WATERSHED RESTORATION ACTION STRATEGY

FOR THE GALISTEO CREEK WATERSHED

An Adaptive Management Plan for Ecological Health of the Galisteo Watershed

Version July 1, 2005
(an ongoing planning process)

By Earth Works Institute
Santa Fe, New Mexico

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Prepared by Earth Works Institute
& The GWRP-WRAS Committee

under a grant from the State of New Mexico
Environment Department - Surface Water Quality Bureau
(authorized by Clean Water Act, Section 319(h))
for The Galisteo Watershed Restoration Project

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For the Galisteo Creek Watershed
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Cover Page: Galisteo Creek at Lower Canoncito at the Brown property during high spring flows in March-April 2004. Photo courtesy J.W. Jansens, April 9, 2004.

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I. EXECUTIVE SUMMARY

The Galisteo Watershed, a 730-square mile drainage basin (467,200 acres), is located in central New Mexico, spanning western San Miguel County, south-central Santa Fe County and eastern Sandoval County. The headwaters of the Galisteo Creek start in the southern Sangre de Cristo Mountains at about 9,500 feet and on the Glorieta and Rowe Mesa at 7,500 feet. The creek flows over a valley length of about 54 miles to its confluence with the Rio Grande at Santo Domingo Pueblo at 5,180 feet. The Galisteo Watershed is part of the Rio Grande-Santa Fe hydrologic unit (HUC: 13020201).

Water quality in the Galisteo Creek is impaired by stream bottom deposits (sediment), caused by the cumulative and historical impacts of grazing, urban development and large-scale stream modifications related to railway building and agriculture in the past 125 years. The Galisteo Creek is an intermittent stream with both snowmelt and summer storm flows. About 10% of the stream length is perennial. In many places, the stream is incised in the landscape, leading to perched grasslands which have dried out, are dissected by gullies, and are very susceptible to erosion. Ongoing urban development leads to annually increasing rates of stormwater runoff and peak flows in the Galisteo Creek. Long-term neglect of ecological and cultural landscape values and resources has contributed to dwindling ecological health and has led in many locations to poor vegetation cover and diversity and accelerated levels of erosion.

In 1998, Earth Works Institute (EWI) of Cerrillos and Santa Fe initiated the Galisteo Watershed Restoration Project to address problems of erosion, water table draw down, and erosive flooding in the Galisteo Creek. With private funding and public funding from the Clean Water Act Section 319(h) (through the New Mexico Environment Department), the U.S. Fish & Wildlife Service, and the U.S. Forest Service, EWI formed a collaborative partnership of stakeholders in the watershed and established education projects, restoration demonstration sites, and a process of community organizing. Through many meetings, public education and outreach, and the identification of the multitude of planning and land use initiatives in the watershed, EWI and project partners have been able to establish a watershed association, the Galisteo Watershed Partnership (GWP). The GWP received support from Santa Fe County through County Resolution 2005-87 on June 28, 2005.

EWI and its partners formulated a Watershed Restoration Action Strategy (WRAS – this document) to provide a long-term guidance strategy to the GWP. The WRAS is a plan in process and includes a vision and strategy components developed during the GWRP and the development of the GWP between 2002 and 2005. The WRAS identifies eight popular issues of concern for the Galisteo Watershed: (A) Flooding, (B) Russian olive and tamarisk proliferation, (C) Soil erosion, (D) Pinon pine die off, (E) Open space creation and urban growth, (F) Wildfire, (G) Grassland health, and (H) Water availability.

The WRAS proposes that the GWP's ecological and open space programs foster landscape health in the Galisteo watershed. The **goal** for the WRAS is to establish a healthy, working landscape that reflects (1) people's

stewardship for the land, (2) economically healthy communities, and (3) resilient and diverse ecosystems. The WRAS identifies three **action priorities** for future planning on a watershed scale:

1. Establishment of a stakeholder advisory and coordination body
2. Soil erosion and runoff control
3. Water retention (sequestration) in the landscape

This WRAS proposes to pursue these goals and action priorities through a set of strategies and planning and implementation principles. The strategies include:

A. The establishment of a watershed association (Galisteo Watershed Partnership)
B. The development of a watershed-wide master plan for "green infrastructure"
C. The development of a multi-year wetlands planning, development, restoration, and conservation program
D. The development of runoff management standards and protocols from roads and built-up areas
E. The development of a selective forestry approach and public/private woodlot management strategy for managing forests and woodlands and for managing invasive species
F. The development of managed grazing protocols and plans for private and public land holdings (and lease areas)
G. The development of wildfire management and education strategies
H. The continuation of (i.e. development of new) stream rehabilitation projects

The WRAS proposes the following planning and landscape rehabilitation principles:

- Collaboration and partnership networks
- Community organization
- Demonstration restoration projects
- Education and outreach activities
- Monitoring and evaluation
- Economic incentives to make landscape restoration pay for itself over time
- Holistic, integrated planning and management of the watershed as one ecosystem and one management unit
- The regeneration of soil as the "sponge" of the landscape and techniques that focus on harvesting stormwater runoff

Implementation of this strategy may require $240,000-$310,000 annually. In addition, it will require rigorous monitoring of interventions to ensure a continuous learning process, timely adaptation and maintenance of rehabilitation projects, and a long-term track record for measuring progress towards project goals. In addition, the GWP, in collaboration with public land management agencies and elected officials from local and state governments, should seek to establish a new water and watershed governance system. Such a watershed governance system should be based on democratic principles and include management and governance processes on a watershed scale. It should address the development of a water and watershed ethic through public education and the celebration of oral history and cultural and spiritual values of water. The water(shed) governance system should also include regulations and enforcement at a local and regional level as well as incentives for water users to be good stewards of land and water resources in the watershed.

II. INTRODUCTION

The Watershed Restoration Action Strategy for the Galisteo Creek

The Watershed Restoration Action Strategy (WRAS) for the Galisteo Creek includes a description of water quality impairments and a series of recommendations for improving the ecological health of the Galisteo Watershed. The WRAS identifies long term goals for watershed improvement, agencies and communities interested in being involved in the process, and the most problematic and high impact areas of the watershed. The WRAS describes the outcomes of a public debate and visioning and planning process on the technical, educational and financial components of watershed restoration. It is the intent of EWI and the WRAS contributors that this WRAS serves as a guide to the Galisteo Watershed Partnership, which is being established in 2005.

Since 2000, EWI assembled this WRAS as a plan with recommendations for future actions in the Galisteo Watershed. The recommendations are based on a series of meetings in 2003, a community survey and input from a committee of five Galisteo Watershed residents (the WRAS Committee). The WRAS Committee was composed of interested residents who attended monthly public community meetings in 2003 and 2004. The New Mexico Environment Department (NMED), under a grant from the U.S. Environmental Protection Agency (Clean Water Act Section 319(h)), provided the funding for the compilation of this WRAS.

In the last decade, residents and stakeholders in the Galisteo Watershed have become increasingly aware of the importance of watershed health and of the need for planning for the social, economic, and ecological future of the watershed. This has led to a watershed-wide restoration and planning program, named the Galisteo Watershed Restoration Project (GWRP), coordinated by Earth Works Institute (EWI) in Santa Fe and Cerrillos, New Mexico.

The GWRP is an on-the-ground restoration and public education project that addresses site specific areas in need of remediation in the Galisteo Watershed. The project works with individual landowners to remedy soil and water conservation concerns affecting their properties and ultimately the entire community. The outreach associated with the project resulted in valuable input from the community at large. The on-the-ground work accompanies public education on watershed health issues and soil and water conservation.

Project Background

EWI established the Galisteo Watershed Restoration Project (GWRP) in 1998. EWI's goal for the GWRP has been "***to establish a working landscape in the watershed that reflects people's sense of stewardship and caring for the land***."

The main strategy components of the GWRP include:

- Education and outreach targeting land owners and local youth
- Technical assistance and facilitation of rehabilitation projects
- Documentation and publication of results

EWI has taken a leadership role in networking between agencies, communities, and partner groups, coordinating land restoration projects and disseminating information about restoration throughout the watershed. Outreach events include workshops, school programs, community meetings, and fieldtrips in the watershed.

EWI monitors project implementation and accomplishments by following a rigorous field verification plan, documented in a Proposal Quality Assurance Plan (PQAP) as approved by the NMED and EPA. EWI works

with a Technical Advisory Group (TAG) that provides Quality Assurance and Quality Control on the implementation and analysis of the field verification process. Monitoring activities include photo points, line point intercept and gap intercept (transects) for vegetation and geomorphological data gathering, longitudinal stream profiles, and rainfall data gathering.

EWI identifies three project phases in the history of the GWRP. The first phase covered the period of 1998 through 2000. During this time, EWI focused on the identification of watershed problems, the identification of the watershed community of stakeholder groups and neighborhoods, the area's geography, and outreach meetings in watershed communities and field tours with government agencies. In the project's second phase from 2000-2002, EWI focused on the development of demonstration sites to address problems related to runoff, erosion, and imbalances in stream morphology. EWI implemented several land and stream rehabilitation projects in three communities in the watershed and conducted education and outreach in local schools and neighborhoods. Currently, the project is in its third phase, which includes ongoing land and stream rehabilitation projects, grassland management planning, monitoring, and community organizing. Total investments for all three phases together are approximately $1,000,000, roughly half of which originates from government grants, while the other half includes volunteer and private in-kind and cash contributions. The New Mexico Environment Department (NMED) (through a U.S. Environmental Protection Agency grant), the U.S. Fish & Wildlife Service, the U.S. Forest Service, The McCune Charitable Foundation, the Five Star Restoration Fund, and private donors provided the project funding.

Methodology

The table of contents for this WRAS conforms to the one established for a WRAS by the NMED. Findings described in the WRAS were collected in the course of the GWRP.

From 1999 to 2003, EWI received assistance with data gathering on the watershed ecology from students and faculty from the University of New Mexico Community and Regional Planning Program. The students conducted rapid ecological appraisals and specific site assessments on soils, hydrology, vegetation, wildlife, and ecological relationships in the watershed. They also produced a series of GIS maps for specific thematic data sets.

In 2003, EWI established a WRAS Committee to assist with the development of a vision, direction, and prioritization of recommendations, along with additional fact finding. The WRAS Committee collected public input for the WRAS process through a community survey (Appendix 1). The WRAS Committee distributed 300 copies of a survey to sub-areas of the watershed. The survey generated 38 responses. WRAS Committee findings and survey responses were shared in monthly citizen-based Galisteo watershed educational meetings to verify the outcomes and generate feedback.

Between June 2003 and February 2004, the committee met twice a month to formulate the recommendations included in this document. Most of the ideas and technical discussion of the problems and possible solutions were developed during committee meetings. These findings were later combined with the outcomes from public visioning and planning meetings, called the Vista Clara Initiative, in 2004, and the initial planning priorities outlined by the Galisteo Watershed Partnership in 2005.

III. PUBLIC OUTREACH

What is a Watershed?

What is a "watershed"? What does this term mean? Why are we concerned with a long-term, strategic action plan for a watershed? What is a watershed management approach? These are the key questions that EWI and the WRAS Committee have been trying to answer in outreach and education activities with professional stakeholders and the public at large.

A watershed is a surface water catchment area within which all precipitation and surface runoff gathers in one central stream that empties in a larger water body, such as a river, lake or ocean. This area of land is confined by a topographic divide (i.e. the watershed boundary) that "sheds" precipitation either in one or the adjacent catchment (drainage) area.

Everybody lives in a watershed. Watershed areas range in size and scale from very small drainages of several thousand square feet that are drained by gullies (arroyos) to millions of acres that are drained by major rivers. The term "watershed" is typically used for drainage areas from about 10,000 acres in size to 500,000 acres. Larger watersheds are often referred to as river (or lake) basins.

The Galisteo Watershed includes 730 square miles (467,000 acres) and could technically be called a "drainage basin" (or "water catchment basin"). Locally, the word "basin" is typically used, however, for the geo-hydrological basin beneath the surface water basin. Therefore, EWI and the WRAS Committee have chosen to speak of the "Galisteo Watershed" meaning the entire surface water drainage basin from the forested headwaters to the confluence with the Rio Grande.

The shaded relief map for the watershed (Appendix 2) clearly reveals the basin shape and the headwaters of the Galisteo watershed where the Galisteo Creek originates. Every watershed hosts the headwaters of rivers and creeks which travel from higher elevations down to confluences with other rivers and streams.

Understanding what a watershed is provides a valuable tool for evaluating our land and water resources in New Mexico, and throughout the country. John Wesley Powell explored the Southwest and determined that the water resources were the defining characteristic in settling the West. During Powell's first sojourn down the mighty Colorado River he realized that water use in the West would ultimately define our economy and shape our livelihoods.

Historically, land use in New Mexico focuses on water rights and availability. Watershed planning is an approach to natural resource management similar to the traditional management system of *acequias*, the irrigation ditches that have been the life source for communities in the Southwest for the past four centuries. Land stewardship and watershed planning share management and community planning activities. Watershed planning focuses on sustainable practices to conserve water and soil and to increase infiltration of water to sub-surface aquifers and springs. Such practices may lead, for example, to a decrease in runoff and an increase in (native) vegetation. Runoff causes extensive soil loss resulting in diminished useable land area. Runoff includes overland (surface) flow and rainwater that has seeped or flowed into the vadose[1] zone (soil-water) before entering the river or creek. Water enters the vadose zone through infiltration. Infiltration is easier when there is vegetation on the surface soil. The vegetation protects the soil from drying out and from the impacts of heavy grazing, development, compaction by heavy rains, and other disturbances.

[1] Vadose zone is the underground water above the groundwater zone. Water in the vadose zone originates from capillary forces that draw water up from the water table and from rainfall infiltrated in the soil.

What is a Watershed Management Planning Approach?

EWI and the WRAS Committee formulated this kind of long-term, strategic action plan for the Galisteo Watershed because of the opportunity it offers for landscape-scale coordination of interventions aimed at maintaining and rehabilitating water quality and general landscape health. Such coordination at a landscape scale is possible because of the ecological and geo-hydrological interconnectedness within a watershed. A planning approach that takes into account the ecological and geo-hydrological relationships in a watershed can in principle reach more cost-effective and lasting solutions to allocation and sustainability problems of land use and natural resource management. Over time, we hope to prove that this supports Powell's premise that such an approach to water resource governance and planning best supports the economy and local livelihoods.

A watershed management planning approach helps citizens and governmental bodies address concerns about water quality, water supply, wetlands, air quality, wildlife habitat and socio-economic health at a landscape scale. Watershed management planning helps address the historical challenge to sustain inhabitants in the region and plan for social, economic, and ecological future of the watershed.

Watershed management involves multiple stakeholders working together on information gathering, technical assistance, and natural resource planning. The stakeholders within the basin play a significant role in watershed planning. This coordinated approach results in a collaborative plan for the watershed, meeting the resource challenges of the watershed and the needs of landowners, businesses, private citizens, county, state and federal agencies while preserving the integrity of the natural ecosystems of the watershed.

According to the EPA, "a watershed management framework supports partnering, using sound science, taking well-planned actions and achieving results."[2] In addition, this framework utilizes data spanning socio-economic, geographic, geologic, social demographics and historical variables that are unique to the area. This approach allows stakeholders and community government to make more informed choices and make regional problem-solving more inclusive.

A Public Dialogue on Watershed Health

Outreach and education (O&E) have been a priority in the Galisteo Watershed Restoration Project (GWRP) since 1998. O&E strategies include partnerships with schools, colleges, other non-profit organizations, businesses, communities, and government agencies. O&E events included networking, educational workshops, field trips, school programs, community meetings, seminars and other community events and festivals. Earth Works Institute (EWI) assisted in efforts to form a citizen-based watershed network, resulting in the WRAS Committee and the Galisteo Watershed Partnership. Monthly meetings were held in various public locations around the watershed, followed by a series of visioning and planning meetings in 2004 and 2005.

Workshops and educational materials focused on stream restoration, managed grazing, and erosion control techniques. Additional O&E involved an environmental education curriculum geared to 4th graders. Curriculum materials included a student workbook, a teachers' guide, an educational video and a coordinator's manual with background materials on watershed restoration techniques. EWI also produced a workbook for landowners on restoration methods and techniques called *Going with the Flow.* In coordination with the Quivira Coalition, Bill Zeedyk and Kirk Gadzia, EWI produced three Technical Field Guides covering specific erosion control techniques, stream restoration with Induced Meandering, and managed grazing.

In the fall of 2002, EWI launched a series of community meetings to explore the interest in establishing a watershed association for the Galisteo watershed. These meetings revealed that there was a great need for educational meetings and events before residents were comfortable to form a watershed association. Over time,

[2] US Environmental Protection Agency. Watershed Academy Web. *Principles of Watershed Management.* http://www.epa.gov/watertrain/watershedmgt/principlea.html. 07-14-04.

EWI and residents worked with a committee of volunteers (the Agenda Committee) to organize 14 community meetings and educational events in 2003 and 2004.

In November 2002, EWI also hosted a meeting with representatives from urban development and planning firms, conservation groups, and the Santa Fe County Planning Department to discuss urban development planning at the Thornton Ranch and other areas in the Galisteo watershed. EWI staff continued meeting with people from these groups to explore the possibility of establishing a public dialogue on open space conservation and urban development issues in the watershed.

