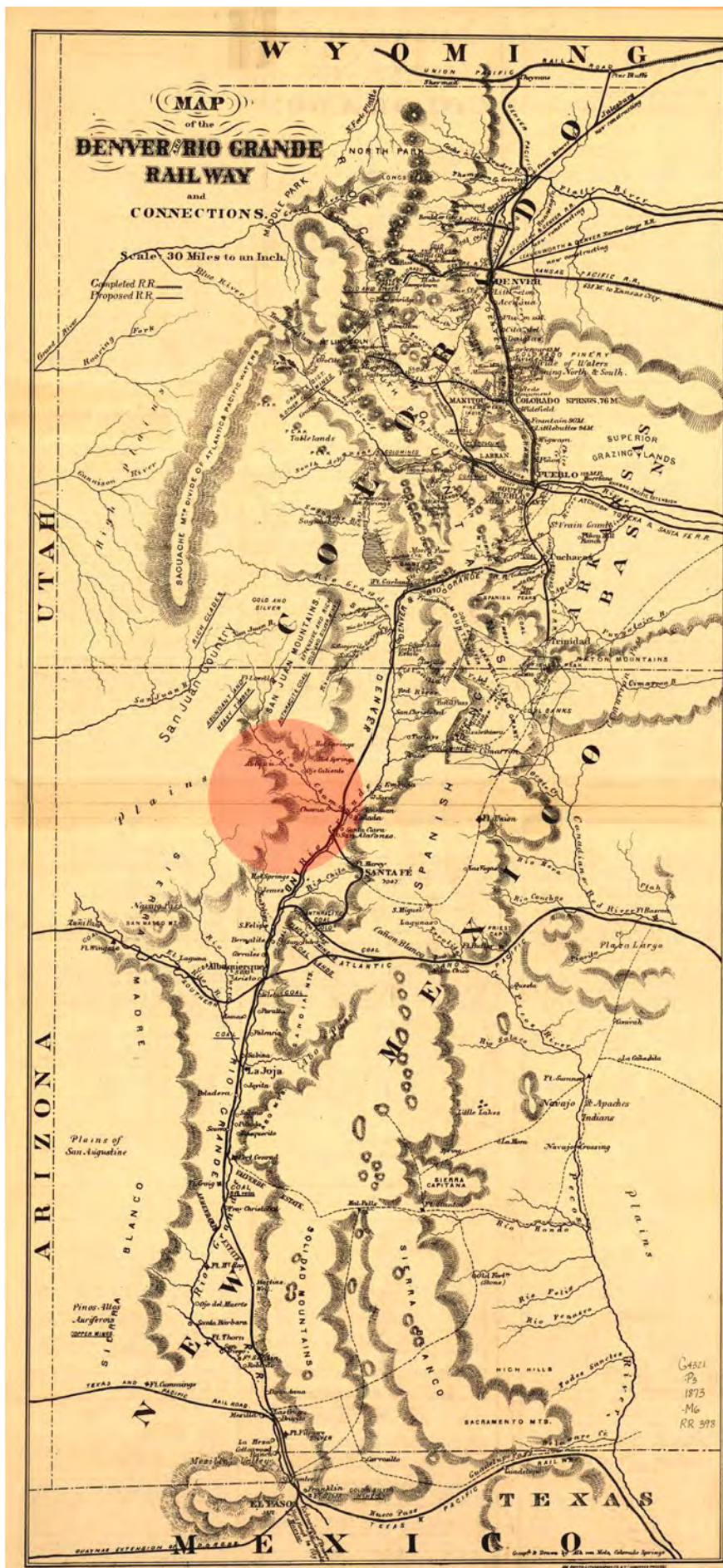
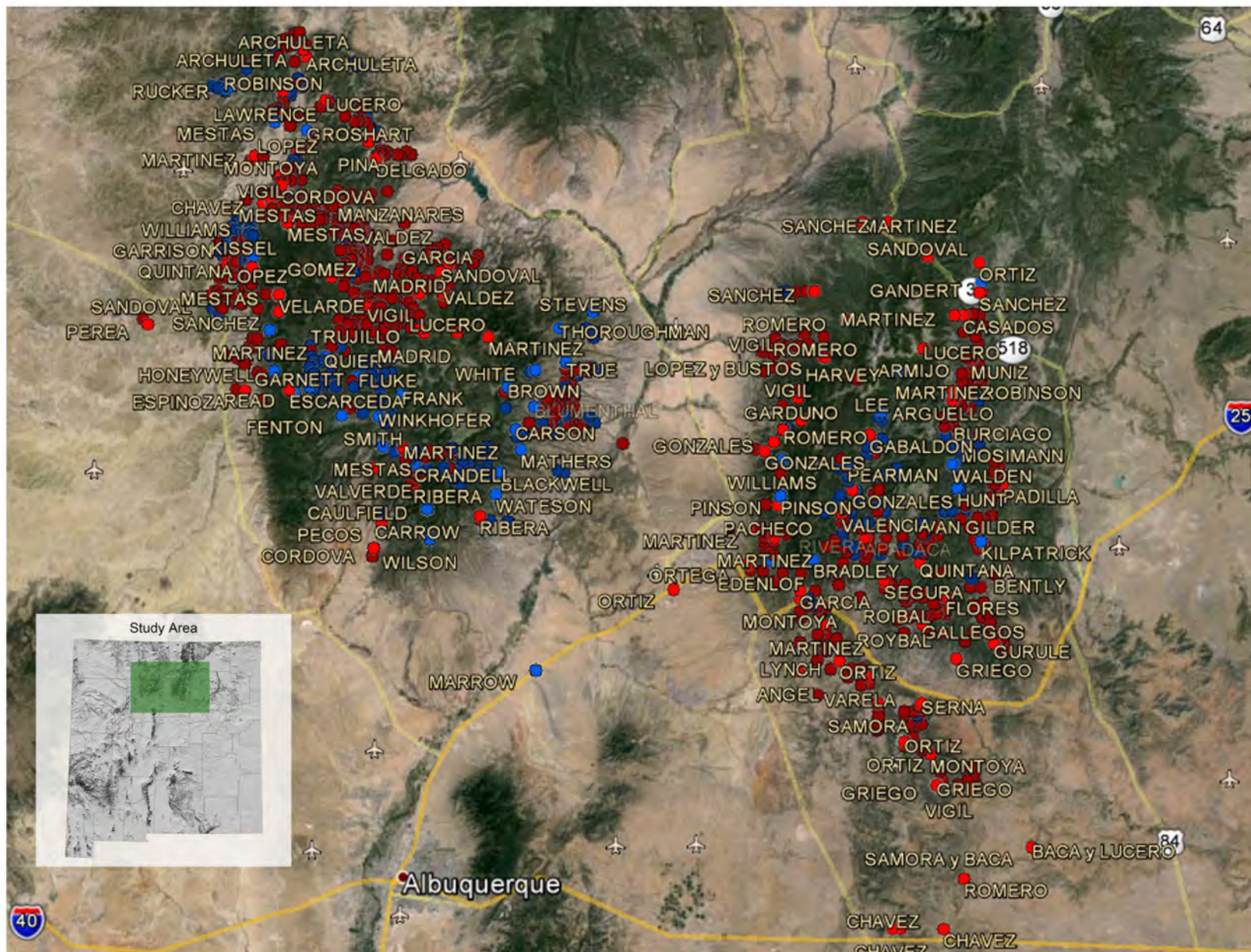