This led to the creation of an informal steering group, consisting of EWI, the Santa Fe Conservation Trust (SFCT), the Santa Fe County Planning Division, and Carl Moore of The Community Store (serving as a facilitator). This group organized two visioning and planning meetings for community members and government officials, informally called the Vista Clara Initiative after the location of the meetings at the Vista Clara Ranch Spa and Resort in Galisteo. On February 28th, 2004, about 55 people gathered at the Vista Clara Ranch for the first watershed-wide meeting, *Paradox and Promise*. The meeting unveiled the prehistoric and historical land use in the basin reiterating the treasures of the land and what components were important to a shared regional vision. On May 6th, 2004, the partnership convened a meeting to discuss the outcome of the Vista Clara meeting with various government agencies. The attendees included county, state and federal agency representatives. On June 19th, 2004, the partnership organized a follow-up meeting at the Vista Clara Ranch, with the title *A Confluence of Initiatives*, to continue the public dialogue on what watershed planning meant for the Galisteo region and to clarify a vision for implementation (Appendix 3 includes the summary reports from the February 28 and June 19 meetings of the Vista Clara Initiative). The implementation vision includes strategic planning activities such as storm water management and runoff abatement, wetland development, vegetation management, archaeological preservation, and regional open space planning. Other recommendations explore techniques for preserving the land's value and unique characteristics and continuing to plan the vision of the basin's future. The outcome of the Vista Clara Initiative strongly influenced the establishment of the Galisteo Watershed Partnership and the formulation of the latest draft version of this WRAS.

Picture 1. Thor Sigstedt from Lower Canoncito at the June 19, 2004 meeting of the Vista Clara Initiative. Photo courtesy J.W. Jansens.

IV. THE GALISTEO WATERSHED

Location and Topography

The Galisteo watershed is located in central New Mexico, and stretches from the far western corner of San Miguel County, across southern Santa Fe County to eastern Sandoval County. The watershed is located in the southern part of the Rio Grande-Santa Fe hydrologic unit (HUC: 13020201). The Galisteo Creek drains a catchment area of approximately 730 square miles or 467,200 acres until it meets the Rio Grande. The watershed covers a large portion of the Galisteo hydro-geological basin and the southern part of the Santa Fe hydro-geological basin.

The Galisteo Watershed is named after the Galisteo Creek, which begins its course on the flanks of Thompson Peak and Glorieta Baldy. These peaks form the southern most reach of the Sangre de Cristo Mountains, officially the last mountain range of the Rocky Mountains. Other headwater creeks include Grasshopper Canyon, Deer Creek and Apache Canyon. These headwater creeks merge at Upper Canoncito to form the main stem of the Galisteo Creek, which has a channel grade of 2% or less. Each mountain creek valley is about eight miles long, while elevation differences between Thompson Peak (10,533 ft), Glorieta Baldy (10,199 ft) and Canoncito (6,937 ft) are significant. Elevation differences over the remaining part of the Galisteo Creek are relatively small. The confluence of the Galisteo Creek and San Cristobal Arroyo south of Galisteo is at 6,000 feet (approx. 16 miles of valley length from Upper Canoncito), the confluence of the Galisteo Creek with the San Marcos Arroyo in Cerrillos is at 5,670 feet (approx. 12 miles of valley length from the San Cristobal Confluence), the Galisteo Dam outflow point is at 5,500 feet (approx. 6 miles of valley length from the San Marcos Arroyo confluence), and the confluence with the Rio Grande at 5,180 feet (approx. 12 miles from the Galisteo Dam).

The Galisteo Watershed forms a bowl, originating from Cretaceous landforms created more than 70 million years ago. Since that era, sedimentation has filled the bowl with layers of shale and sandstone. Volcanic eruptions and related uplifts of the earth during the most recent 10 million years have largely shaped the landforms that we experience today. The bowl shape has been interrupted by a series of volcanic dykes that run from the northeast to west-southwest throughout the watershed. One prominent one runs from Glorieta Mesa to Galisteo and flanks the Galisteo Creek for many miles west of Galisteo. Other volcanic eruptions formed the Cerrillos Hills (7,097 ft) and the Ortiz Mountains (8,898 ft). These mountain areas flank the Galisteo Creek in its lower reach and cause it to be confined in a narrow rocky path until it empties in the delta of the Rio Grande.

Other prominent elevations include the Glorieta and Rowe Mesa (7,530 ft), which forms the eastern boundary of the watershed, and several island mountains, such as the White Bluffs (6,710 ft) on the San Cristobal Ranch and Cerro Pelon (6,870 ft) on the Ford Ranch a.k.a. Cerro Pelon Ranch. The San Cristobal Arroyo drainage area, which includes the Glorieta and Rowe Mesa and the White Bluffs, is more than 100,000 acres in size and the largest sub-watershed. U.S. Geological Survey (USGS) maps, therefore, identify it as the headwaters of the Galisteo Creek.

Besides the headwaters in the mountains and the San Cristobal Arroyo sub watersheds, several other prominent sub-watersheds contribute to the Galisteo Creek's water flow to the Rio Grande. These include the sub-watershed of the San Marcos and Gallinas Arroyos that drain the mountain slopes around Canada de los Alamos, the area of Eldorado, the grasslands of the western part of the Thornton Ranch, the southern parts of Rancho Viejo, and the San Marcos and Lone Butte area along Highway 14. This is the second largest sub-watershed and also the most developed and populated one. Other important sub-watersheds are those of the Arroyo La Jara flowing from the western flanks of the White Bluffs on San Cristobal Ranch and Gaviso Arroyo flowing from the eastern flanks of Cerro Pelon, the Arroyo Chorro and Cunningham Creek running from the eastern piedmont of Ortiz Mountain, and the Arroyo de los Angeles draining the central and eastern parts if the Thornton Ranch, just west of Galisteo. These three sub-basins are the most important contributors of sediment to

the Galisteo Creek, more or less in increasing order of sediment loadings. Other, smaller sub-watersheds originate from Ortiz Mountain in the southern part of the watershed and from the volcanic plateau north of the Galisteo Creek between Galisteo and La Bajada. These sub-watersheds are strictly ephemeral and carry little sediment to the Galisteo Creek. However, in their geological history they have formed significant alluvial fans in the floodplain of the Galisteo Creek, between which the Galisteo Creek negotiated its path. These drainages are known to cause serious flooding of the alluvial fans and the Galisteo Creek during localized summer thunderstorms, possibly due to the very limited infiltration capacity and short time of concentration of their respective drainage areas. The alluvial fans have played a crucial role in the settlement and agricultural land use patterns of the Native peoples that settled in the watershed in the thirteenth and fourteenth centuries.

Climate

The Galisteo watershed's high desert climate exhibits extreme weather conditions, great differences in weather from one place to another and from one year to the next. This makes it difficult to get an impression of the area's climate from looking at average or mean weather data only. The extremes tell as much about the potential and limitations for soil development, plant regeneration and habitat conditions for animals and humans. The extremes also explain in part the high levels of soil erosion throughout the landscape and sediment accumulation in the creeks of the watershed.

There are no official weather stations in the Galisteo watershed. Weather data for the watershed have to be created by interpolating data from weather stations in surrounding areas. Based on these data, EWI calculated that long-term average precipitation variability in the watershed runs from 25 inches in the mountains to 15 inches in Apache Canyon, 12 inches in Canoncito, 10 inches in Galisteo, and 8 inches and less in the lower central and western parts of the watershed. Glorieta and Rowe Mesa, Cerro Pelon, Ortiz Mountain, and other elevated areas may receive much more precipitation and even snow in the winter. In dry years, precipitation in the watershed has been as low as 4 inches, while in wet years, it has been 18 inches in the central parts and more than 40 inches in the mountains. In the forested mountains and on Ortiz Mountain a significant portion of the precipitation (perhaps 50% or more) falls in the form of snow. Heavy snowfall in the winter is known to cause prolonged spring runoff in the Galisteo Creek, sometime tying spring flows to summer flows.

Differences in rain intensity in time and space best exemplify the erratic weather patterns in the watershed. In 2001, the GWRP Galisteo demonstration site logged 0.51" on June 24 and 0.28" on May 3 as the most severe rain storms. In comparison, the EWI Ranch site, just five miles to the west, logged 1.51" on June 18 and 0.98" on August 27 as the most severe storms of that year. In another example, the Galisteo watershed received no rainfall of significance between December 1995 and September 1996, followed by fall and winter precipitation that made the Galisteo Creek run continuously from the headwaters to Galisteo during the entire winter, spring and summer of 1996-1997. After a period of relatively poor rainfall from 1997 through early 2004, spring runoff in March-April 2004 caused serious flooding and severe streambank damage in the Canoncito area with a sustained over-bankfull flow of two weeks. The spring of 2004 was followed by a dry summer in most of the watershed (8" or less), while different rain gages in the village of Galisteo logged 12"-13" of rainfall for 2004. Similarly, the winter of 2004-2005 has been the wettest on record, leading to heavy spring runoff and flooding in the Galisteo Creek in February 2005 with a sustained flow in the entire creek from Canoncito to beyond Cerrillos until June 2005.

Temperatures in the watershed range from about 35 degrees in the winter to 90 degrees in the summer. Extremes go down to 10 degrees or colder in severe cold spells and more than 100 degrees during heat waves. These temperature extremes seriously impact plant growth possibilities. As a result, evaporation, transpiration, and wind are severe in the watershed as well. In the central part of the watershed, the frost-free growing season for plants is about 180 days in the valley bottom and about 200 days in the hills, and runs roughly from late May through early October. Higher areas have a frost-free season from early June through mid September. Estimates for annual potential evaporation from water bodies and soils range from 19 inches in the central parts to 23 inches in the Rio Grande valley. These figures clearly exceed the annual precipitation, which means that

throughout the watershed the soil, water bodies, and life forms have a tendency to dry out rapidly. The watershed is also exposed to severe wind storms. In particular in the months of March and April and October and November, dry westerly and easterly winds damage soils and plants. The NRCS estimates that wind erosion on rangelands, like the ones in the Galisteo watershed, can be as high as 5 tons per acre per year. This is five to ten times more than the measured soil loss from surface runoff (sheet and rill erosion).

Water Resources

Water largely determines the geomorphological, ecological, and human habitation conditions in the Galisteo Watershed. Water sources and ephemeral streams have played a central role in the watershed's history. Yet, water remains an elusive resource and force in this landscape. Government agencies, private institutions and EWI have just begun to document and analyze some of the watershed's water resource characteristics. Large gaps remain in our collective data sets.

Surface water resources nourish the central riparian zone while providing drinking water for livestock and wildlife. The watershed's riparian zones are essential for wildlife habitat, visual quality and outdoor recreation.

The Galisteo Creek is a seasonally intermittent stream. The main stem from the Sangre de Cristo Mountains to Galisteo receives a significant portion of its water from snow melt and has a perennial or nearly perennial character in specific reaches, such as the Apache Canyon and the reaches near Valencia and in Galisteo. Due to the complex geological underground and the arid climate, certain reaches are water gaining while others are water losing, which explains the existence of certain perennial and intermittent reaches in the main stem. The San Cristobal Creek and the Galisteo Creek downstream from the confluence with the San Cristobal Arroyo (south of Galisteo) are predominantly ephemeral streams fed by rain storms.

The NMED-SWQB 303(d) list recognizes only 5.5 miles of perennial stream flow in the Galisteo Creek. However, observations by project staff and landowners indicate perennial sections of the creek might be higher than indicated in the 303(d) list. Long-term observations will be required to establish a more correct estimation of the perennial character of specific creek reaches.

The Galisteo Creek is listed as an impaired water body by the NMED-SWQB. It does not meet water quality standards for stream bottom deposits (2000-2002 State of New Mexico 303(d) List). The 303(d) list attributes the impairment to agriculture (rangeland conditions), hydromodification (channelization, dam and bridge construction), removal of riparian vegetation, and streambank modification and destabilization. Other detrimental impacts to riparian zones come from grazing, urban development and construction activities. The Galisteo Creek was channelized to protect the railroad from Las Vegas to Albuquerque because the majority of the rail line was built in the floodplain. In addition, runoff from the highways, residential areas and construction sites constitute a significant part of the non-point source pollution in the watershed and the stream bottom deposits reported in the 303(d) list. Several evaluations suggest that rangeland conditions in many locations are non-functional for grazing purposes. Even limited grazing by cattle and horses causes considerable damage to soil and vegetation which accelerates runoff and soil erosion, and accumulation of stream bottom deposits in the creek.

Groundwater resources provide domestic drinking water in the watershed. Groundwater is found in the unconfined, Quaternary alluvial (sediment) bed in the central stem of the Galisteo Creek and the San Cristobal Arroyo, which varies in depth from nearly 0 to perhaps 150 feet, and in the shallow forest soils on Rowe Mesa and the flanks of the Ortiz Mountain. Geologic strata surface and cross or confine the Galisteo Creek at many locations and influence whether and how alluvial groundwater can come to the surface. For example, we believe that the volcanic ridge that runs from the northeast to southwest north of the village of Galisteo plays an important role in the permanent flow of water in the Galisteo Creek in the village of Galisteo. There are also some springs in the Arroyo Salado on the flanks of Rowe Mesa, which are most likely fed by water stored in the forest soils on the mesa. Likewise, sandstone and volcanic rock dykes that run across the Galisteo Creek at

several locations between Galisteo and Cerrillos are probably the cause of small springs and seeps, patches of quicksand, and reaches with a nearly permanent flow.

Most neighborhoods and homes along the Galisteo Creek rely on the relatively shallow, alluvial aquifer for their drinking water needs. The community of Eldorado also maintains a well near Lamy that provides part of the drinking water for this subdivision. Yet, as the water supply in these wells is directly related to precipitation both in the mountains and in the lower parts of the watershed, supply is nearly as erratic as the precipitation patterns in the watershed. Between 1996 and 2003, many alluvial wells dried up or were producing only part of the year.

Deeper groundwater is found in several layers of confined aquifers that underlay the surface water basin in an incongruous way. The layers have various inclines which make them accessible at a different depth in different places throughout the watershed.

Most residents in the watershed, especially those living away from the creek, rely on these deeper groundwater layers for their drinking water needs. Unfortunately, drinking water quality from these aquifers is reportedly of variable quality. Population growth has caused an increase in the number of deep groundwater wells in the watershed, and an increasing drawdown of groundwater resources. Drawdown, possibly in combination with a spell of dry years between 1996 and 2003, has resulted in many wells drying up or producing water with high mineral concentrations that render them nearly useless for drinking water purposes.

Soils, Vegetation, and Wildlife Habitat

The process of soil formation results from the interaction between climate, organic matter, and parent material (rock). In the Galisteo watershed, soil-forming processes have led to several different soil types, ranging from rocky areas to areas dominated by sand or clay. Appendix 4 includes findings of soil and erosion studies conducted by UNM students.

Most soils in the watershed are moderately to severely susceptible to erosion. Clay soils in perched meadows between gullies or next to major streams often exhibit problems of “deflocculation,” in which the clayey soils lose their structure due to the leaching of salt minerals. They collapse and become anaerobic and devoid of life. At many places along the Galisteo Creek this leads also to serious tunnel erosion (piping) and, eventually, gully erosion and migrating headcuts.

The Galisteo Creek runs through three soil associations. The “Las Lucas-Pojoaque” and “Panky-Pojoaque Harvey” associations are characterized by level to hilly topography with dissected and eroded terraces. The third soil association is called the “Travessilla-Rock outcrop-Bernal” and is found in higher elevations and characterized by steeper slopes and rockier terrain. All three associations are made up of mostly loamy soils. Along the Galisteo Creek around Galisteo, the soil is often saline and made up of loamy sand or silty clay loam in Creek drainage areas. This type of soil exhibits a severe gully erosion hazard, with 10-40 feet deep gullies. Other areas along the creek with greater permeability are moderately susceptible to erosion. The soil types highlight the need to mitigate high-speed flooding in the creek to slow bank erosion and the build up of problematic sediment banks along the creek.

Galisteo watershed plant communities include ponderosa pine forest in the upper watershed, pinon/juniper woodlands, plains grassland, and riparian areas. Each plant community is habitat to different groups of animals. Vegetation communities and wildlife habitat have not been studied well in the watershed. The most comprehensive studies known to us were done by Dr. Roger Peterson, a local ecologist and botanist, and UNM students from the Community and Regional Planning Program between 2000 and 2004. Findings of the UNM studies are included in EWI’s workbook on the Galisteo Watershed “Going with the Flow” (second edition, July 2002). A plant list compiled from various sources is included in Appendix 5.

GWRP monitoring studies found that vegetation cover and diversity of the demonstration restoration sites was fairly limited and highly variable from place to place and over time under the influence of precipitation and land use. Range (grassland) cover is most critical to non-point source pollution abatement and general landscape health rehabilitation. Rangeland health data show a variation of cover from about 70% to practically 0%. Species richness typically does not exceed a dozen grass species and half a dozen forbs and shrubs, and is more often limited to 3 or 4 grass species and 3 or 4 forbs and shrubs.

Significant wildlife species are limited to pronghorn in several open grassland areas, deer, mountain lion, and bear on mountains, mesas, and seasonally in the river corridors, and coyotes, which are ubiquitous throughout the watershed. The majority of native large game animals of the regional high plains were extinct by 1525. Locally, perennial reaches of the Galisteo Creek are habitat to Flathead chub. In the upper watershed, individual landowners have been raising trout, which occasionally have escaped and temporarily populated lower reaches. The watershed is also known as a significant alternate fly route for bird species that annually migrate up and down the Rio Grande corridor. The gradual rehabilitation of the Galisteo Creek and development of wetlands has led to sightings of yellow-billed cuckoo, herons, egrets, geese, ducks, plovers, and other common waterfowl. Much of the Galisteo Creek riparian bosques are considered potential Southwestern willow flycatcher habitat, and some areas along the Galisteo Creek and in the Rio Grande delta may be bald eagle habitat.

Population

The Galisteo Watershed has a rich and complexly layered history of human population. Research indicates that people may have lived in the Galisteo Watershed as early as 14,000 B.P. The first confirmable population living along the Galisteo Creek was the Clovis Culture around 10,500 B.P. Archaeological and historical research data show that during the last 10 millennia the Galisteo Watershed has been a land of many wandering people.

Until today, the area's history is characterized by a coming and going of people. The watershed's historical timeline shows that people have often been attracted to the area by some luring promise. Perhaps it was the promise of big game, fertile floodplains and pastures, turquoise and lead, gold or coal, and of beautiful vistas and the proximity of mountains and the river delta that drew people to the Galisteo Watershed. Paradoxically, however, highly variable water resources, disease, and conflicts of various kinds may have been major reasons for the historical down-turns in the watershed's populations. In the 1300s, about 18 permanent Puebloan settlements with hundreds of homes each gave shelter to as many as 10,000-20,000 people throughout the watershed. This population dwindled to only a few thousand after the Pueblo revolt in 1680. Spanish settlement continued throughout the 1700's. These settlements lead to the discovery of gold in 1821, in Cerrillos and Madrid. By 1840 an estimated 10% of the State's population resided in the Ortiz Mountains, the country's first Gold Rush site in history. Madrid and Cerrillos boomed, attracting thousands of people from around the world looking to make a fortune in gold. The population grew to around 30,000 during the height of the mining days in the mid and late 1800s, with high population concentrations in the Madrid and Cerrillos area. This population was decimated to nearly 3,000 by the 1930s. The book "The Place Names of New Mexico" gives an explanation of the population fluctuations at the place of the contemporary village of Galisteo.

> *Long before Europeans settled here, this site on Galisteo Creek was occupied by Indians. When Coronado passed through in 1541, he visited their pueblo, located 1.5 miles north of the present village; he recorded its name as "Ximena." The pueblo was still here when the Fray Rodríguez expedition came in 1581, as it was when Castaño de Sosa visited in 1591; he named the pueblo San Lucas. In 1598, Oñate renamed the pueblo Santa Ana, and it was known by that name until the Pueblo Revolt of 1680, when the Indians killed the priests and drove out the Spaniards. In 1692 Vargas retook the pueblo from the Indians, but in 1706 Gov. Cuervo y Valdes reestablished the pueblo with 90 Tano Indians, this time naming it Nuestra Señora de los Remedios de Galisteo, "Our Lady of the Remedies of Galisteo," though it also was called Santa Maria. By 1749, the pueblo had 350 inhabitants, but smallpox and repeated Comanche raids reduced their number so that in 1794 the few survivors moved to Santo Domingo Pueblo, where their descendants still live.*

Modern settlement of the site appears to have occurred after 1850, though Hispanic ranchers and sheepherders had been in the area earlier. The name Galisteo is an old term for a native of Galicia in Spain, but it could also have been transferred from a town in Estremadura, Spain. To the Tewas, the ancient pueblo and the modern town are called by a name meaning "down-country place," which also refers to the whole region south of Santa Fe.

There are no precise population statistics for the watershed area at the present date. Santa Fe County maintains population data for specific administrative areas such as voter precincts and County Commissioners Districts. Based on population projections for these areas, the County Planning Director estimated that the watershed population in 2004 was about 17,000 people spread over about 8,000 households, comprising portions of Santa Fe County and Sandoval and San Miguel Counties. The majority of this population is concentrated in the northern part of the watershed in the communities of Sunlit Hills, El Dorado and Lamy (along Highway 285) and in the San Marcos, Lone Butte, and Silverado area (along Highway 14).

Land Use History

The greatest landscape and land use impacts that are relevant to watershed health and watershed degradation date from the nineteenth and twentieth century. They could be summarized in the following list of events. This list is a summary of a historical timeline reproduced from interviews and documentation by William Baxter of Cerrillos (see Appendix 6).

1820-1830

- Beaver trapped out of all streams in the Sierra Madre (approximately 50 years later to be called Sangre de Cristo Mountains). This probably caused dramatic changes to hydrology and soil stability in the upper watershed. Accelerated soil erosion caused rapid incision of mountain streams, which caused forest soils to dry up and become more susceptible to erosion. Creeks began to develop a flash flood regime, increasing the dynamics on alluvial fans and streambank erosion downstream.

- Strong increase of mining and gold panning in the area. Population boom in the Ortiz Mountains. By the winter of the 1830s, 10% of the New Mexican population resided in the Ortiz Mountains, seeking gold. This must have caused a widespread cutting of woodlands to provide for firewood and construction materials. It probably also increased agriculture and sheep herding activities for local food production.

- Land grants established: the Mexican San Cristobal Grant, and the Dolores del Oro Grant. This probably was the beginning of a steep increase in sheep herding in the area, as well as an increase in the construction of acequias and water retention structures around the villages of Galisteo, Dolores, and the later location of Cerrillos.

1830-1860

- Expanding mining activities in the Ortiz Mountains and Cerrillos Hills

- U.S. Army establishes a horse camp in Galisteo at the old Spanish/Mexican fort. Galisteo is the closest area to Santa Fe with good drinking water and grass forage.

- 1858: areas in the Galisteo watershed first surveyed (mostly for mining and ranching purposes).

1860-1880

- The cattle boom era.

- Major land grabs, claim reversals, and rejection of land grant rights. Areas opened for public purchase.

- 1871: Supply of free milling ore runs out. NMMC Ortiz Mine closes. 1879-1884: Cerrillos Hills Mining boom.

- 1877 (and/or 1879): major flood in Galisteo Creek in Galisteo. Acequia systems ruined due to sediment. Galisteo Creek moves from current Highway 41 location to the east side of Galisteo village. 1879: Galisteo Creek not yet incised.

- February 1880: Railway construction reaches Galisteo Junction, which is renamed Lamy. Railway tracks extended in and along the Galisteo Creek bed to Santo Domingo Pueblo and Albuquerque.

1880-1900

- Development of large-scale trade, migration, and cattle ranching.

- Cattle loading stations built along the Galisteo Creek cause overgrazing and erosion. Cattle tracks turn into gullies.

- Development of small village settlements along Galisteo Creek with irrigated agriculture and bean farming. Cerrillos and Carbonateville are boom towns. Lamy, Ortiz (probably current EWI ranch), and Cerrillos are railroad stops.

- Atchison-Topeka & Santa Fe Railway builds dams and levees in the Galisteo Creek and tributaries (San Marcos Arroyo) to protect the railroad.

- Madrid established. Growing mining activity in Madrid, Cerrillos, and Waldo. Railroad spurs built.

- Years of severe rainfall follow decades of drier weather, which causes increased runoff and erosion.

1900-1920

- Forest Service enforces forest reserves. Cattle removed and concentrated in the bottomlands of the watershed. Barbed wire fencing introduced. End of free range. Serious overgrazing and erosion (sheet and gully erosion throughout the landscape).

- Galisteo Creek incises deeply (15 feet and more). Russian olives and saltcedars planted to stabilize streambeds.

1920-1940

- Three year drought: Dust Bowl. People move away to find work elsewhere. Land is poorly managed. Probable spreading of junipers and pinions throughout the landscape, along with cholla and other colonizing plants.

- Automobile introduced. Dirt roads developed. Tourism developed in the Santa Fe area.

- Major railroad restoration works with concrete abutments and dams and sand levees all along the Galisteo Creek. Rail lines to Santa Fe abandoned. Increased bank erosion on banks opposite of railroad reinforcements.

- A 40-foot dam was built at the McKee Ranch (SW of Galisteo) for diversion of water to a large pond and stock tank at the ranch.

1940-1960

- Collapse of ranching industry. Consolidation and reorganization of ranches and small ranchitos.

- Major drought and flooding in the 1950s. Bridge in Cerrillos washed out, and Hwy 14 bridge rebuilt and relocated ½ mile east. Railroad embankments in Canoncito washed out and were repaired with rock and concrete. Levees and stream detour at Richardson and Ziegler properties (CR 55-A) possibly implemented in this period.

- Mining in Madrid comes to an end. Cerrillos school closes. Galisteo post office closes.

1960-1980

- A period of 30 years with an excessively wet weather pattern begins. Increased runoff and erosion. Construction and paving projects accelerate runoff and erosion and increase the Galisteo Creek's flash flood regime. Large amounts of sediment wash downstream into the Rio Grande.

- 1960s: Paving of Highway 41 and 14. 1974-75: Widening of I-25 to four-lane freeway.

- 1968: J.W. Eaves begins construction of a movie set at Rancho Alegre.

- Construction of Galisteo dam (completed in 1970).

- Dams built in Canada de los Alamos (creek).

- The Finger Lakes and other lakes and springs still have water, but begin to dry up in this period as a result of the dropping water tables in the creeks. Saltcedar and Russian olive begin to dominate the riparian ecosystem.

- The U.S. Forest Service conducts large-scale thinning and logging projects in the upper watershed.

- 1975: Simpson Ranch out of business. Plans made to develop El Dorado de Santa Fe.

1980-2000

- Rapid urban development in the upper watershed (mountain zone and El Dorado). 1980: Construction of El Dorado begins. 1981: First development in Galisteo – Ranchitos.

- 1980-85: Canada de los Alamos reservoir excavated. Filled in quickly afterwards.

- Gold Fields Ltd. Opens Cunningham Gold Mine in Ortiz Mountains.

- 1990s: Rowe Mesa being slowly developed.

- 1990-1996: Closure of Cunningham Gold Mine, planning and implementation of rehabilitation work. Accelerated runoff from the mine area (intentional in order to minimize cyanide leaching to downstream areas) contributes to flash flood regimes in Cunningham Creek and lower Arroyo Chorro.

- Extensive grazing (large area, low impact, poorly managed) by cattle and horses leads to further over-grazing and erosion in many rangelands throughout the watershed.

- 1996: Singleton Corporation purchases San Cristobal Ranch (81,000 acres) for cattle and preservation purposes. 1997/1998: Thornton Ranch (17,000 acres) taken out of production: slated for development and open space.

- 1996: Wet period ends. Beginning of an 8-year dry period.

- 1998: I-25 median paved in Canoncito-Valencia area and near La Bajada. Accelerated runoff causes deep gully erosion on adjacent private lands.

- 1998: U.S. Forest Service redesigns roads and trails to reduce erosion and off-road vehicle access. U.S. Army Corps perforates Galisteo Dam, enlarges the spillway and increases the dam height.

- 1999: Beneficial Farm builds dam in Arroyo Salado.

- 2000: Santa Fe County purchases 1,100 acres for Cerrillos Hills Historic Park

2000-2005 (present)

- More ranches taken out of production and consolidated. J. Epstein purchases a significant piece of the King ranch, now named Zorro Ranch, for conservation and recreation purposes. T. Ford purchases the Cook (Cerro Pelon) Ranch and begins agriculture projects and movie productions. W. Sanders purchases the Canyon Blanco Ranch and consolidates adjacent smaller ranches into a 100,000-acre ranch holding. Starting in 2002/03, the Peppler family is making plans to develop a 10,000-acre ranch west of Cerrillos and transfer surface water rights from Galisteo (McKee Ranch) to groundwater rights on the Peppler property. Development of the 6,000-acre Montoya ranch on the northern flanks of Ortiz Mountain is temporarily shelved. In 2005, J. Grace purchases pieces of the old Cash Ranch for development.

- Trust for Public Land is selling a piece of the Thornton Ranch to Commonweal Conservancy for the development of an open space-oriented community (Preserve) west of Lamy. Santa Fe County purchases the Petroglyph Hill area for open space.

- Santa Fe Botanical Gardens receives 1,345 acres of the Ortiz Mountains Educational Preserve.

- EWI launches the Galisteo Watershed Restoration Project and establishes demonstration restoration sites in Canoncito, Galisteo, and along CR-55A. Projects include stream rehabilitation, grazing management, erosion control, and wildfire management.

- Highway 285 widened to a four-lane highway from I-25 to Lamy. Eldorado's south side built up, Rancho Viejo development begins, and Highway 14 is improved and widened.

- All mining in Santa Fe County halted, except gravel mining in Cerrillos. State completes mine tailing reclamation projects in Madrid.

- Cerrillos Hills Historic Park opened to the public. Increasing interest in archaeology and low-impact tourism in the Galisteo watershed.

- 2004: Galisteo Basin Archaeological Sites Protection Act[3] passes. BLM takes up implementation of the Act. Santa Fe County and several state agencies interested in collaboration on low-impact tourism development in the area.

[3] The Galisteo Basin Archaeological Sites Protection Act (P.L. 108-208) was signed into law by President George W. Bush on March 19, 2004.. The Act designates specified archaeological sites in New Mexico as the Galisteo Basin Archaeological Protection Sites, and also instructs the Secretary, upon written request of an owner of private property included within the boundary of such a site protected under this Act, to immediately remove that property from within that boundary. http://thomas.loc.gov/cgi-bin/bdquery/z?d108:HR00506:@@@L&summ2=m&

- 2005: Establishment of the Galisteo Watershed Partnership, a collaboration network of local, state and federal agencies, private landowners, businesses, and non-profit institutions for coordination and public education on land and watershed management planning in the Galisteo Watershed.

Contemporary Land Ownership and Land Use

Approximately 69% of the land area in the watershed is privately owned. The San Cristobal Ranch of 81,000 acres is the largest ranch in the watershed, located in the southeastern part of the watershed (17% of the land area of the watershed). Other ranches vary in size from ten-thousands of acres to a few hundred acres.

The headwaters of the Galisteo Creek are primarily located on public land managed by the USDA Forest Service (Pecos-Las Vegas Ranger District of the Santa Fe National Forest). The Bureau of Land Management (BLM) and the State Lands Office manage scattered blocks of land throughout the watershed. The BLM lands are leased to ranches for grazing purposes and are managed for archaeological and open space values. State Land Office lands are managed for outdoor educational support to local schools and archaeological values. The U.S. Army Corps of Engineers (USACE) manages an area of approximately 4.5 square miles around the Galisteo Reservoir for sediment and flood control. The Bureau of Indian Affairs (BIA) on behalf of the Santo Domingo Tribe manages about 30 square miles in the western part of the watershed. In addition, the U.S. National Park Service (NPS) Pecos National Monument manages about 50 acres of land as part of the historic Glorieta Battle Field in Lower Canoncito, just south of I-25.

Land use in the watershed includes (1) residential use in traditional communities, sub-divisions, scattered ranchettes, and individual home sites, (2) small businesses in the arts, hospitality, outdoor recreation, and film production sectors, (3) low-intensity ranching and farming, (4) small scale mining and quarrying, and (5) mine restoration sites. More than 30% of the land in the watershed is managed by state and federal agencies for purposes of public resource management. In addition, Santa Fe County manages lands in three areas as well as a trail along the Santa Fe Southern Railroad tracks for open space conservation and public trail access. Private organizations hold approximately 3,100 acres in land under some form of protective easement, such as conservation easements and easements related to archaeological protection[4].

Urban and ex-urban development is concentrated north of Galisteo Creek. In particular, the San Marcos and Gallinas sub-watersheds, covering an area of about 80 square miles, are largely built up in a mosaic of small subdivisions. This area includes the communities of Canada de los Alamos, Sunlit Hills, Eldorado, Rancho Viejo, Silverado, and the San Marcos District (Lone Butte area). These communities account for the majority of the Galisteo watershed population and water users. Residential land use is concentrated in Eldorado, along Highway 285 toward Lamy, north of I-25 between Canada de Los Alamos and Apache Canyon, along Highway 14 around Lone Butte, the Turquoise Trail and San Marcos areas and around County Road 42. Because of the heavy concentration of built up terrain, runoff from this sub-watershed is relatively high as it adds to the natural runoff from this large sub-watershed. Generally gentle topography and grass cover have limited accelerated erosion in the upper parts of this sub-watershed, while there is significant gully erosion downstream toward Cerrillos. Natural runoff from the upper parts of this sub-watershed feeds springs and wetlands in the San Marcos Arroyo on either side of Highway 14, which most likely was an important reason for the establishment of the San Marcos Pueblo just north of these wetlands. In addition, there are wetlands and springs in the reaches of the San Marcos Arroyo and Gallinas Arroyo just north of Cerrillos.