Figure 10B. DRGR 1873 Abundant and Heavy Timber



Santa Fe National Forest Homesteads

Initiated Under The
Act of June 11, 1906
For Settlers in the High
Elevation and Forested
Regions of North Central
New Mexico

A Study of the Rio
Chama Basin Funded by the
National Science Foundation
to New Mexico State University
Award #1010516

Compiled by:
Roberto Valdez, Research Assistant

Sponsored by UNM-CNH Project

Center for Regional Studies
and
Resource Center for
Raza Planning
University of New Mexico



Figure 11. Santa Fe National Forest Homesteads, Act of 1906 (Roberto H. Valdez)

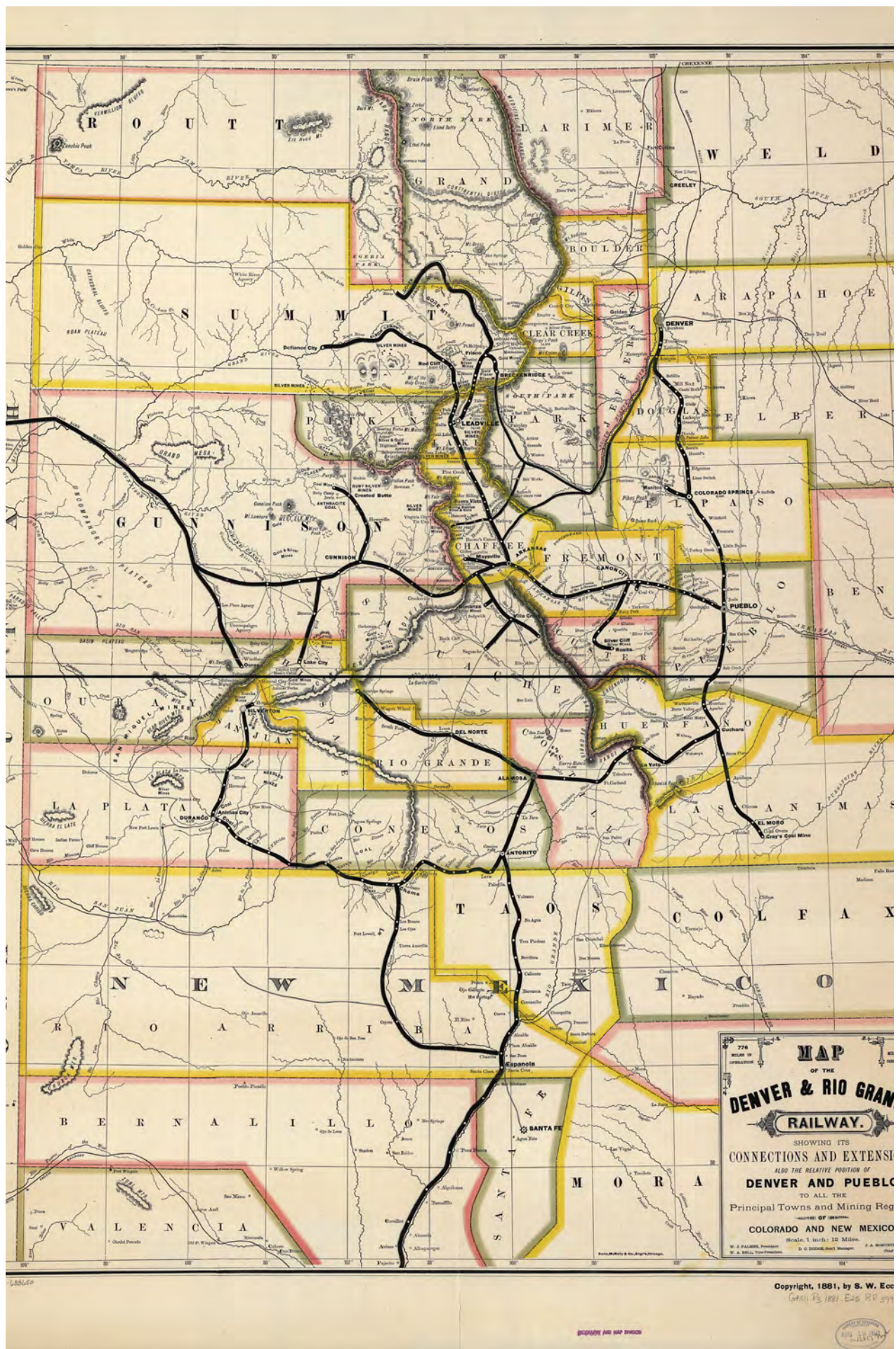


Figure 12A. Denver & Rio Grande Railway 1881 82

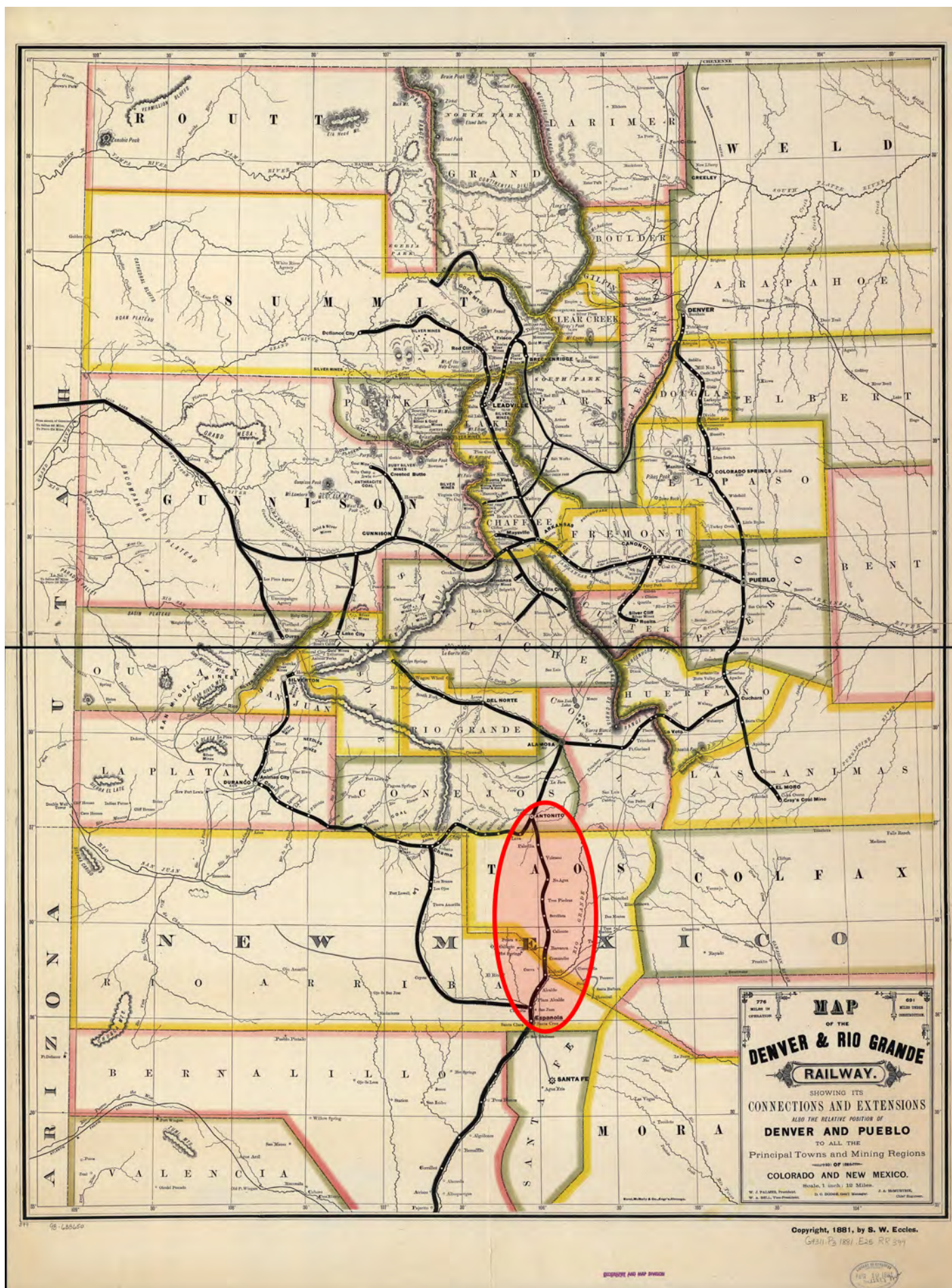


Figure 12B. Denver & Rio Grande Railway 1881Chile Line

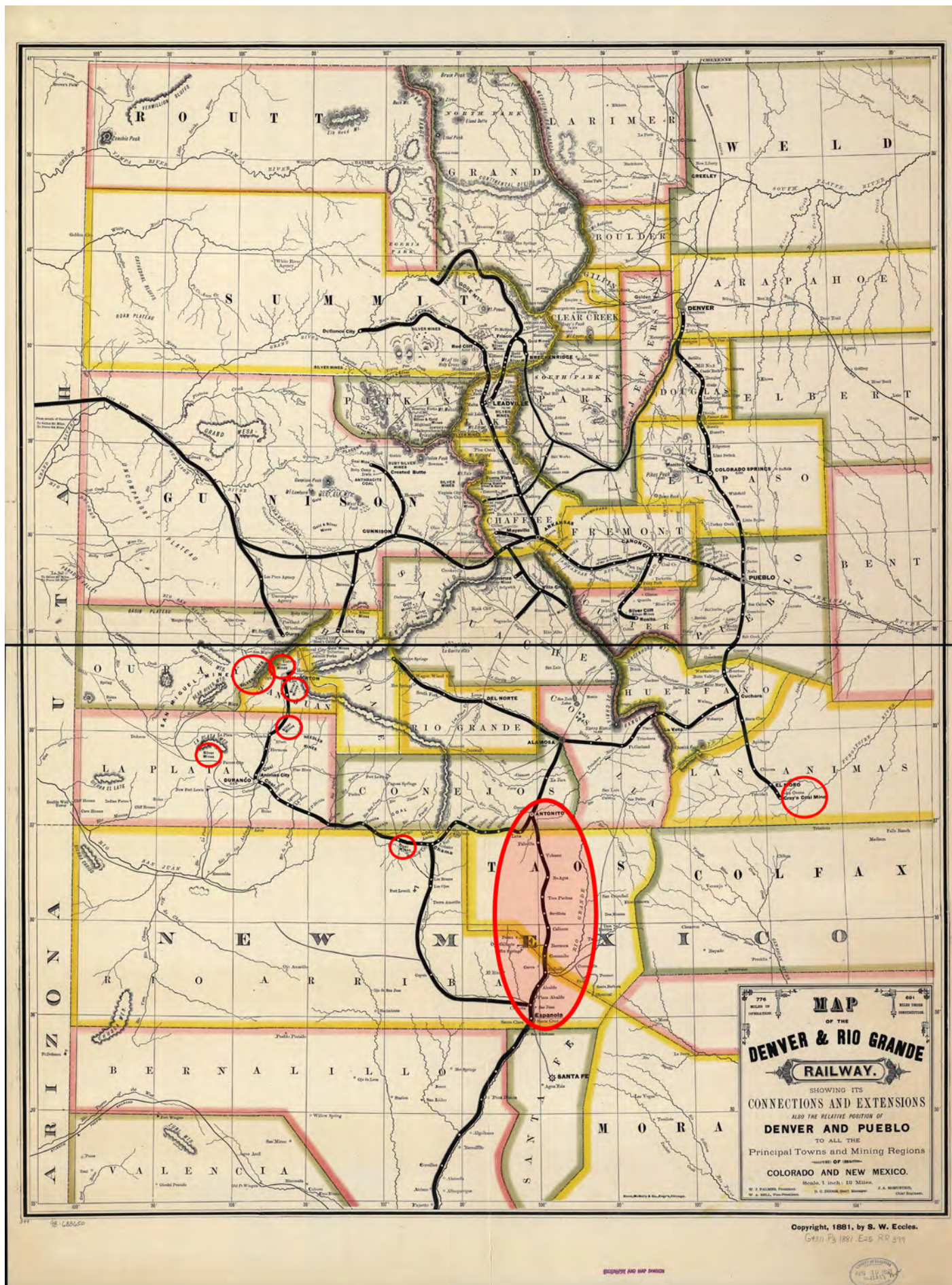


Figure 12C. Denver & Rio Grande Railway 1881 Chile Line and Minerals