Land use in the southern part of the watershed is limited to scattered residential and commercial uses, such as ranching, farming, film industry, outdoor recreation, and mine reclamation. Grazing activities in the watershed

[4] Conservation organizations with management responsibilities in the Galisteo Watershed include the Santa Fe Conservation Trust, The Taos Land Trust, The Nature Conservancy, and The Archaeological Conservancy.

are limited to a few active ranches that probably account for no more than about 1,000 animal units. The Santa Fe National Forest manages land on Rowe Mesa including several active grazing allotments. Lands managed by the Bureau of Land Management (BLM), located between Galisteo and Cerrillos also include several active grazing allotments. The national forest lands are used for firewood cutting, wildlife management and wetland reclamation. Human impacts on the land include woodcutting, removal of moss rock, and homebuilding on private lands, adjacent to the national forestlands. Other land uses in the watershed include recreation in the open space areas and on national forest lands. Until the 1960's, some locations along the Galisteo Creek provided recreation and fishing opportunities. However, the ecological conditions of the Galisteo Creek do not justify the State designation of the stream as a "high quality cold water fishery."[5]

Since the 1990s, there has been growing public support for maintaining a rural character and preserving open space areas within the Galisteo Watershed. Parties interested in ecological preservation, open space conservation, archaeological preservation, wetlands, and viewsheds are gradually developing long-term preservation plans and bundling forces. The interest groups are also considering new economic opportunities to strengthen preservation efforts of the valued character of the area.

An important development in the protection of historical resources and open space in the watershed was "The Galisteo Basin Sites Protection Act" which passed by the U.S. House and Senate and was signed into law by President George W. Bush on March 19, 2004. The Act recognizes twenty-four important heritage sites, totaling 4,591 acres, within the basin as worthy of protection. The BLM New Mexico State office is currently exploring strategies for the implementation of the Act. The Act opens opportunities for federal or state park designation for its cultural treasures, pre-historic rock art and artifacts. Santa Fe County has shown an interest in encouraging tourist-oriented business development in the area.

Transportation lines in the watershed include County and State roads and rail lines. Several State Highways cross the watershed, simply entering and exiting watershed boundaries at several different locations, and do not directly link the communities in watershed. The highways include Interstate Highway 25, State Highway 285, and State Highway 14. I-25 parallels four miles of the Galisteo Creek canyon from Glorieta Pass to the confluence with the Apache Canyon. I-25 crosses the Galisteo watershed again over a length of eight miles between La Bajada and Santa Domingo Pueblo. Highway 285 crosses the watershed from Eldorado to the divide between the Galisteo Watershed and the Estancia Basin. Highway 14 runs from Santa Fe south past Cerrillos and Madrid to Cedar Crest. Most County Roads in the watershed are unimproved, although the County has recently paved parts of CR 51 and CR 42, and built a raised stream crossing in CR 55-A across the Galisteo Creek. More County road paving projects are anticipated in 2005 and 2006.

Since 2000, the State Department of Transportation developed various road improvement and widening projects. In 2004, a section of Highway 14 between Madrid and Cerrillos has been widened and improved, while the section from Cerrillos to Lone Butte is slated for improvements in 2005. Old Las Vegas Highway will also be improved in 2005. In 2006, the State Department of Transportation plans to improve and widen Highway 285 from Lamy to Clines Corners. Highway 41 from Lamy to Stanley may be improved around 2010. Residents have spoken out repeatedly to keep road designs and other transportation plans in tune with the rural character of the area.

Highway 14 ("The Turquoise Trail") is the only official scenic byway in the watershed. The Turquoise Trail (Business) Association has been working actively to improve the attractiveness of the route for visitors and customers to local businesses along the Turquoise Trail, especially in the area from Cerrillos south to I-40.

[5] New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB) 303(d) List for Assessed Stream and River Reaches).

The Burlington Northern and Santa Fe Railway is a single track railroad with several side tracks to allow trains to pass, and closely follows the Galisteo Creek from Glorieta pass to Santo Domingo Pueblo on an elevated ramp. The railroad grade runs for nearly 20 miles directly along the creek, within or at the edge of the floodplain area. In addition, the Santa Fe Southern Railway Company operates a single track rail line from Santa Fe to Lamy, passing through Eldorado. Under the leadership of Gov. Bill Richardson, the State of New Mexico has been developing plans for the establishment of a commuter rail line from Santa Fe to Albuquerque, which will follow a still undetermined alignment through the watershed. The most likely new rail line alignments may impact the northern part of the watershed between Rancho Viejo and La Bajada or an area west of Lamy connecting the rail line of the Santa Fe Southern with the Burlington Northern rail lines. Implementation of the new commuter rail line in the watershed is expected to take place around 2007-2008.

Picture 2. Stream rehabilitation site at the Richardson – Ziegler properties east of Cerrillos. This was a site of serious bank erosion and riparian habitat destruction resulting from stream modifications to protect the Atchison-Topeka and Santa Fe Railway in the early part of the twentieth century. Rehabilitation work included the installation of rock vanes and the construction of a floodplain bench in front of a steep bank that had been undercut by the creek. These structures help to protect the banks and restore a natural meander pattern in the channel that is able to move sediment through a narrow passage just downstream (to the right) of this photograph. The rehabilitation project generated a high quality wetland in an oxbow at the toe of the steep bank (red-brown colors in the center of the picture). Photo courtesy J.W. Jansens, October 2004.

V. EVALUATION OF WATERSHED HEALTH

Historical Background of Watershed Health Problems

The following evaluation of watershed health is based on observations collected during the Galisteo Watershed Restoration Project. Lack of funding for in-depth land health assessments, remote sensing assessments, or water quality assessments have limited the EWI and WRAS team to the following analysis based on data collected by UNM students, field monitoring work, photo points and individual observations. The evaluation outcomes are structured according to the State of New Mexico's 303(d) list's categories for impaired streams and a list of key issues in the watershed developed by the WRAS committee.

As has been illustrated in the overview of historical and contemporary land use (above), the ecological balance in the watershed has been impacted by land use practices over more than two centuries. Many of these land use practices were conducted with the best intentions for individual purposes, but clearly with little to no knowledge about their landscape-wide and long-lasting impacts to the land. The cumulative effect of these land use practices has led to the current signs of watershed degradation. The systematic lack of rehabilitation and mitigation has most likely exacerbated the ecological problems that resulted from the many land use impacts that tumbled over the watershed.

Railway and highway construction have impacted watershed health in particular. The initial construction of the railway across the watershed from Glorieta to the Rio Grande was accomplished between October 1879 and February 1880 as part of the railway construction from Las Vegas (NM) to Albuquerque. The railway structure was in many places installed in or just next to the stream channel of the Galisteo Creek. In many places, the floodplain of the Galisteo creek was cut in half lengthwise, which destroyed the creek ecosystem. In subsequent flood events the concentrated flood waters caused severe damage to the railway structure. As the railroad grade and opposite streambanks were frequently undercut, the railroad sought to stabilize them with concrete bank revetments and large stream modification structures, such as levees and dams. In addition, highway widening, drainage structures, culverts, bridges and other hard infrastructure design have shortened the time of concentration of stormwater runoff throughout the watershed. Poorly installed culverts have contributed to the lowering of gully and stream channel levels. Absence of protective measures against the erosive forces of concentrated stormwater runoff from the highways outside the Highway Right of Ways seem to have contributed to accelerated erosion in many locations. Until today railway and highway infrastructure continues to cause severe erosion and pollution to the surface water resources and should therefore be closely monitored. Unfortunately, the State of New Mexico does not have legislation in place to enforce NPDES stormwater regulations, and defers to the EPA Region-6 office in Dallas to follow up on the worst cases of uncontrolled runoff.

The landscape health problems observed in the 21st century are to a large extent due to the cumulative effect of land degradation over the past 125 years. The deepening of the Galisteo Creek, which seriously began after 1880, led to the dewatering of rangelands throughout the watershed area. Dewatering of stream-side meadows, higher grasslands and pinon-juniper woodlands made these ecosystems more vulnerable to land use disturbances. In addition, the vegetative regeneration capacity of these ecosystems was reduced due to the lowered water table. The changes in land surface hydrology coincided with relatively high rainfall between 1891 and 1920, and with intensive ranching, mining, logging, road development, and urban growth. Together these factors have caused serious soil loss throughout the watershed and the loss of general landscape health.

Water Quality Problems

Water quality problems in the Galisteo watershed are primarily due to an excess of sediment in the creek (a.k.a. stream bottom deposits). The stream bottom deposits stem from widespread soil erosion and streambank failure, as described above. Many ecologically destabilizing land use practices have occurred in the upper watershed,

leading to accelerated storm water runoff and soil erosion with severe downstream consequences. Natural regeneration of vegetation is impaired by development activities, unmanaged grazing, lack of soil cover and fertile topsoil and exposure to extreme climate conditions.

NMED conducted water quality samples in the Galisteo Creek in 2001. Sampling stations included the GWRP demonstration sites on the Cummings property (Canoncito), in the village of Galisteo, the Richardson property (east of Cerrillos), and the Galisteo Creek at the Highway 14 bridge in Cerrillos. A recent report of findings from this sampling study indicates that the perennial reaches sampled "fail(s) to meet segment-specific criteria for specific conductance, temperature, and turbidity. A mercury detection" (at the Highway 14 bridge in Cerrillos) "indicates possible failure to meet chronic fishery criteria. Some stations on this stream were sampled only three times."[6] The report also states that "the creek may be misclassified as a high quality coldwater fishery due to the fact that some portions of the creek go dry at times." Temperature is the most critical criterion in determining the kind of fishery class. The perennial nature of the creek results in shallow water levels, which may cause water temperatures to exceed the levels of a high quality cold water fishery, despite shade from tree cover. In addition to the NMED study, residents have observed that oil spills from the railroad and manure and septic waste spills from residential areas along the creek may also contribute to temporary and/or local water contamination, although no data were recorded on these pollutants.

Water quality in the Galisteo Creek is impaired as a result of the following three categories of causes:

A. Cumulative impacts of grazing and urban development
Impacts: Increased storm water runoff, reduced infiltration, accelerated soil erosion, streambank destabilization, and heavy sediment load deposits in the middle reaches of the Galisteo Creek and its tributaries.
Other Symptoms: Poor grass cover, low vegetation diversity, low levels of nutrient recycling, increases in the number of invasive species, sheet, rill and gully erosion, formation of sediment banks causing creek to meander wildly and undercut stable stream banks, increasing depth of groundwater levels, and desiccation of top soil and vegetation.

B. Hydro-modification resulting from infrastructural works (railroad, bridges, levees, and dams)
Impacts: Ongoing creek bed degradation and bank scouring where the railroad grade, levees, and bridges have narrowed the floodplain.
Other symptoms: Periodic accumulation of sediment in blowout areas cause heavy bedload deposits disturbing natural regeneration and development of riparian habitat. Valuable private property and public infrastructure such as power lines, wells, roads and the railroad grade are being undercut.

C. Poor decision making and coordination in natural resources management
Impacts: Lack of coordination between communities or government agencies for natural resource management in the Galisteo watershed region.
Other symptoms: Lack of understanding of what is needed to make better natural resource management decisions. Poor communication between branches of government working within natural resource management programs for the improvement of land, soil and water quality. There is a lack of coordination of individual and institutional level decision making for natural resource management. There is a need for more community leadership and land stewardship.

Soil Loss

The cumulative effects of past and current land use have destabilized hydrologic and ecological functions in the watershed. Although soil erosion is a natural process in this landscape, the current rate of erosion is much higher than what experts think is acceptable as a natural phenomenon. In addition, the rate of soil recovery and plant

[6] New Mexico Environment Department – Surface Water Quality Bureau. August 2004. Water Quality Survey Summary for the Upper Rio Grande Watershed, Part II (between North of Embudo Creek and Angostura Diversion), 2001.

regeneration is very low, which results in a cumulative net loss of productive soil from the area and an accumulation of soil in the form of sediment in arroyos, the Galisteo Creek and Galisteo Reservoir. However, data to support these assertions are lacking, since no systematic data collection on erosion rates and sediment budgets throughout the watershed has ever taken place to our knowledge. Available data on erosion are derived from local measurements with erosion bridges and stakes over short periods of time. Other than that, EWI largely relied on soil loss estimations based on the Revised Universal Soil Loss Equation and NRCS data for typical soils in the area and standard NRCS data for wind erosion on open rangeland in New Mexico.
Accelerated soil loss at specific places throughout the watershed leads to top soil depletion, reduced plant regeneration, proliferation of weedy plant species, reduced infiltration capacity and increased stormwater runoff. In addition, soil loss leads to the accumulation of sediment in water ways, which causes stream pollution in the form of high levels of turbidity and stream bottom deposits. Locally, large floods have created large point bars of unsorted coarse sediments with a high drainage capacity. These sediment banks typically force stream channels to undercut the outside banks of adjacent meander bends, leading to increased accumulation of sediment in the streams. The coarse point bar substrate is unsuitable for the regeneration of any native vegetation and marginally suitable for invasive species such as salt cedar, which causes the development of large sandy and gravely denuded areas, "riparian deserts," that have a destabilizing effect on the riparian ecosystem.

Analysis of GWRP findings indicates that stream bottom deposits are most likely a natural phenomenon in streams such as the Galisteo Creek. The area's geology naturally leads to certain forms of erosion, stream morphology, and wetland conditions in the stream systems that depend on the accumulation and movement of sediment. Native species such as the Flathead chub, toads, and frogs depend on the availability of stream bottom deposits to hibernate and survive in these ecosystems. Natural flood and sedimentation regimes also contribute to the regeneration of native riparian tree species, such as cottonwoods and willows.

Popular Landscape Health Concerns

The WRAS committee identified eight popular issues of concern in the Galisteo watershed that require rehabilitation interventions in the near future. These issues involve jurisdictional responsibilities within county, state and federal mandates to plan restoration efforts.

1. **Flooding**: The Galisteo Watershed has a history of flooding resulting in severe damage to homes, roads and utilities, and property loss. Flooding also causes severe stream bank erosion and disturbance to the riparian ecosystem. Increased desertification and urban development have led to increased stormwater runoff and violent floods. There are two dams in the Galisteo Creek that control flood events: one west of Galisteo and

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[7] Galisteo Basin Archaeological Sites Protection Act: **This measure has not been amended since it was passed by the House on November 4, 2003.** Galisteo Basin Archaeological Sites Protection Act - (Sec. 3) Designates specified archaeological sites in New Mexico as the Galisteo Basin Archaeological Protection Sites. Instructs the Secretary, upon written request of an owner of private property included within the boundary of such a site protected under this Act, to immediately remove that property from within that boundary. http://thomas.loc.gov/cgi-bin/bdquery/z?d108:HR00506:@@@L&summ2=m&

[8] The soil was blown away by the wind and formed huge dense clouds of dust. This affected parts of eastern Colorado, Kansas, northern New Mexico, Oklahoma and northern Texas, and led to the area becoming known as the "Dust Bowl". Coupled with the thirties depression, this caused enormous economic hardship. Many impoverished farming families made their way west from the Dust Bowl along US66 - Route 66, "The Dustbowl Highway" - to the crop fields, fruit orchards and wine growing areas of California in search of work.
http://freespace.virgin.net/john.cletheroe/usa_can/usa/dustbowl.htm. 07-23-004.
[9]The 1965 Flood Control Act assisted in the reclamation of flood damage to the Galisteo Creek

one west of Cerrillos. Flooding problems are most seriously felt in Canoncito, Galisteo, along County Road 55-A, and in Cerrillos.

2. **Invasive plant species**: In many places along the Galisteo Creek and its tributaries, Russian olive and tamarisk (saltcedar) have gradually become more successful than native cottonwoods and willows. Changes in hydrology and soil conditions have most likely contributed to the ecological success of these invasive species. Their advancement is detrimental to biological diversity (of bird life and vegetation undergrowth) in the riparian and wetland areas. Invasive species problems are most seriously felt in the middle and lower parts of the watershed.

3. **Soil Erosion**: We estimate that throughout the watershed the soil loss rate is greater than soil accumulation. Soil loss equates to a loss of regeneration capacity of vegetation, reduction of wildlife habitat, and dwindling water infiltration and storage capacity throughout the landscape.

4. **Pinon die-off**: The recent loss of pinon biomass across the landscape has led to a loss of wildlife habitat and diversity and to increased erosion hazard. For some, the pinon die off also reduced the visual quality of the landscape. The problem was felt most seriously in the upper watershed, but occurred watershed-wide.

5. **Open space and urban growth**: Unmanaged growth in the homestead zone and around traditional communities in the watershed has created a rapidly growing ex-urban development trend at a rate of 300-500 homes per year. Unmanaged growth may over time deplete the cultural, ecological, historical and economic values of the landscape. This problem is most seriously felt in the upper watershed, on Rowe Mesa, and along Highway 14.

6. **Wildfire**: The dry period between 1996 and 2004 coupled with pinon die off and over-stocked stands of ponderosa pine in the upper watershed have increased the catastrophic wildfire hazard in the watershed. Dead riparian vegetation and the increase of grass regeneration in wet years also contribute to wildfire hazard, even when forest fires are less likely to occur. Population growth and erratic landscape use make wildfire hazard an increasingly serious problem. The problem is watershed-wide but most serious in the forested, upper watershed.

7. **Grassland health**: Dewatering of grasslands as a result of gully erosion, poor vegetation management, and poor grazing practices have reduced grassland health conditions in many parts of the watershed. This has resulted in reduced vegetation and species richness. Middle to lower watershed

8. **Water availability**: Ground water resources in the Galisteo Basin are locally specific due the complex geology of the area. Surface water is ephemeral and erratic. Completed groundwater research will provide a better understanding of available water resources in the region.

In the past six years, EWI and its GWRP partners concluded that watershed health restoration activities should focus on general landscape health improvement with a focus on soil stabilization, increased vegetation cover and plant richness, and improved infiltration and water storage capacity in the soil. EWI embarked on such restoration work through iterative restoration projects with a high level of follow up for maintenance and monitoring.

Long term field monitoring of restoration sites with standardized indicators are important to measure land health and evaluate improvements in the basin. Standardized criteria for soil and water conservation efforts help gauge different approaches for land rehabilitation and employing new research and development programs in improving land health status. Indicators utilized to evaluate land health status in the watershed include:

A. Soil cover and soil loss features (monitored with photo points and in part with Line-point Intercept and Gap Intercept transects and geomorphology transects):

- Wind scoured blowouts or deposition areas
- Litter movement
- Bare ground (vegetation cover gaps)
- Pedestals or terracettes
- Water flow patterns
- Rills
- Gullies
- Soil surface resistance to erosion (pebble counts and surface descriptions)
- Soil surface loss or degradation (Revised Universal Soil Loss Equation)
- Compaction and crusting

B. Vegetation cover and species richness (monitored with photo points and in part with Line-point Intercept and Gap Intercept transects):

- Plant community composition and distribution
- Functional and Structural groups (plant communities fulfilling soil enhancing or nutrient cycling roles within the ecosystem)
- Plant mortality and decadence
- Litter amount
- Annual production
- Invasive plants
- Reproductive capability of perennial plants

The GWRP team developed a study design for each demonstration restoration site, which included some of these indicators to monitor project achievements.

Picture 3. Wicker weir as part of the Induced Meandering technique for stream rehabilitation in the Galisteo Creek in Lower Canoncito (Brown property). The Burlington Northern Santa Fe railroad embankment is visible in the background. Photo courtesy J.W. Jansens. Summer 2004.

VI. WATERSHED HEALTH GOALS AND EXPECTED RESULTS

Mission and Goal for the WRAS

The WRAS Committee (2003-2004) proposes that:

It is the Galisteo Watershed Partnership's **mission** regarding the implementation of the Watershed Restoration Action Strategy (for the Galisteo Watershed) to foster landscape health in the Galisteo watershed.

The Partnership's **goal** for the WRAS is to establish a healthy, working landscape that reflects:
- People's stewardship for the land
- Economically healthy communities
- Resilient and diverse ecosystems

Landscape health of the Galisteo watershed should be achieved in a "working landscape." The WRAS and Galisteo Watershed Partnership (GWP) understand that a working landscape supports the communities that depend on this landscape for their livelihoods. This may include ranching, farming, arts & crafts, residential land use, outdoor recreation services, home-based businesses, and other economic and land use activities that find a place in this landscape.

A healthy, working landscape that reflects the subordinate goals listed above allows to some extent for monitoring to measure progress toward the achievement of the stated goal. One could monitor and measure people's stewardship actions, the economic health of local communities, and the resilience and diversity of the various ecosystems in the watershed.

People' stewardship for the land should be pursued through ongoing education and outreach activities and promoted through the establishment of a watershed association, the Galisteo Watershed Partnership. Economically healthy communities should be pursued through smart management of natural resources, landscape values and functions, and concerted planning of urban development, infrastructure, and other incentives for an economically viable future for the area. Resilient and diverse ecosystems should be pursued through a variety of actions, which form the center piece of this WRAS. The proposed actions are subdivided in eight categories of "headline" concerns in the watershed community (Table 1). The proposed actions must be supported by actions concerning the promotion of land stewardship and the promotion of economically viable communities in the watershed.

Priorities for the Galisteo Watershed Planning Approach

Watershed planning in the Galisteo Watershed has evolved from the a growing awareness among landowners, ranchers, and professional resource managers, that ecological problems, such as flooding, erosion, drying up of springs and wells, rapid degradation of plant communities, and catastrophic wildfire, are the symptoms of an unraveling ecosystem. People also realized that their existence as a community depends on the commodities and intangibles that the watershed ecosystem provides.

The WRAS Committee identified three **goals** or **action priorities** for future planning on a watershed scale:

1. Establishment of a stakeholder advisory and coordination body (a watershed association: the Galisteo Watershed Partnership)

   Establishing a watershed planning and coordination body, such as a watershed association, will facilitate the dissemination of information, the coordination of planning initiatives and a public dialogue about plans and events that impact the watershed and are of interest to a diverse group of stakeholders. A watershed

stakeholder organization can also pool resources to accomplish needed interventions, lobby for state and federal support, and coordinate public and special interest group education programs.

2. Soil erosion and runoff control

Soil erosion abatement and runoff retention and control will help reduce the level of non-point source pollution of sediment (stream bottom deposits) in the Galisteo Creek and its tributaries. In addition, strategies focusing on erosion and runoff control will increase soil cover with mulch and vegetation, which regenerates the soil and related ecosystems and wildlife habitats. Specific strategies include:

- Research on runoff and erosion caused by urban development and road construction.
- General education and outreach activities on erosion and runoff control, vegetation management, and sediment budgets in the creeks.
- Flood control systems and early warning protocols for flood events.
- Development of wetlands and buffer zones for runoff management.

3. Water retention (sequestration) in the landscape

Restoration of soil structure, vegetation cover, and stream morphology will help increase the land's capacity for water retention (i.e. the restoration of the soil as the "sponge" of the landscape). Specific strategies and actions for this priority include:

- Land use and well management (mapping of well data, impact assessments of wells and land use, protocols and regulations reducing the impacts).
- Wetland planning, identification, rehabilitation, conservation and development. (Assessment of wetlands and springs and development of conservation and restoration projects).
- Water harvesting and conservation around homes and in association with highways and other paved areas.
- Water infiltration and storage in (rehabilitated) stream banks, flood plains, riparian zones, forested terrain, and alluvial meadows (alluvial storage and landscape-scale water sequestration).

As described above, the WRAS Committee identified eight popular issues of concern for the Galisteo Watershed stemming from the historical soil and water problems in the area. The eight issues are important for watershed-wide planning and mapping. The assessment of the health of the watershed can be placed within the scope of these popular issues of concern:

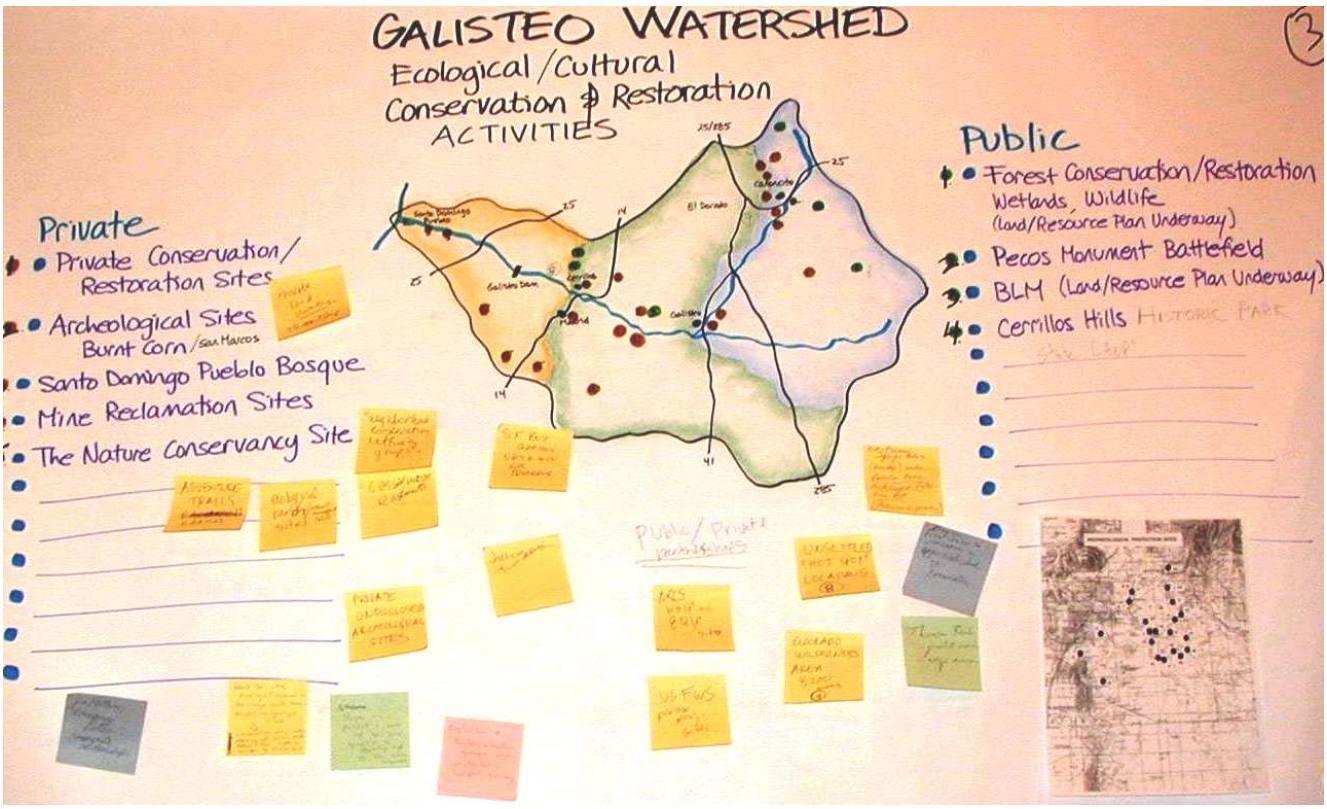
A. Flooding
B. Russian olive and tamarisk proliferation
C. Soil erosion
D. Pinon pine die off
E. Open space creation and urban growth
F. Wildfire
G. Grassland health
H. Water availability

The recommendations in this WRAS weave these eight issues of concern and their specific suggestions for interventions together with eight action strategies (see Chapter VII: Recommended Rehabilitation Actions).

The **expected results** of these goals and priorities include:

1. Establishment of the Galisteo Watershed Partnership in 2005
2. Launching of an open space master planning project and long-term wetlands planning and conservation program in 2005

3. An annual increase of 10% of the body of dedicated landowners and public land managers who show interest and knowledge in appropriate land stewardship and terrain management for the watershed
4. An annual increase of 10 acres of rehabilitated land and 0.5 miles or rehabilitated streams
5. An annual increase of water quality standards, leading to a declassification of the Galisteo Creek as an impaired stream by 2015.



Picture 4. Example of a discussion map about Ecological and Cultural Conservation & Restoration Activities in the Galisteo Watershed from the June 19, 2004 meeting of the Vista Clara Initiative. Watershed zones are indicated in colors. Upper watershed: Blue, Middle watershed: Green, Lower watershed: Yellow. Photo courtesy J.W. Jansens.

VII. RECOMMENDED REHABILITATION ACTIONS

General Planning and Rehabilitation Strategies

Rehabilitation actions stem from a series of general planning and rehabilitation strategies for the entire Galisteo Watershed. The strategies include:

A. The establishment of a watershed association will be central in the future planning and rehabilitation of the watershed. A movement of stakeholders, which called itself the Vista Clara Initiative in 2004, grew into the Galisteo Watershed Partnership (GWP) in 2005. This group has made important strides with the following planning and rehabilitation strategies. The GWP identified a dozen ongoing planning and rehabilitation initiatives in the watershed that need the group's ongoing attention and four themes for future planning and information exchange. These four themes are: ecological/open space management, water management, transportation management, and urban development. The GWP will be established in a charter meeting on July 7, 2005 at Vista Clara Ranch in Galisteo.

B. The development of a watershed-wide master plan for "green infrastructure." The web (or matrix) of open space in the watershed consists of stream corridors, wetlands, archaeological sites, and other areas of cultural and ecological significance. Private properties in the green infrastructure will, where possible, be protected with conservation easements. Master planning for the "green infrastructure" matrix and the (ex)-urban matrix will be based on land suitability for open space vs. urban development functions and follow landscape ecology theory regarding corridors and islands for habitat connectivity. This program, named the "Galisteo Watershed Conservation Initiative" (GWCI) intends to develop a "green infrastructure" open space plan for the watershed supported by GIS data sets and maps. In 2004, the GWCI received funding in part through an appropriation from the State of New Mexico, managed by the Office of the State Engineer. The Santa Fe Conservation Trust and Earth Works Institute (EWI) have taken the lead in the implementation of the GWCI.

C. The development of a multi-year wetlands planning, development, restoration, and conservation program in the Galisteo watershed plays a central role in the establishment of the green infrastructure network. The wetlands program will include buffer zones with conservation easements. In 2005, EWI and the State Environment Department (NMED) have launched a four-year wetlands planning and development program, which is integrated in the long-term planning of the GWP.

D. In collaboration with Santa Fe County and state and federal government agencies, the GWP should develop runoff management standards and protocols from roads and built-up areas These standards and protocols could over time be expanded to guide ecological planning of built up areas and education programs for developers, builders and homeowners in order to promote water harvesting and conservation for neighborhoods and individual homes. Currently, the GWP has begun a dialogue with the State Department of Transportation on runoff management and other primary and secondary and cumulative impacts of highway planning and design. The GWP and EWI have also developed a working relationship with the Galisteo Basin Preserve development on the former Thornton Ranch to establish protocols for ecological urban planning and development.

E. The development of a selective forestry approach and public/private woodlot management strategy for managing forests and woodlands and for managing invasive species will be essential to improving the health of conifer forests, pinon/juniper woodlands and riparian forests (*bosques*). Small scale initiatives are underway in Galisteo and on the Santo Domingo Pueblo reservation. In addition, the U.S. Corps of Engineers has begun research of invasive species management in the Galisteo Dam reservoir. GWP should pursue collaboration with state and federal agencies to expand these initiatives to other private and public forest lands and woodlands. Interventions should include the development of protocols,

education programs, and technical services that promote selective forest management and woodlot management. Public forest lands should also be managed by treating small plots at a time with selective harvesting/thinning and/or prescribed burning prescriptions. Managed grazing and browse should be considered as well as in these vegetation management strategies.

F. The development of managed grazing protocols and plans for private and public land holdings (and lease areas) will help improve vegetation management of grasslands and woodlands. The BLM and a few private landowners (under GWRP-II) have begun grassland inventories and completed or partly completed grazing management plans for certain grasslands in the watershed. It may help future managed grazing strategies to have periodic meetings or seminars that review lessons learned and provide educational opportunities to ranchers, landowners and land managers.

G. The development of wildfire management and education strategies will be essential to increasing wildfire preparedness and reducing the risks of catastrophic wildfires in the watershed. EWI conducted wildfire preparedness education and planning with six communities in the Upper Watershed between 2001 and 2003. In 2005, the U.S. Forest Service plans to conduct a prescribed burn in the area, accompanied by public education, while the Santa Fe County Fire Department is developing increased wildfire preparedness planning in Santa Fe's Wildland/Urban Interface zone under a Collaborative Forest Restoration Program.

H. The continuation of (i.e. development of new) stream rehabilitation projects in the Galisteo Watershed is essential for the general rehabilitation of the health of streams and riparian areas. Projects should focus on reducing sediment loads in the creek from major bank failure and on regenerating more streamside vegetation to lower the water temperature of the creek. By improving these stream conditions, projects will improve the ecological quality of the stream and riparian habitat of the Galisteo Creek. In addition, projects should seek to remove obstructions to high flows in the creek (bridges, levees, wells, dams, narrow rock passages), which typically cause large-scale bank erosion and the formation of large point bars of unsorted sediments that encourage invasive trees rather than native tree species. Projects should include new Induced Meandering in straightened stream reaches as well as the straightening of reaches that have an unnatural curve or where an exaggerated sinuosity is not supporting a healthy stream system.

Planning and Landscape Rehabilitation Principles

In addition, the following planning and landscape rehabilitation principles apply to these strategies and the specific rehabilitation actions associated with them:

1. Collaboration and partnership networks should be established, where appropriate, to guide watershed planning and rehabilitation interventions to include a broad group of stakeholders.

2. Community organization in volunteer teams, committees, and neighborhood groups that can be mobilized for monitoring, rehabilitation work, and planning and decision making will support the longevity of interventions.

3. Demonstration restoration projects in neighborhoods are very effective for educational purposes and the promotion of rehabilitation and landscape management techniques throughout the watershed.

4. Education and outreach activities should accompany all strategies and interventions. Education programs in schools, neighborhoods and watershed-wide is essential to promote new techniques and stewardship behavior and to share findings from monitoring of past rehabilitation work. Education activities and technical interventions should serve and grow people's relation to the land and promote better land stewardship.

5. Monitoring and evaluation (both ecological and social monitoring) of interventions will reveal which techniques are appropriate for the area, which need improvement, and what can be learned in general.

6. Economic incentives should be developed to make landscape restoration pay for itself over time.

7. Holistic, integrated planning allows the watershed to be managed as one ecosystem and one management unit. All land use management decisions should take in consideration the long-term, cumulative impacts upstream and downstream in the entire watershed.