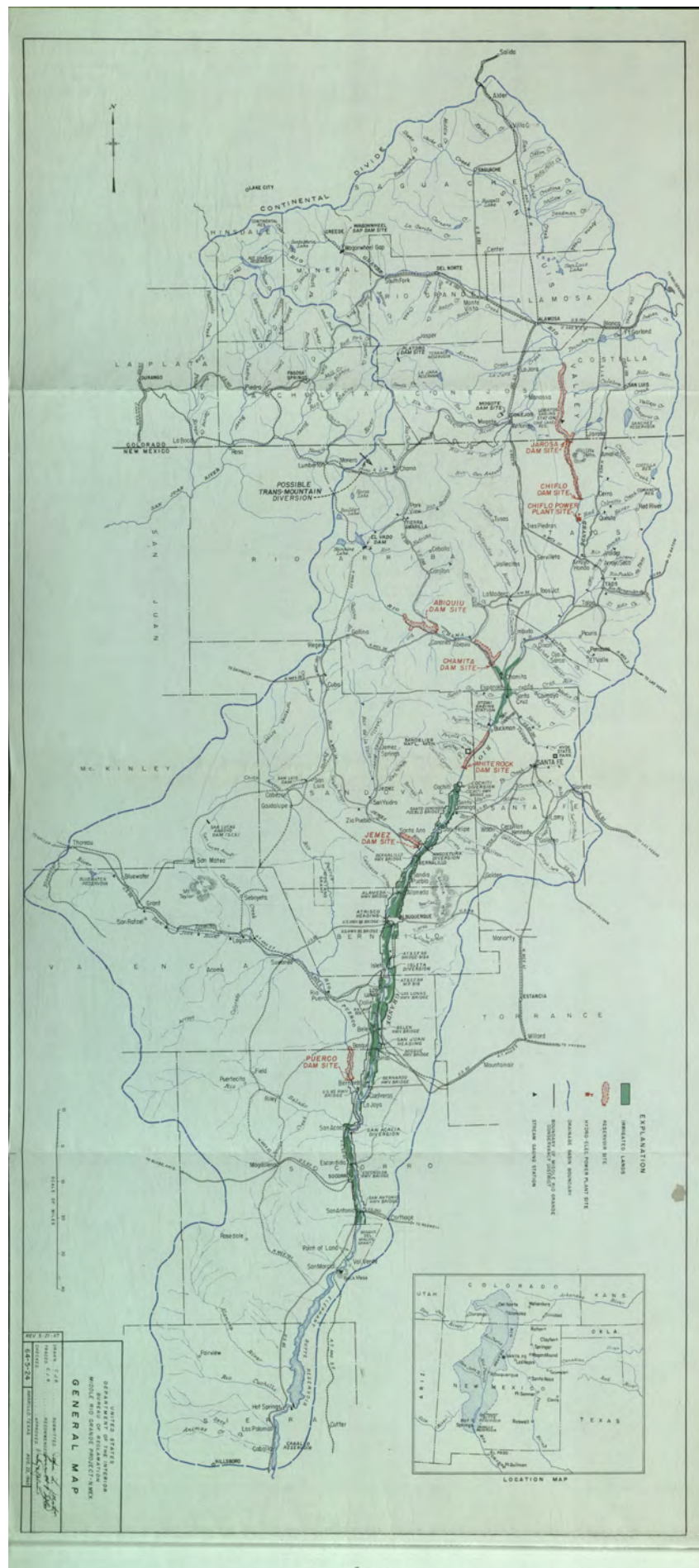


Figure 13A. Middle Rio Grande Project NM-1945

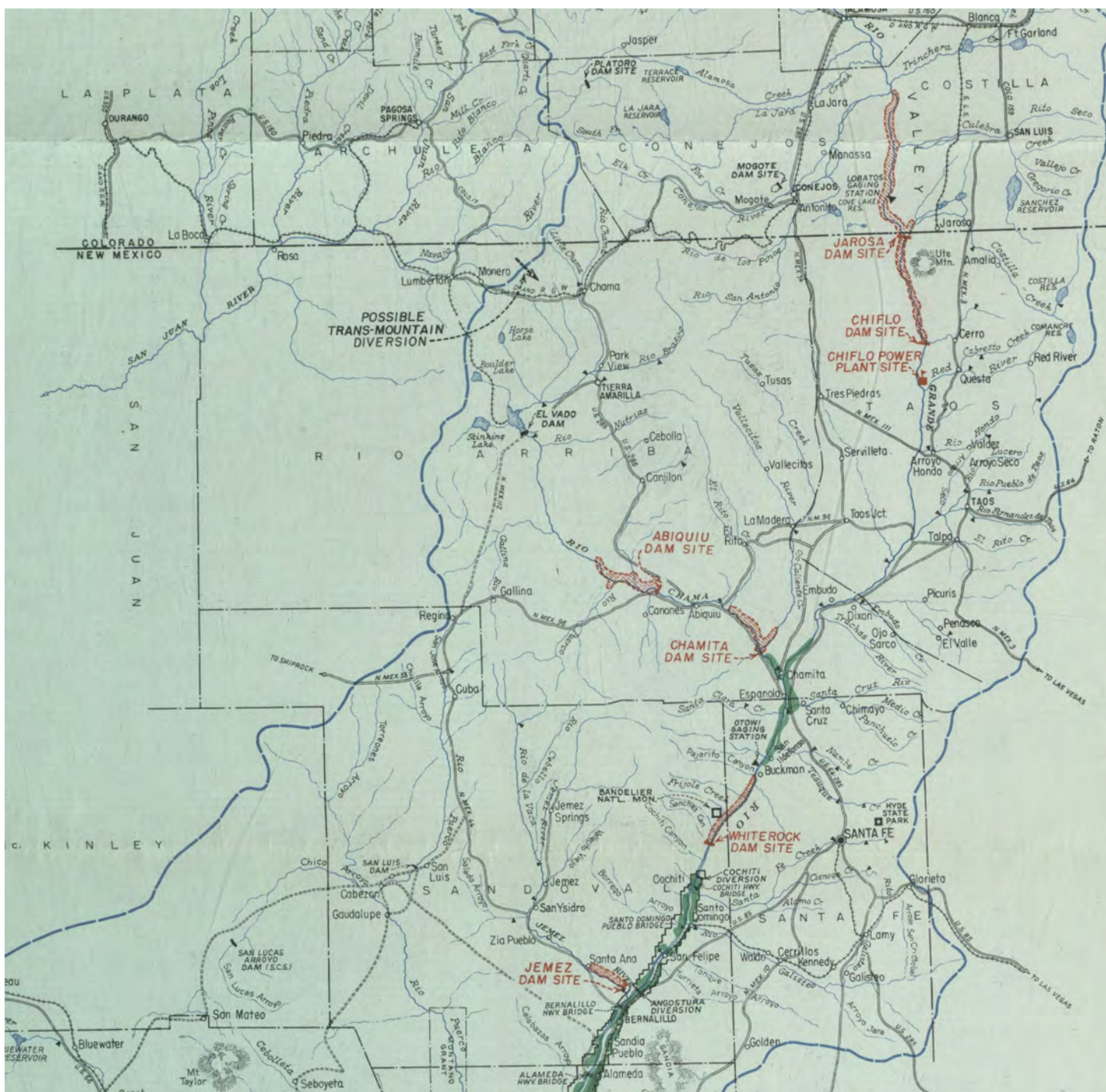


Figure 13B. Middle Rio Grande Project-NM 1945 Rio Chama Sites

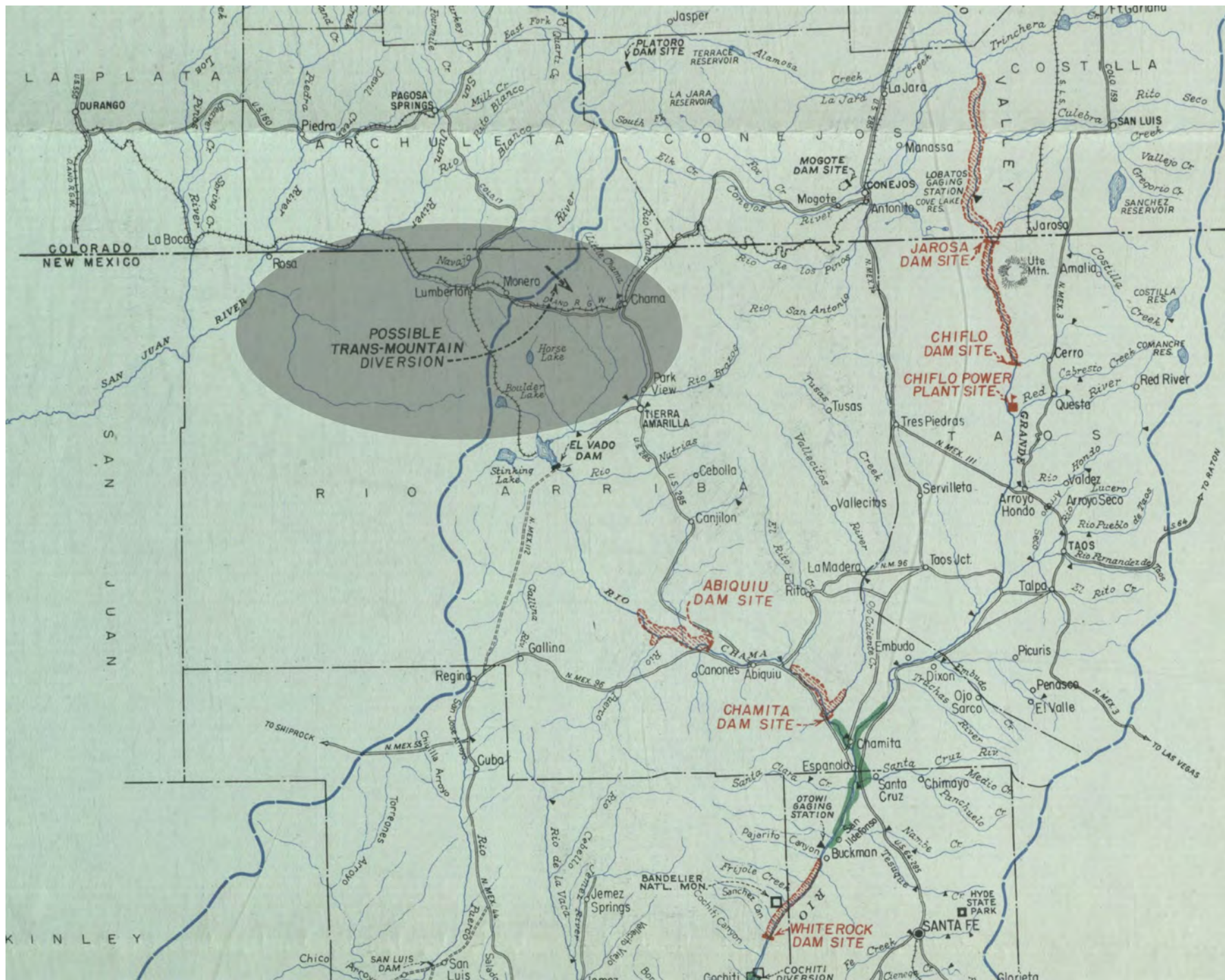
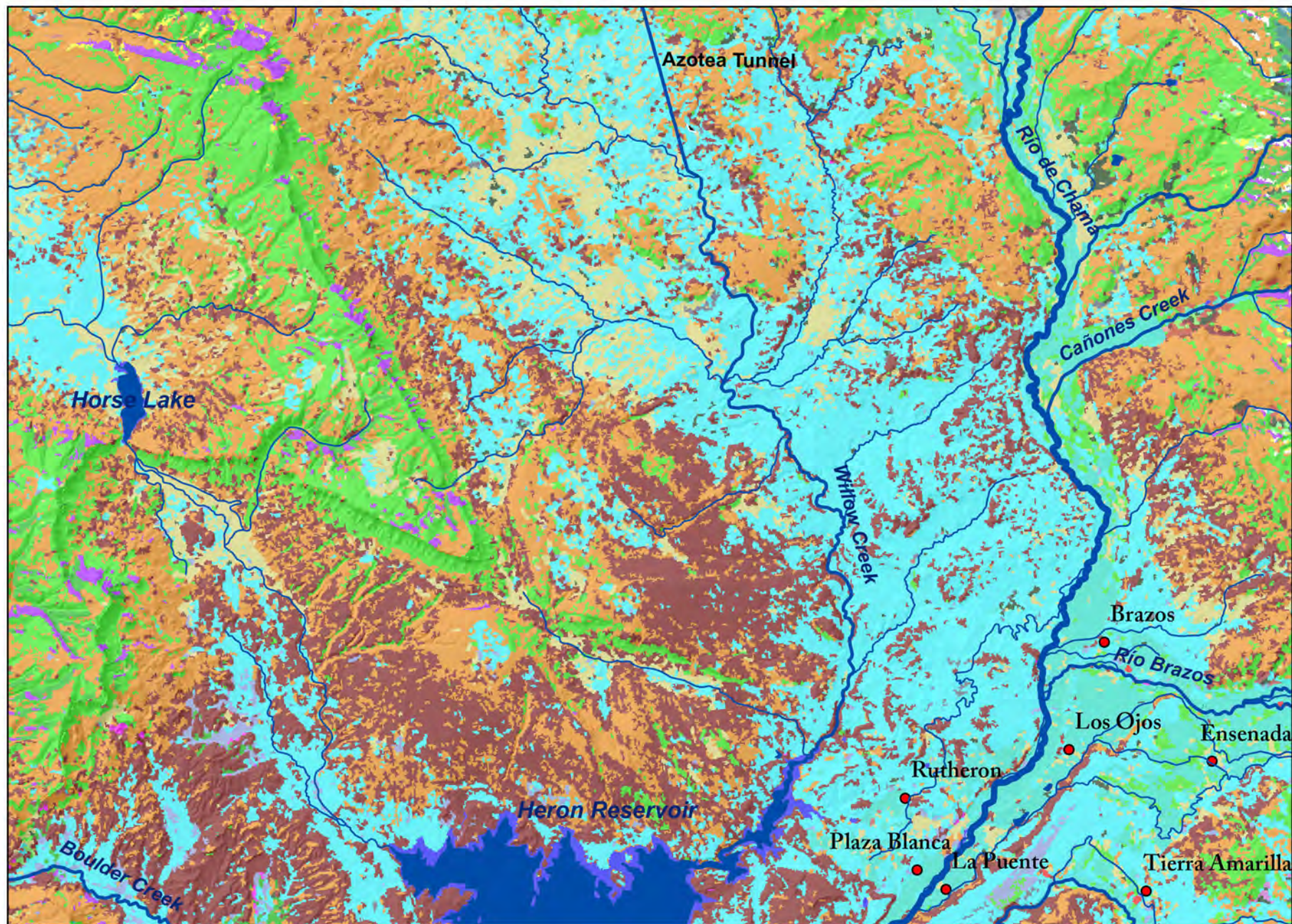