8. The regeneration of soil as the "sponge" of the landscape and techniques that focus on harvesting stormwater runoff should be central in most watershed restoration (rehabilitation) strategies and actions. We can strengthen the ecological resiliency and diversity in the watershed's landscape if we increase the biological activity, infiltration capacity and productivity of the soil. In so doing, we will reduce soil loss and non-point-source pollution.

Popular Issues of Concern and Proposed Interventions

The WRAS committee has identified eight popular issues of concern throughout the watershed. The issues of concern and the suggested interventions for each issue relate to specific strategies. In the development and implementation of the strategies, the listed concerns and interventions will be addressed. Conversely, by implementing the interventions, a contribution will be made to the implementation of one or more strategies and to one of the three priority goals identified in the previous chapter.

The WRAS identifies several implementation zones in the watershed based on landscape characteristics (Appendix 7):

Upper Watershed:
This is the eastern part of the watershed, dominated by mountainous or hilly topography, mesas and a piedmont plateau, with conifer forests, woodlands, and wooded grass savannah. Population is sparse. A large part of the area is public land managed by the U.S. Forest Service

Middle Watershed:
This is the central part of the watershed, dominated by flat to rolling topography with steep volcanic outcroppings and ridges ("dykes"), with open woodland, grassland savannah, and bare rock hillsides. Population is concentrated in the northern part and very sparse in the southern part. Most land is privately owned and interspersed with small parcels of State and Federal land.

Lower Watershed:
This is the western part of the watershed, dominated by volcanic hills and mountains, ridges and rocky outcroppings and deep, narrow canyons, and ultimately the delta of the Rio Grande and Galisteo Creek, with bare rocky hillsides, riparian forest, woodlands, and grass/scrubland. Population is concentrated in small villages and neighborhoods and spread in small ranchettes. Part of the land is privately owned, while significant areas are managed by various State and Federal agencies and the Santo Domingo Tribe.

Table 1: Popular Issues of Concern

Popular Issues of Concern	**Proposed Interventions/Actions And Related Strategies**	**Location**
1. Flooding Increasing amounts of stormwater runoff with a decreasing time of concentration lead to peak flows in arroyos and the Galisteo Creek. Flooding causes serious bank erosion, deterioration of riparian habitat and increased human safety risks.	Disseminating strategies for runoff harvesting and storage (Str. D). Developing a flood alarm system and safety procedures (Str. D). Mobilizing FEMA and other government assistance (Str. D).	Watershed-wide. Particularly serious in the Lower Watershed.
2. Invasive Tree Species Hydro-ecological conditions of riparian areas currently favor the competitive advantage of non-native, invasive species such as tamarisk and Russian olive.	Conducting site-specific, applied research on ecosystem and species conversion to favor native tree species. A selective forestry approach (e.g. a woodlot management approach on private land) and a diversified approach to invasive tree removal should lead any species conversion initiatives (Str. C, E, G, H).	Middle and Lower Watershed
3. Soil Erosion Soil loss in the watershed is greater than soil accumulation. Wind erosion, sheet erosion, rill and gully erosion and bank erosion all occur due to poor soil conditions and lack of protective cover.	Propagating soil cover techniques (mulch, vegetation) and land use strategies that limit runoff and increase infiltration and soil stabilization (Str. D, F, H).	Watershed-wide
4. Piñón Die Off The sudden die off of about 80% of pinons between 2002 and 2004 has led to the occurrence of many dead trees in the landscape. This has changed soil conditions, wildlife habitat, and the visual quality of the land.	Promoting woodlot management and land stewardship focused on soil stabilization (Str. D, E).	Watershed-wide. Particularly serious in the Upper Watershed and in the Ortiz Mountains.
5. Open Space Encroachment Unmanaged ex-urban development results in degradation of the landscape's rural quality, open space values, and cultural and historical identity.	Promoting open space and smart growth planning in a collaborative manner (Str. A, B). Developing a "green infrastructure" plan that identifies suitability for open space conservation vs. suitability for urban development (Str. B).	Watershed-wide

Popular Issues of Concern	Proposed Interventions/Actions And Related Strategies	Location
6. Wildfire Dry forest conditions and poor vegetation management have increased the chance for catastrophic wildfire in forests and woodlands. The problem is extremely severe where homes have been built in the forests and where access roads are insufficient for emergency response.	Promoting wildfire preparedness and forest management and construction techniques that will reduce the impact of wildfire (Str. E, G). Promoting road management and urban development that are in compliance with County regulations (Str. D).	Upper Watershed
7. Grassland Health Grassland vegetation cover is scant due to soil deterioration and gully erosion (dewatering). Present vegetation cover and soils are often mismanaged.	Promoting grassland restoration techniques, such as managed grazing, mulching, runoff irrigation, wildlife management, and trespass control (Str. F).	Watershed-wide. Especially in Middle and Lower Watershed
1. Water Availability Dry weather conditions between 1996 and 2004 and increasing demands on the aquifers under the Galisteo watershed have limited the amount of available drinking water. Population growth may cause water needs to exceed supply in the northern part of the watershed by 2005.	Promoting water conservation strategies around the home (Str. D). Promoting water harvesting and storage (Str. B, C, D, H). Developing new technologies and searching new sources of water for sustainable use (Str. B, C, D, H).	Watershed-wide. Particularly serious in Middle and Lower Watershed.

Key concerns and actions may be watershed-wide or related to a specific zone of the watershed.

Watershed-wide interventions:

- The eight general planning and rehabilitation strategies listed above (A-H).
- Issue-oriented interventions:
    - (1) Flood control,
    - (3) Erosion and runoff control (increasing soil cover and infiltration),
    - (4) Woodlot/woodland management,
    - (5) Open space (green infrastructure) and smart growth planning,
    - (7) Grassland restoration,
    - (8) Water conservation (harvesting and storage).

Upper Watershed interventions:

- Woodlot/woodland management.
- Wildfire management and preparedness education.

Middle Watershed interventions:

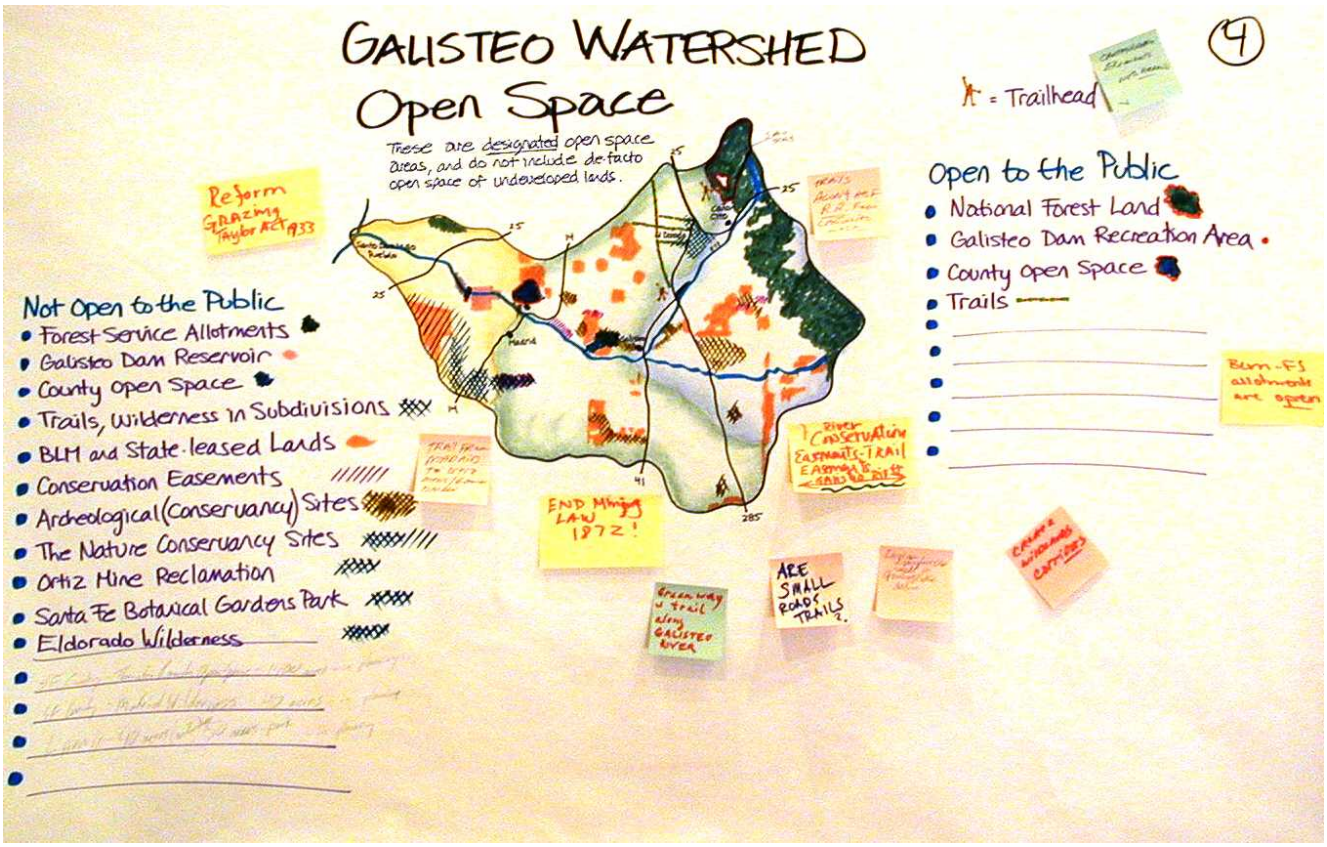
- Research and selective forestry approaches for invasive tree species management.
- Grassland restoration.
- Water conservation (harvesting and storage).

Lower Watershed interventions:

- Flood control.
- Research and selective forestry approaches for invasive tree species management.

- Grassland restoration.
- Water conservation (harvesting and storage).

Appendix 8 includes an overview of relevant literature, references used, and web sites that may be used in future planning and conservation activities for the Galisteo Watershed.



Picture 5. Example of a discussion map about open space development and conservation opportunities in the Galisteo Watershed during the June 19, 2004 meeting of the Vista Clara Initiative. Watershed zones are indicated in colors. Upper watershed: Blue, Middle watershed: Green, Lower watershed: Yellow. Photo courtesy J.W. Jansens.

Monitoring

An implementation plan for the proposed interventions should specify requirements for monitoring and field verification for each project. A monitoring strategy should be developed through a study design process, preferably with inclusion of a broad group of stakeholders. Monitoring should be coordinated by a professional coordinator who is responsible for managing a Quality Assurance and Quality Control process, data storage, analysis and reporting. Monitoring should be funded for 5-10 years after completion of the project in order to allow the development of meaningful data sets. Experiences to date in the Galisteo Watershed do not show promising results from volunteer monitoring due to the sparse and scattered population and diverse social structure of the population. Monitoring of behavioral changes toward increased natural resource stewardship would be very valuable as well in combination with monitoring of on-the-ground accomplishments of technical interventions.

Water Governance at a Watershed Scale

The Galisteo Watershed Partnership should develop proposals for the governance of water supply, water quality, harvesting and diversion, storage, distribution, and monitoring at a watershed scale. Water is and will increasingly become a critical factor in the economic development and wellbeing of people in the watershed. A locally grown and supported water governance system will become essential for ecological health, the implementation of land stewardship, public involvement and public education, corporate and government involvement, and corporate and government accountability.

An important first step toward good governance is the development of a "water ethic" that includes the public acknowledgment of water as a vital resource, water conservation as a way of life, and the celebration of the cultural, spiritual and other intangible values of water. Knowledge about the history of the watershed, strengthened by both historical research and the reintroduction of an oral history (story telling) tradition may help bring back the special appreciation for land and water in people's lives. Visual art and poetry may also play a role in growing people's relation to the land and the water as fundamental resources to our livelihoods and future.

Water governance should also include the development of regulations and enforcement capabilities at the watershed, County, and/or State levels regarding water supply issues, water quality, water delivery, etc. for individuals, businesses, and communities. Water management regulations should focus, for example, on water conservation, monitoring of water availability, quality and use, and land use and terrain management. A water governance system for the watershed should provide technical and economic incentives and technical assistance to individuals and businesses to achieve the recommended and mandatory water management conditions.

Water governance should be harbored in a public trust institution, such as a government body. Democratic principles should play a central role in the governance structure to ensure accountability to all. At that basis, the governance system could include the corporate sector for the implementation of specific aspects of water management.

Picture 6. Discussions about water governance and a watershed management organization structure during the Vista Clara Initiative meeting on June 19, 2004. Photo courtesy J.W. Jansens.

VIII. FUNDING NEEDS AND PROSPECTS

Funding Needs for each Strategy

The following is an overview of estimated funding needs for the Galisteo Watershed Partnership at this time (2005) and does not include funds available to the discretion of individual partners.

A. Galisteo Watershed Partnership

Available in 2005:	$0 (not including in-kind support from the National Park Service for Technical Assistance)
Needed additionally in 2005:	$10,000
Needed annually:	$15,000-$25,000 (depending on occurrence of special events)

B. Green Infrastructure Master Plan

Available in 2005:	$50,000
Needed additionally in 2005/06:	$0
Needed annually:	$50,000 for first year (2005/06) and $5,000 for periodic updates

C. Wetlands Program

Available in 2005:	$50,000 (approximate amount; $140,000 for 2005-2008)
Needed additionally in 2005:	$0
Needed annually:	$50,000 (approximately: for rehabilitation and development projects)

D. Runoff Management Standards & Protocols

Available in 2005:	$0
Needed additionally in 2005:	TBD. Estimate: $30,000
Needed annually:	$30,000 (depending on specific activities and interventions)

E. Selective Forestry and Woodlot Management

Available in 2005:	$0
Needed additionally in 2005:	TBD. Estimate: $50,000
Needed annually:	$50,000 (depending on specific activities and interventions)

F. Managed Grazing Protocols and Plans

Available in 2005:	$0
Needed additionally in 2005:	TBD. Estimate: $25,000
Needed annually:	$25,000 (depending on specific activities and interventions)

G. Wildfire Management & Education Strategies

Available in 2005:	$0
Needed additionally in 2005:	TBD. Estimate: $10,000
Needed annually:	$15,000-$25,000 (depending on specific activities and interventions)

H. Stream Rehabilitation Projects

Available in 2005:	$0
Needed additionally in 2005:	TBD. Estimate: $50,000
Needed annually:	$50,000-$100,000 (depending on specific activities and interventions)

TOTAL FUNDING AVAILABLE FOR 2005:	**$100,000 (plus NPS Technical Assistance)**
TOTAL ADDITIONAL FUNDING NEEDED for 2005:	**$175,000**
TOTAL FUNDING NEED per year:	**$240,000-$310,000**

Funding Prospects

- Start up or grassroots groups geared towards community oriented watershed health activities are often funded through organizations affiliated with the New Mexico Funding Directory. This is a free resource hosted by the University of New Mexico, Office of the Vice Provost for Research located at: http://research.unm.edu/funding_opportunities/nmfd/. For more information about the directory, its use or obtaining a hard copy, email research@unm.edu.

- River Network is an organization supporting watershed activities nationwide; they provide up to date information on how watershed organizations conduct useful projects. The River Network supplies a useful funding source directory through their website www.rivernetwork.org.

- The following funding organizations and agencies focus on ground restoration and rehabilitation work.

    - EPA Funding for wetlands protection and identification
    - US Army Corp of Engineers: funds for contractors and materials; no overhead, not community oriented.
    - US Forest Service
    - US Bureau of Reclamation: funding for outreach and watershed plans by municipalities, counties and other governmental entities or advisory groups.
    - Partners for Fish and Wildlife, USFW
    - Federal Highway Administration (FHA): sponsors university research on water resource management: http://www.fhwa.dot.gov/
    - Natural Resources Conservation Service: Money available to private landowners for watershed and river basin planning and installation program,
    - NRCS: Stewardship Incentive program
    - Environmental Grantmakers Association: 250 grant making foundations worldwide: www.ega.org.

APPENDICES

1. **Community Survey**
2. **Shaded Relief Map of the Galisteo Watershed**
3. **Report from the February 28, 2004 meeting "Paradox and Promise" at the Vista Clara Ranch, and Report from the June 19, 2004 meeting "A Confluence of Initiatives" at the Vista Clara Ranch.**
4. **Soils Data**
5. **Vegetation Inventories for the Galisteo Watershed**
6. **Historical Timeline of the Galisteo Watershed**
7. **Implementation Zones and Communities in the Watershed**
8. **Additional Resources and Citations**

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[10] If you are interested in learning more about conservation easements, call the Santa Fe Conservation Trust at (505) 989-7019 or the Taos Land Trust at (505) 741-0363.

[11] MEMORANDUM OF AGREEMENT BETWEEN THE ENVIRONMENTAL PROTECTION AGENCY AND THE DEPARTMENT OF THE ARMY CONCERNING THE DETERMINATION OF MITIGATION UNDER THE CLEAN WATER ACT SECTION 404(b)(1) GUIDELINES. http://www.wetlands.com/fed/moafe90.htm

[12] 'Before You Start Work in a Stream, Lake, or Wetland...Read This! Why do I need a permit?'. http://www.spa.usace.army.mil/reg/Application%20Process/NMEDPAM.HTM

[13] Standard Information Needed for Section 106 Consultation. http://www.nmhistoricpreservation.org/OUTREACH/outreach_section106.html

[14] Refer to previous references for detailed information.

APPENDIX 1. Community Survey

WATERSHED RESTORATION ACTION STRATEGY (WRAS)
GALISTEO WATERSHED

Questions for Watershed Communities

September 2003
By the WRAS Committee for the Galisteo Watershed
In Collaboration with Earth Works Institute

Dear Community Member and Watershed Resident,

Since 1998, **Earth Works Institute (EWI)** of Cerrillos has coordinated the **Galisteo Watershed Restoration Project (GWRP)**. In 2001, EWI wrote a long-term strategy plan (WRAS) for the watershed. In order to update this plan EWI has established a committee of landowners and stakeholders in the watershed to help revise the plan and generate input from as broad a local audience as possible. It is **our goal** to form a watershed association and help conserve and rehabilitate vital ecological functions and natural resources in the watershed, such as productive and water-absorbing soils, ground water reserves, vegetation cover, and wildlife habitat.

We invite you to fill out this questionnaire and return it to EWI. Your response will greatly help us gage the breadth and depth of ecological concerns and solutions of residents like you in our Galisteo watershed. We ask that you be succinct and discrete in your answers. For privacy reasons, we ask you not to state your name or to disclose any specifics about your neighbors. Please feel free to use the back of the sheets to write out longer answers to the questions, while making reference to the specific question number.

The information you provide will be analyzed together with all other questionnaires. We will use the survey findings in the new WRAS. We plan to have a Draft version of the WRAS completed by December 20, 2003. In the winter of 2004, we will make the Draft WRAS available for public comment. After review of comments, we plan to have the final WRAS available by May 2004. EWI is producing the WRAS under a contract with the New Mexico Environment Department. WRAS Committee members include: James Crain, Dr. David Henkel, Mark Kaltenbach, Alice Loy, Thor Sigstedt, Sigmund Silber, Tracey Williams, and Jan-Willem Jansens.

Please call **Jan-Willem Jansens or Tracey Williams at 982-9806** if you need more background information about this survey.

THANK YOU!

Please send your questionnaire to:
Earth Works Institute, Attn: WRAS
1413 Second Street, Suite 4
Santa Fe, NM 87505

1. In what neighborhood or community do you live and/or own land? (Please circle all that apply)

Glorieta – Valencia – Apache Canyon – Apache Ridge area – Canada de los Alamos –

Upper Canoncito – Lower Canoncito – Rowe Mesa – Ojo de la Vaca – Lamy – Galisteo –

Old Santa Fe Trail – Seton Village – Sunlit Hills – El Dorado – San Marcos area –

Lone Butte – CR 42 – CR 55-A – Cerrillos – Waldo – Rogersville Road – CR 55 –

Goldmine Road – Madrid – Other (please specify): _____

2. How would you want to describe your interest in the area and/or relation to the land (please circle all that apply):

Homeowner – Tenant – Landowner – Rancher – Gardener – Forester – Farmer –

Architect – Landscape architect – Developer – Builder – Land-based Business Owner –

Landscaper – Contractor – Artist – Naturalist – Alternative/ecological builder – Hiker –

Horse owner – Educator –Photographer –Hunter – Other (please specify): _____

3. To what extent is (storm water) runoff and/or flooding and/or soil erosion a concern in your area? (Please circle those that apply).
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

4. To what extent is lack of/excessive vegetation cover a concern in your area?
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

5. To what extent are soil conditions (water absorption, etc.) a concern in your area?
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

6. To what extent is wind erosion (and effects such as dust in the air, evaporation, loss of soil fertility, etc.) a concern in your area?
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

7. To what extent is the hazard of wildfire a concern in your area?
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

8. To what extent is lack of fire and lack of active vegetation management (such as thinning) a concern in your area?
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

9. To what extent are invasive plant species (such as tamarisk, Russian olive, tumbleweed, locoweed, ragweed, chamisa, juniper, etc.) a concern in your area?
   _____ Not a concern. Why not?
   _____ Yes, it is a concern, namely/because _____.

   What efforts are made to deal with it?

10. To what extent is the health and well-being of wildlife a concern in your area?
    _____ Not a concern. Why not?
    _____ Yes, it is a concern, namely/because _____.

    What efforts are made to deal with it?

11. To what extent is the pace and nature of development in your area a concern?
    _____ Not a concern. Why not?
    _____ Yes, it is a concern, namely/because _____.

    What efforts are made to deal with it?

12. What is the recent history of existing and new wells in your area? Any problems?
    _____ No problems. Why not?
    _____ Yes, there are problems, namely/because _____.

    What efforts are made to deal with it?

13. What is the history of seeps and springs in you area? Any problems?
    _____ No problems. Why not?
    _____ Yes, there are problems, namely/because _____.

    What efforts are made to deal with it?

14. To what extent are unintended consequences of land restoration measures, water catchment ponds, etc. a concern in your area?
    _____ Not a concern. Why not?
    _____ Yes, it is a concern, namely/because _____.

    What efforts are made to deal with it?

15. To what extent would water rights transfers within the Galisteo Watershed affect your area?
    _____ No effect. Why not?
    _____ Yes, they would affect the area, namely/because _____.

16. To what extent would water transfers from outside the area into the Galisteo Watershed affect your area?
    _____ No effect. Why not?
    _____ Yes, they would affect the area, namely/because _____.

    Would you be willing to be taxed for the cost of water pipelines from outside the area?

17. What would be the environmental, economic and/or social impacts to your neighborhood of having a new source of water for development or domestic use?
    _____ No impacts. Why not?
    _____ Yes, there would be impacts, namely/because _____.

18. To what extent do you have access to relevant information to address the issues listed above?
    _____ Access to information is not a problem. Why not?
    _____ Yes, it is a problem, namely/because _____.

    What efforts are made to deal with it?

19. To what extent do any of the issues of concern listed above affect real estate prices in your area?
    _____ No effect. Why not?
    _____ Yes, in particular the following issues affect real estate prices: _____.
    They drive up prices / lower prices (circle one).
    They do so because _____.

    What efforts are made to deal with it?

20. Where do the issues of concern listed above originate? Upstream/ downstream/ neighboring areas/ elsewhere? (Please, circle all that apply).

21. What other concerns do you have regarding the ecological functions and natural resources in the Galisteo watershed?

    _____ No other concerns.
    _____ Yes, in particular the following issues of concern: _____.

    What efforts are made to deal with it?

22. Where do you currently look for leadership in watershed-related issues? Is it adequate?

23. What do you think about the need to establish an organization to foster healthier conditions for soil, water, vegetation, wildlife and humans in the Galisteo watershed?

24. What would be the most important issue of concern for your area/neighborhood to be addressed by such a watershed association?

25. Comments, suggestions:

Please relate any interesting **stories**, in particular about the Galisteo Creek, and pass them on to us to enliven our effort and increase public involvement and mutual interest in the area. (For example, stories about adventures in the area, flood events, quicksand incidents, wildlife sightings, interesting people, important achievements, etc.). Please, also share some interesting **literature suggestions** about the Galisteo watershed or watershed related issues. Please send them along with this questionnaire to the address printed below.

THANK YOU FOR YOUR HELP!

For more information, please contact Tracey or Jan-Willem at Earth Works Institute: 505-982-9806, jjcgclp@earthlink.net

Please send your questionnaire, and possible stories and literature suggestions to:
Earth Works Institute, Attn: WRAS
1413 Second Street, Suite 4
Santa Fe, NM 87505

APPENDIX 2. Shaded Relief Map of Galisteo Watershed

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APPENDIX 2. Shaded Relief Map of Galisteo Watershed

Produced by students from the Community & Regional Planning Program of the University of New Mexico in Albuquerque led by Dr. David Henkel. Fall 2001.

APPENDIX 3. Historical Time Line of the Galisteo Watershed

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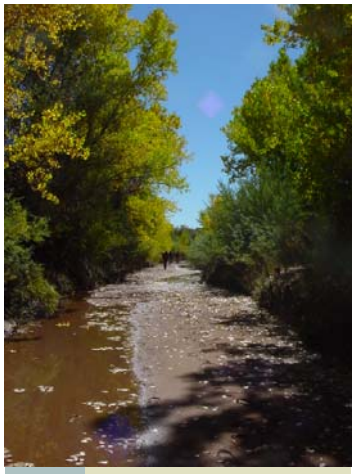


VISION DRAFT, VERSION 1, MARCH 2004

The Galisteo Watershed: A Vision for the Future

Bounded by Rowe Mesa, the Estancia Basin Escarpment, and the Ortiz Mountains to the South; the Sunlit Hills, the heights of Rancho San Marcos, and the Cerrillos Hills in the North; the Galisteo Watershed sweeps downward from Thompson Peak to the Rio Grande, creating a large basin spanning three counties and encompassing 730 square miles.

This watershed (as that is how we shall refer to it) does not exist in isolation. It is continuously affected by activities in and around it. Different initiatives are competing for limited resources while (sub) urban development is expanding into the watershed at a rate of approximately 500 homes a year. The watershed is a fragile environment, able to sustain, and alternately not sustain, its residents. This historical perspective is a warning that it is critical to plan for the social, economic, and ecological future of the watershed. To undertake such planning, people who care about the Galisteo Watershed - landowners, residents, and stakeholders - came together to learn about the watershed and to say what is their shared vision.

On **February 28th , 2004,** an all-day meeting was graciously hosted by **Vista Clara Ranch Resort and Spa**. The meeting was sponsored by EarthWorks Institute, Santa Fe County Planning Division, and the Santa Fe Conservation Trust, and facilitated by The Community Store. The day was divided into two parts. In the morning people learned about the general history of human habitation in the watershed, ecological challenges that human occupation presents, and what is entailed in community watershed planning. During the second half of the day participants had the opportunity to say what it is about the watershed that they treasure, and how they picture a desirable future for the watershed.

The meeting participants asked the core group that planned the meeting to summarize the results, including a draft vision statement for the Galisteo Watershed. What follows in this report is the draft vision statement for the Galisteo Watershed.

Stop! Help! Please! As you read the following, keep in mind that it is a ***DRAFT***. We have tried our best to represent what 50 people said. That is hard to do and we have likely made mistakes. Please let us know what we have left out or misstated.

A shared vision will be the primary building block to create a plan for the watershed. After your input, we will meet with others who were not at the meeting to see what they think of the draft. We are seeking widespread input into the creation of the vision statement. On June 19th, 2004, a second large community meeting will convene people to outline how the detailed planning for the watershed will be done.

One last request. We want to reach people who were not at the meeting on February 28th . We have to figure out how to involve the diversity of the population within the basin – youth and residents of all communities and cultures. Help us do that. Share this report with your neighbors and friends, and tell us who else should see and respond to the vision and how we can reach them.

Your contact for sending comments is:
Marjo Curgus
phone: 989-7673
email: marjocurgus@hotmail.com

The Complete Meeting Summary

A full report of the meeting is available on the Santa Fe County website: *www.santafecounty.org* as a PDF file. Look for the ***Galisteo Watershed Collaborative Planning*** link under **News and Headlines**. You can request either a paper or digital copy from Beth Mills, County Planner, 505-995-2727. The report contains:

- The full meeting summary
- Handouts including:
  - What is a watershed
  - Examples of watershed planning
  - The Galisteo Watershed Restoration Action Strategy Draft
  - Wet and dry cycles in NM
- A historical timeline of the Galisteo
- A participant list

The Galisteo Watershed: A Vision for the Future

LESSONS LEARNED

The history of the watershed reveals lessons for current and future planning.

- Lessons from the past have largely gone unheeded.
- Water has been essential to human habitation in the past and is likely to be the key influence in the future.
- The watershed reflects the changing reality of New Mexico. Extraction has been a dominant feature of the watershed's past, but no longer is an economic reality.

- The watershed tells the story of a long history of migration, where people took what they needed from the land. Environmental impacts have compounded over time. How can the current inhabitants more sensitively live in balance with the natural surroundings?
- The people in the watershed have been adversely impacted by decisions made outside of the watershed.
- Technology and affluence enabled expansion in the watershed that exceeds the capacity of a fragile and dynamic environment.
- People have come to the watershed because they were enchanted by the promise it represented. They had dreams that were larger than what the watershed could support.

In planning for the future of the watershed, how can we deal with some of these lessons?

For example, what will the new economy in the watershed be?

And how might water transfers affect the future of development in the watershed?

TREASURES

Residents and stakeholders of the watershed treasure:

- The natural beauty of the landscape (open space, vistas, night skies, solitude).
- Access to open space.
- Wildlife.
- The Galisteo River.
- A diverse, functioning ecosystem.
- That the people who live in the watershed are independent thinkers, engaged, and environmentally conscious. Many people live in a way that is connected to the land.
- The relaxed rural character.
- The rich historic and cultural heritage.

The Galisteo Watershed: A Vision for the Future

THE FUTURE

Residents and stakeholders of the watershed share common values that are the foundation to creating a desirable future.

People who live in the Galisteo watershed want to protect the natural beauty of the land – open spaces, vistas, night skies, wildlife, and solitude. They treasure the creeks that run through the sparsely populated landscape. They want to maintain small scale communities with a culturally diverse group of independent, environmentally conscious neighbors, many of whom live connected to the land. They value the unique historic and cultural heritage of the watershed.

The watershed is a microcosm of the inter-mountain West. Like the rest of the region, people living within the watershed have not heeded the lessons from their past. Climactic cycles and the resulting availability (and lack) of water – and how that water has been managed – is a large part of the reason why the watershed has sustained and not sustained its residents. The economy of the watershed in the past was based on extractive industries that no longer provide an economic engine for the local population. The new economy is a variation on the historic attraction (or is it extraction?) of the watershed – the enchantment with the place and the subsequent value of the land for residential development.

The challenge for the people living in the watershed is how they can live in balance with a fragile, impermanent environment. Thus, what should guide how people in the watershed plan for the future?

- Growth for commercial and residential development should be ecologically sensitive.
- Open spaces and the sense of open space must not be compromised by growth. What growth does occur should use smart growth strategies, including cluster development and mixed use. Ideally, open spaces and villages will be interconnected by trails and public transportation.
- Strategies should be undertaken to conserve and preserve important ecological areas.
- Water availability should limit all plans for growth.
- Appropriate technologies - such as water catchment systems, recycling water, and high tech waste water systems - should be required.

The meeting on 2/28/04 was titled ***Paradox and Promise****. Given our vision, how can we reconcile potential conflicts in planning for the future? For example:*

- *What is the role of government with regards to activities such as open space preservation and land use management?*
- *Who should be responsible for open space preservation strategies?*
- *What is the right way to plan for the extent and nature of urban development?*
- *How can we both protect and integrate private property rights into the planning vision?*

- New construction and restoration of existing buildings should utilize environmentally friendly designs and reflect environmental limits.
- The watershed should be restored so that the riparian areas are healthy, water flows in the river, and wildlife is abundant. Watershed restoration will require land management strategies such as rotational grazing, grassland restoration, and storm-water management.
- Archeological sites should be protected.
- There is a need for a healthy, local economy that fits the custom and culture of the watershed: small-scale, clean, and locally-owned.
- Residents of the watershed should participate in decisions likely to affect them.
- Local decision-making should be the product of regional cooperation reflecting a watershed orientation.
- Continuing environmental education – especially for youth – should be a commitment of the communities within the watershed.

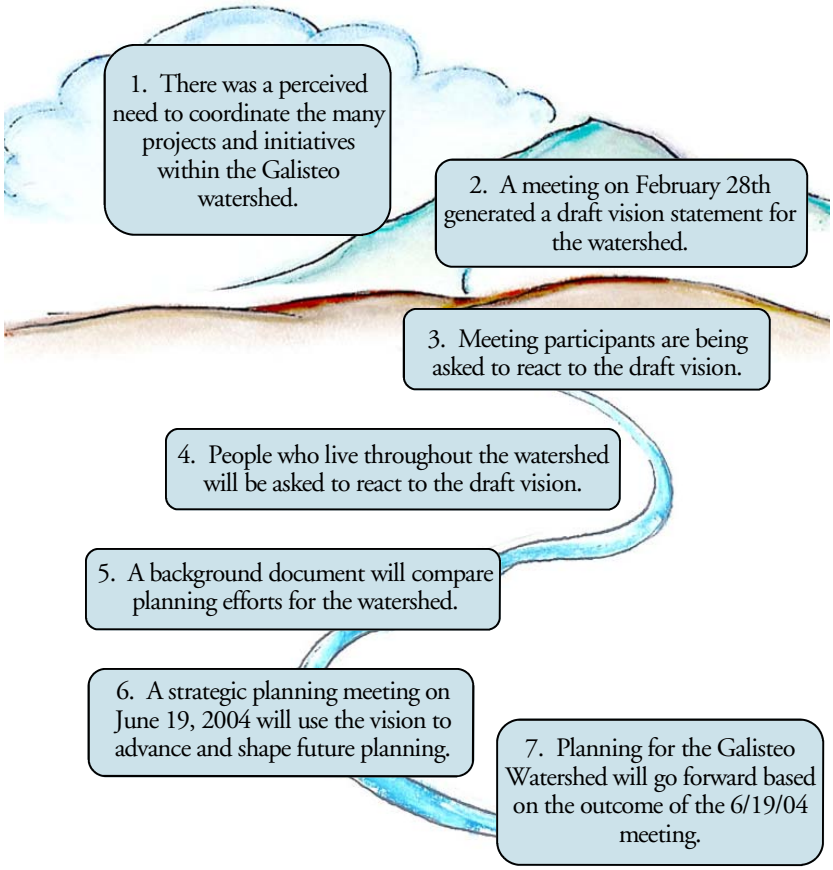
The Galisteo Watershed: A Vision for the Future

Why Should I Get Involved?