Figure 13C. Middle Rio Grande Project-NM 1945 Transmountain Diversion Site



Figure 14A. Azotea Tunnel and Heron Reservoir

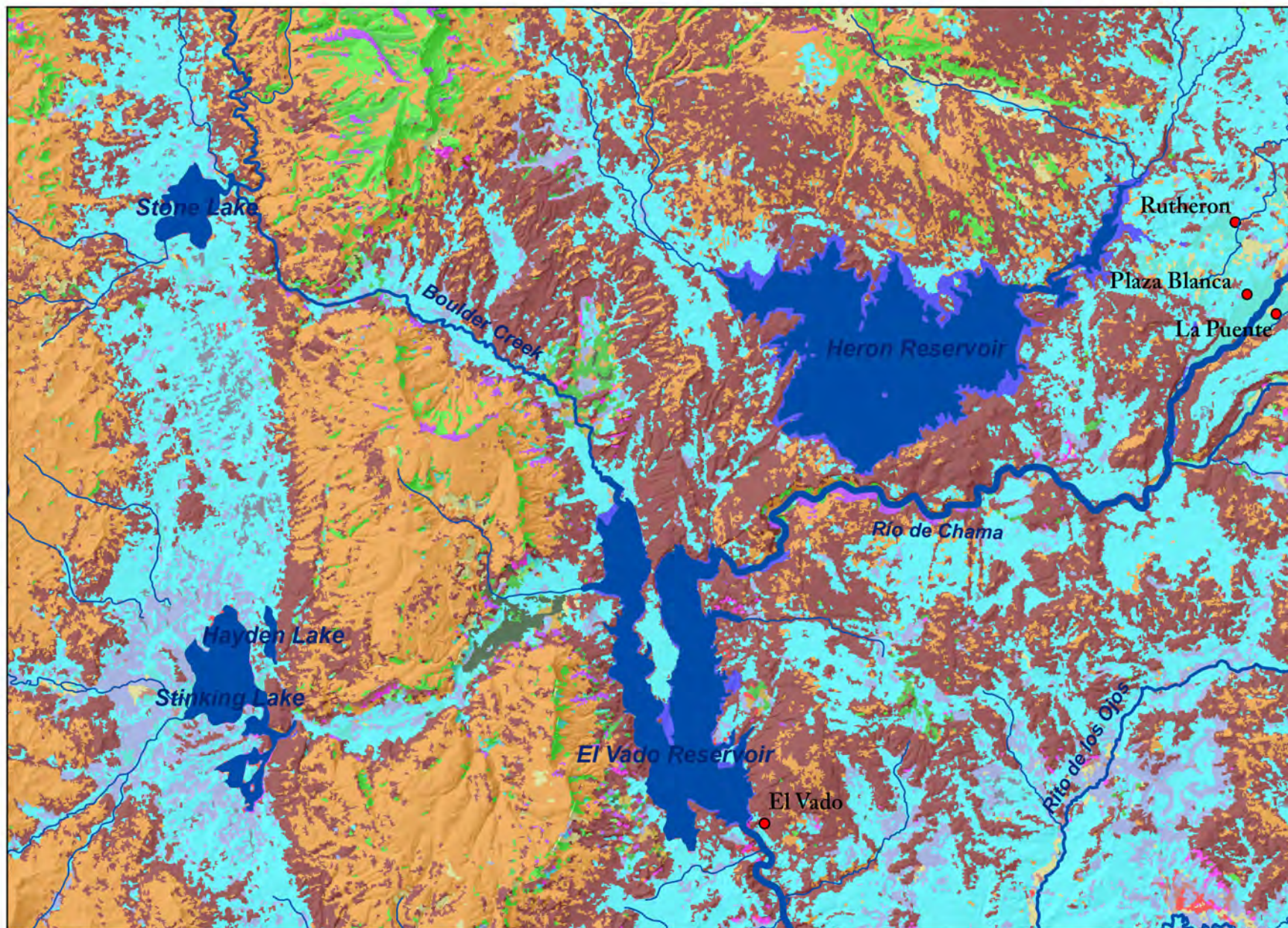


0 0.5 1 2 Miles

Rio Arriba County Landcover and River Systems

UNM School of Architecture and Planning
Community and Regional Planning Program
CNH: Acequia Water Systems Linking Culture and Nature:

Figure 14B. Azotea Tunnel and Willow Creek



0 0.5 1 2 Miles

Río Arriba County Landcover and River Systems

UNM Center for Regional Studies
 CNH: Acequia Water Systems Linking Culture and Nature:
 Integrated Analysis of Community Resilience to Climate
 and land-Use Change

Figure 14C. Heron and El Vado Reservoirs

New Mexico's Water Planning Regions

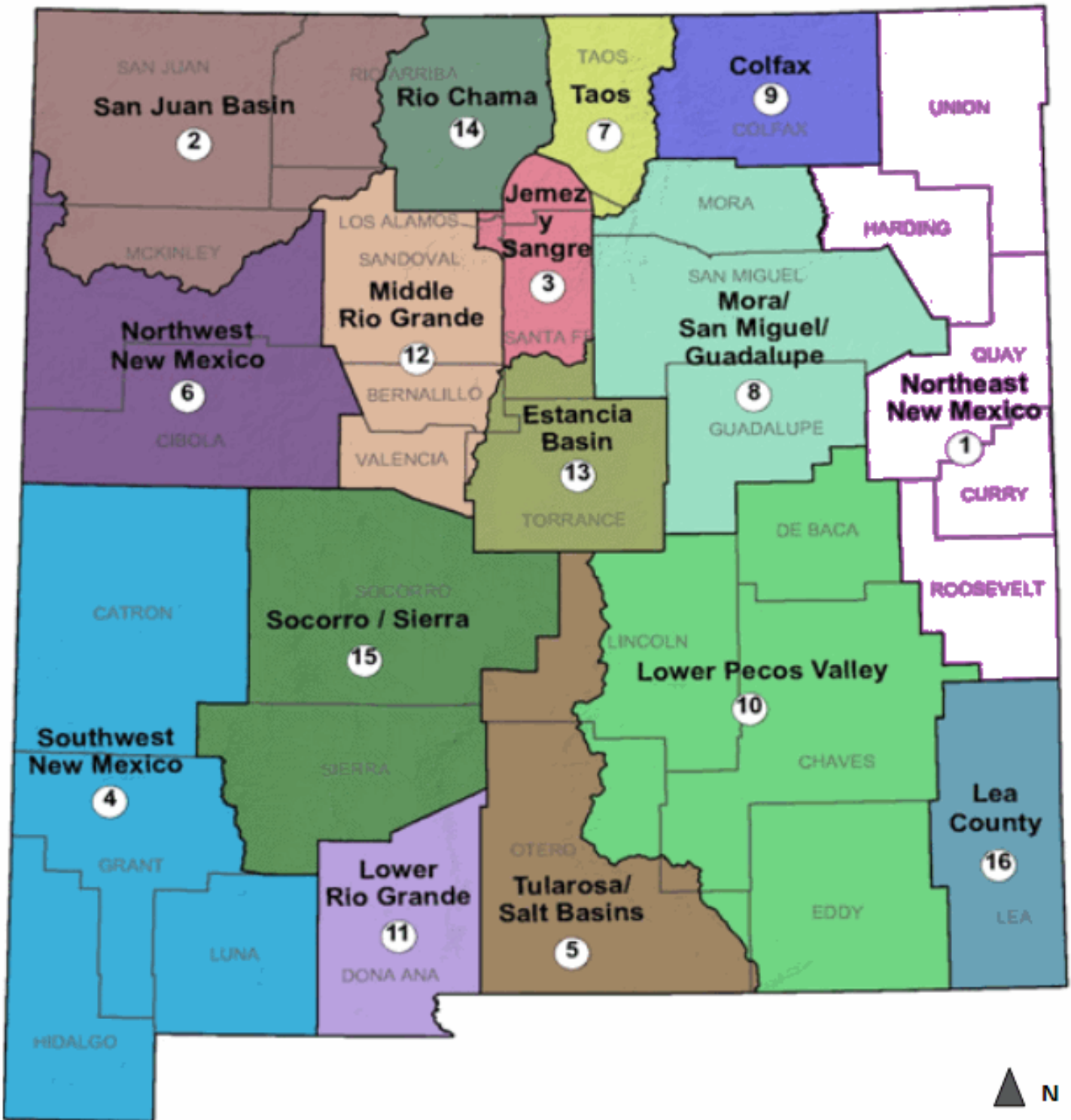


Figure 15A. NM Water Planning Regions (NM Office of the State Engineer)

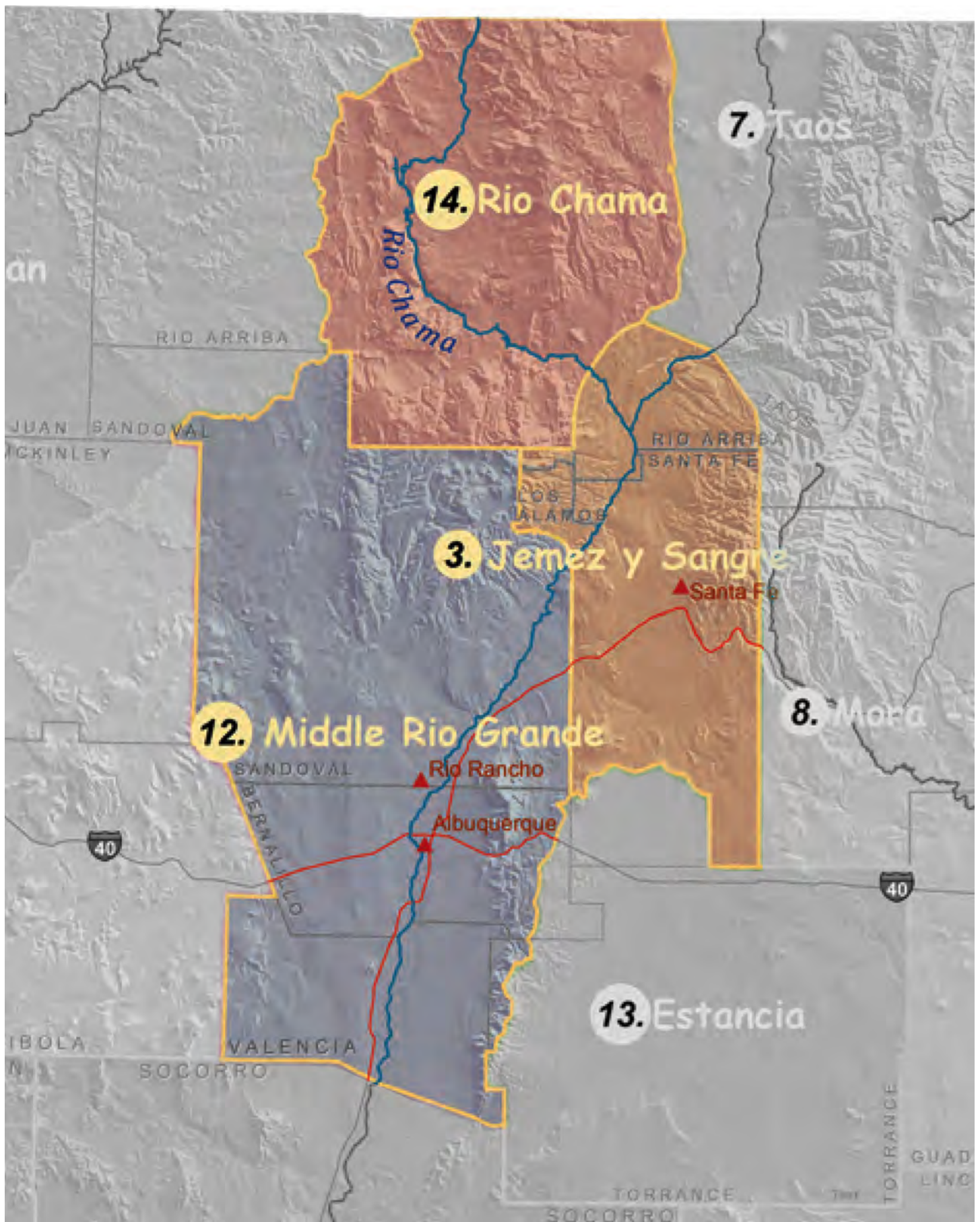


Figure 15B. NM Water Planning Regions 14, 3 and 12 (NM Office of the State Engineer)



Figure 16. SJCP Adjustable Dam on Rio Grande at Alameda

CNH Modeling Strategy for the Rio Chama Basin

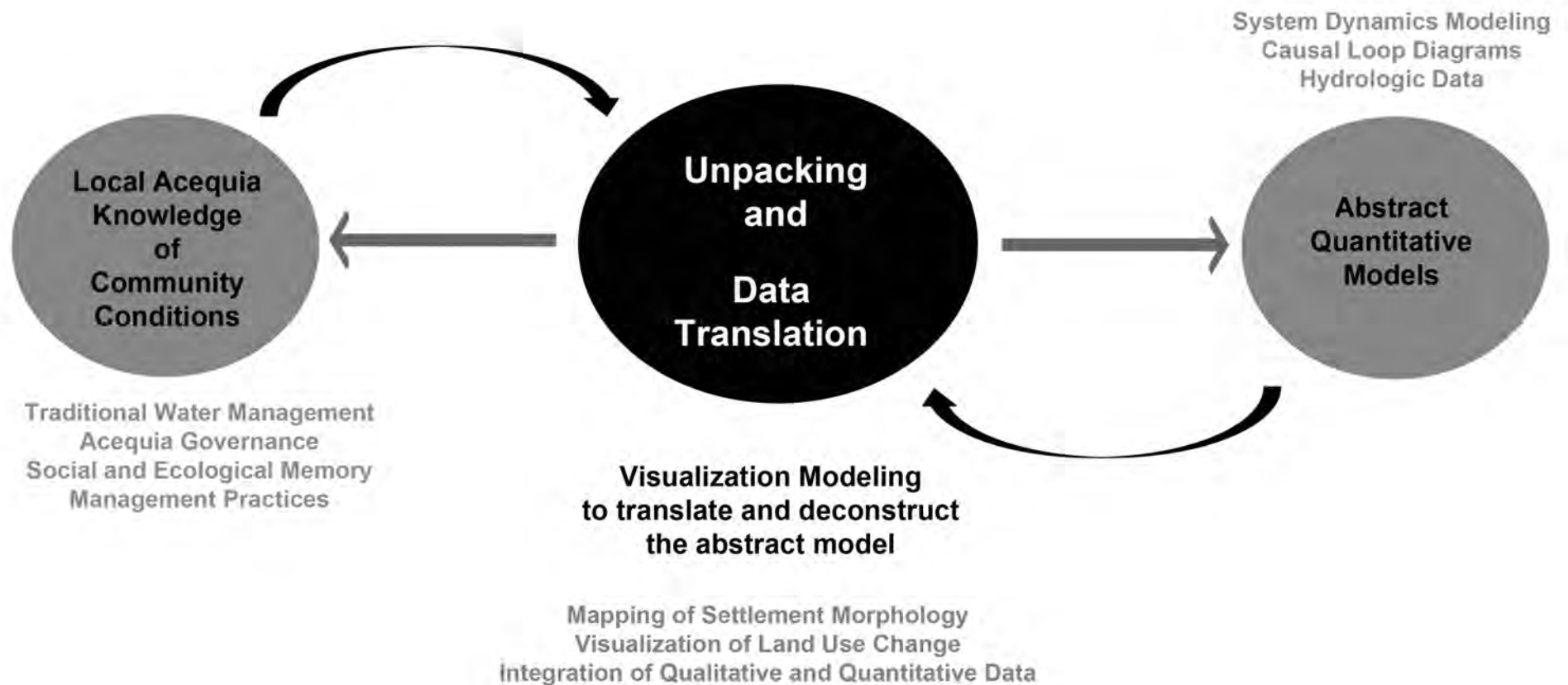


Figure 17. Visualization Modeling Diagram



Figure 18A. El Rito Valley and Sapawe Pueblo



Figure 18B. Sapawe Pueblo

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Figure 19A. Nicolas Sanson Map 1650 Amerique Septentrionale



Figure 19B. Niclolas Sanson Map 1650 Amerique Septentrionale Apache Bands

TABULA GEOGRAPHICA MEXICÆ ET FLORIDÆ &c.



Figure 19C. Guillaume de L'Isle 1722 Carta du Mexique et de la Floride

TABULA GEOGRAPHICA MEXICÆ ET FLORIDÆ &c.



Figure 19D. Guillaume de L'Isle 1722 Carta du Mexique et de la Floride Apache Bands



Figure 19E. Alzate y Ramirez 1768 Mapa Geographico de la America Septentrional. 101



102