This is a unique process. It is trying to plan based on the watershed, because that makes the most environmental and geographical sense. The goal is to focus on the whole region—how the environment, communities, agencies and individuals are all interconnected—and how the planning initiatives and other activities currently happening in the Galisteo Watershed can work together.

- Read and react to the draft vision statement. Tell us how it can be improved.
- Share the draft vision with your family, neighbors and friends.
- Let us know how we can reach people who did not come to the 2/28/04 meeting.
- STAY INVOLVED! Plan now to attend the meeting on June 19th.

A Planning Process Map



Who Is Organizing This Effort ?

Please feel free to contact any of us for more information or about why we are involved.

The Earth Works Institute
Jan Willem Jansens, Executive Director
Tracey Williams Ellis, Program Coordinator
1413 Second Street, Suite 4
Santa Fe, NM 87505
505-982-9806
earthworks_jan@earthlink.net
earthworks_tracey@earthlink.net
www.earthworksinstitute.org

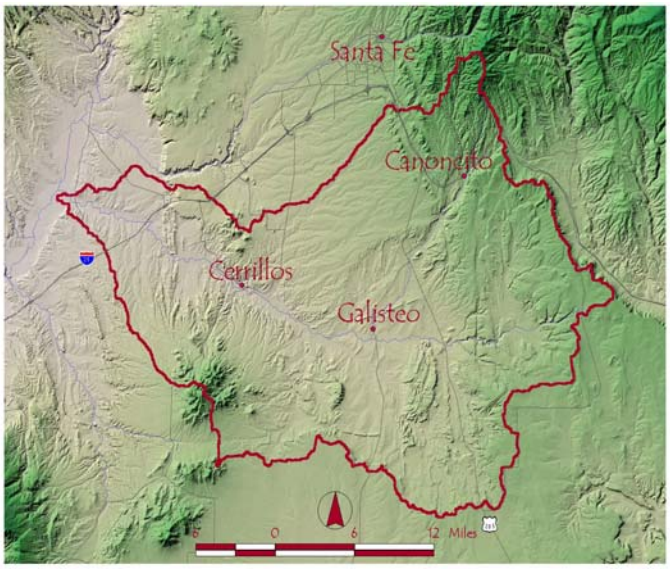
Santa Fe County Land Use Department
Jack Kolkmeyer, Planning Director
Beth Mills, Planner
PO Box 276-102 Grant Avenue
Santa Fe, NM 87504-0276
505-995-2727
jkolkmeyer@co.santa-fe.nm.us
bmills@co.santa-fe.nm.us
www.co.santa-fe.nm.us

The Santa Fe Conservation Trust
Jim Crain, Director of Land Conservation
PO Box 23985
Santa Fe, NM 87502
505-989-7019
jim@sfct.org
www.santafeconservationtrust.org

Process facilitated by:
The Community Store
16 Camino Delilah
Santa Fe, NM 87505
505-820-6826
Carl Moore, Owner
Marjo Curgus, Project Assistant
carl@thecommunitystore.com
www.thecommunitystore.com

CONFLUENCE DRAFT, VERSION 2, SEPTEMBER 2004

The Galisteo Watershed: A Confluence of Initiatives



Overview

The Galisteo Watershed sweeps downward from Thompson Peak to the Rio Grande, creating a large basin spanning three counties and encompassing 730 square miles. Activities in and around the Galisteo basin continuously affect the watershed. Competition for limited resources is exacerbated by these ongoing initiatives and expanding (sub) urban development, producing approximately 500 homes a year.

The watershed is a fragile environment. Throughout its history it has been able to sustain, and alternately fail to sustain, its inhabitants. This historical perspective is critical to planning for the social, economic, and ecological future of the watershed.

People who live in the Galisteo watershed want to protect the natural beauty of the land – open spaces, vistas, night skies, wildlife, and solitude. They treasure the creeks that run through the sparsely populated landscape. They want to maintain small scale communities with a culturally diverse group of independent, environmentally conscious neighbors, many of whom live connected to the land. They value the unique historic and cultural heritage of the watershed.

Thor Sigstedt & Patrick McGinn: Confluence of Initiatives meeting, 06-19-04.

Why A Watershed Focus?

The importance of a "watershed focus" rests in the clear understanding, protection and management of the natural resources unique to the Galisteo basin. The following ideas support this vision:

- John Wesley Powell argued that water is the key to development in the West. Therefore, land management should be organized around watersheds.
- Planning based on the watershed makes the most environmental and geographical sense.
- Watershed planning does not mean to plan only for the creek and the riparian area; it includes using the creek as the organizing feature to plan for all the elements that affect the health of the Basin.
- This region-wide focus aims to link the environment, communities, agencies and individuals—working together on planning initiatives and other restorative activities throughout the Galisteo Watershed.

Challenges

The challenge for the people living in the watershed is how to live in balance with a fragile, impermanent environment. People are concerned that a new era is about to begin in the basin. The watershed is at the brink of significant changes; existing and proposed new development pose challenges for people in the basin. Should history repeat itself? Should people living in the basin wait and watch or should there be a concerted, collective effort to plan for their shared future? If they decide to plan together, what methods should be used? What should guide how people in the watershed plan for the future? Residents, landowners, and other stakeholders came together in February and June of 2004 to address these questions.

Organizational Structure

The people, who came together in February and June 2004, realized that there is no existing organizational structure to help plan for the future. They decided it is necessary to create an organization that will coordinate different development and conservation activities, educate stakeholders about the area (including the proposed activities and their consequences), and generate studies to collect needed information.

The organization would initiate and coordinate the following responsibilities:

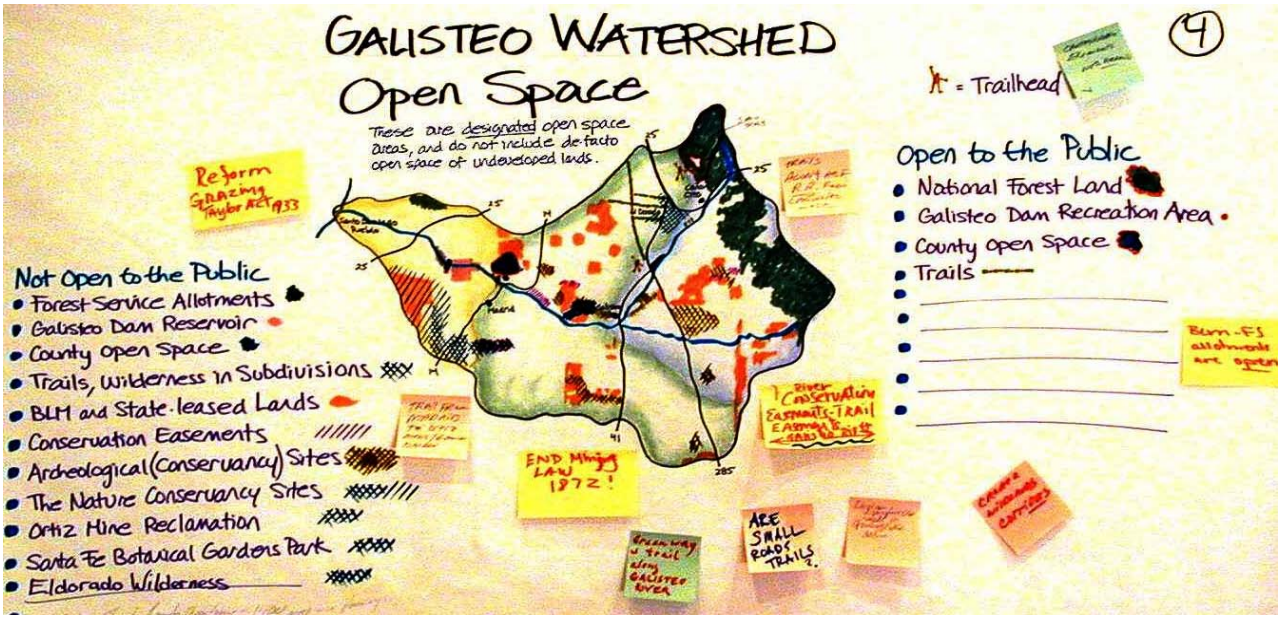
- Community building and education
- Preservation and restoration of natural resources and other landscape values
- Protection and enhancement of archaeological and cultural resources
- Smart growth initiatives
- Management of water resources

In addition, the organization could encourage and support local economic development, including sustainable agriculture and ranching.

The organization can take shape through a Memorandum of Understanding (MOU) between County, State and Federal government bodies. The MOU may also be a Public-Private Partnership between government bodies and private organizations and individuals. Over time the MOU could evolve to be a federally designated special planning area, such as a National Heritage Area. A widely representative "commission" should lead the organization.

Regardless the form or designation of the organization, real progress will require the following criteria:

- Authority to act on behalf of the full watershed
- Sufficient resources (including staff) to collect the data and undertake the technical work necessary to plan credibly
- Represent and be accountable to various communities in the Basin.



Concrete Projects

The Commission will be responsible for several proposed and current projects. The objective of the organization is to provide structure to these initiatives which benefit the entire basin. Examples of such projects include:

- An **archaeological preservation program** based on the Federal Galisteo Basin Archaeological Sites Protection Act which protects 23 major archaeological sites in the area. The planning is coordinated by the BLM. Citizen input would be very desirable.
- A **wetland restoration, creation and protection program** in collaboration with NMED, landowners and Santo Domingo Pueblo, coordinated by EWI and NMED.
- An **environmentally sound urban development and open space project** at the Thornton Ranch, conceived and managed by Commonweal Conservancy, in cooperation with other public open space managers in the basin and coordinated with the rail transportation initiatives currently under consideration by the state of New Mexico.
- The San Marcos District Community Plan, working towards the goal to **preserve the rural lifestyle of residents** in the western portion of the basin.
- An inventory of **large ranches** to discuss ways to manage a transition to smaller holdings in the least destructive and most constructive way.
- Santo Domingo Pueblo is conducting a **bosque restoration project** to reduce invasive species and fire hazard.
- Santa Fe Conservation Trust is working on a 5-year strategy to secure **50,000 acres of conservation easements** in the Galisteo watershed. In 2004-2005, the Trust plans to **map all existing and potential open space areas and conservation easement sites** in the watershed.
- The Nature Conservancy's **conservation area,** Ball Ranch tract NW of the Ortiz Mountains. A collaborative between TNC, Santo Domingo, BLM, and private landowners.
- The County Open Space properties and management plans for **preserving public open space and providing managed access to archaeological resources**.
- The Forest Service plan for **forest and fire management** in the upper watershed.
- Possible legislation authorizing the State Engineer to declare residential Critical Management Areas (CMA). Potential community role in assessing the positive and negative impacts of such a designation on water availability, economic development, and property values, **defining of the location, size, and shape of the CMA within the Galisteo Basin** to make it maximally effective and equitable.

Next Steps

Participants in the February 28 and June 19 meetings will continue the dialogue concerning issues in the watershed and the structure of the Commission. As requested, Earth Works Institute (EWI) will continue to coordinate the watershed planning conversations and activities in the interim. An organizing meeting will be held on Thursday September 23 from 5:00-7:00 p.m. at the National Park Service building at 1100 Old Santa Fe Trail. This will be a public meeting, and all interested parties are invited to attend. The steering committee will prepare a draft MOU for discussion. The agenda for this steering committee meeting includes the following inquires:

Confluence of Initiatives meeting 06-19-04

- Is a MOU the right vehicle to begin a watershed planning initiative?
- What is the purpose of the MOU, who are the right parties to participate in the MOU, and is this the right approach to creating the MOU?
- What kind of commission does the MOU establish and is there a place for any sub-commissions in coordinating different initiatives?
- What are the immediate funding needs to start an organization? What financial assistance from government agencies is available for staffing and administrative needs

Earth Works Institute bosque restoration workshop

Please Join Us

Watershed based planning is a unique process that makes the most environmental and geographical sense. The goal is to focus on the whole region - how the environment, communities, agencies and individuals are all interconnected - and how the planning initiatives and other activities currently happening in the Galisteo Watershed can work together.

Galisteo Creek Restoration in Canoncito

How can you participate?

- Attend the steering committee meeting on September 23, 2004, from 5-7 p.m. at the National Park Service building located at 1100 Old Santa Fe Trail, to lay the foundations for a public-private organizational structure for the watershed
- React to this Draft Initiative Statement. Provide feed back for improvements and new ideas
- Share this Draft Initiative Statement with your family, neighbors and friends
- Let us know how we can expand our efforts to reach more people who should know about our efforts
- Participate in ongoing projects and new initiatives and ongoing projects

The Complete Meeting Summary

A full report of the meeting is available on the Santa Fe County website:
www.santacounty.org as a PDF file. Look for the ***Galisteo Watershed Collaborative Planning*** link under **Hot links.** You can request either a paper or digital copy from Beth Mills, County Planner, 505-995-2727. The report contains:

- Full meeting summary
- Galisteo Watershed Activity Map
- Meeting Participant List

Your contact for sending comments:
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Who is Organizing This Effort?
Please feel free to contact the organizations listed below regarding their involvement in the Galisteo Watershed Initiative.

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Other key players:

Colleen Baker: SF County
Paul Cusumano:National Park Service
Paul Olafson:SF County
Alan Ragins: National Park Service
Thor Sigsted: Resident
Sigmund Silber: Resident
Steve Warshawer: Beneficial Farm

APPENDIX 4. Soils Data

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APPENDIX 4. Soils Data

The following information on soil erosion and soil types for the Galisteo Watershed was compiled by the UNM/CRP classes that worked in the watershed from 1999-2003.

GALISTEO EROSION AND SOILS SUMMARY

UNM/ CRP graduate students studied aerial photographs of the Galisteo Creek, deducing an increase in soil erosion since 1987. Erosion is caused by the displacement of solids (soil, mud, earth, rock) by moving water or wind across a landscape. The combination of highly erosive soils and low vegetation cover with peak runoff flows develop tunneling and bank sloughing, characteristic of the patterns seen in the Galisteo Creek. According to the 1975 Soil Conservation Service (SCS, now the Natural Resources Conservation Service) Index for Santa Fe County and part of Rio Arriba County, the predominant soil in the Galisteo basin is a saline, alluvial land soil (AM series). Its character ranges from a loamy sand to a silty clay that is highly erosive. See table.

Code	Name	Slope (%)		Runoff	Erosion	Permeability	Material	Use	Relative Location
		Min.	Max						
AM	Alluvial land, saline	0	3	Rapid	Severe	Slow	loamy sand to silty clay loam	Range	creek basin

Two soil layers in cliff bank

In the Galisteo Creek the upper soil layer is highly erosive and sits above a layer of clay loam (not as erosive). When precipitation permeates the upper layer and hits the clay layer, the water begins to migrate horizontally, leading to potential tunneling. The picture shows the two soil layers on an exposed bank on the east side of the Galisteo Creek. The old creek channel has been relocated about 20 feet above and east of the present creek location, exacerbating the erosion problem because the old creek bed acts as a basin for runoff from the adjacent properties. In effort to understand the location of the soils and future relationship studies of wildlife, grasses to soil types, aerial photographs are used as a base map, then the SCS soil information was transposed onto the map. Measurements

from the three properties east of the creek and between the bridges were taken using the Revised Universal Soil Loss Equation (RUSLE). The measurements were taken from the head cut to the natural break of the slope (where water would start flowing). See summary of the RUSLE, below. The Slope-length and Slope-steepness (LS) was estimated because the matrix did not account for that gradual of a slope.

	Headcut to Morin	Morin-King Fence	King-Lippard fence	Old Creek channel
Slope Length (in ft) (L)	250	320	700	360
Height of Slope	8	8.2	8	9.1
Slope Steepness (in %) (S)	3.2%	2.6%	1.1%	2.5%
LS Factor	0.7	0.6	0.5	0.7
Vegetation Cover (G or M)	G	G	G	G
Runoff Coefficient (C)	0.3	0.3	0.3	0.25
Soil Erodibilty Factor (K)	0.3	0.3	0.3	0.3
Erosivity of Climate (R)	40	40	40	40
RUSLE	2.52	2.16	1.80	2.10

PRECIPITATION RUNOFF

Runoff from precipitation contributes to erosion. Development of land takes the place of vegetation and stable soil and can greatly exacerbate runoff, because the water can not infiltrate into the ground easily. Thus, building rooftops, gravel driveways and denuded (or removed) vegetation contribute to increased peak runoff and diminish natural vegetation. Reduced vegetation increases erosion because precipitation runs overland verses penetrating the soil; moreover, vegetation slows runoff whereas development increases erosion.

A comparison of three properties adjacent to Galisteo Creek demonstrate the increase in runoff from the addition of rooftops and gravel driveways verses undeveloped land in its natural state. The runoff coefficient is a number based on the amount of infiltration that occurs on a site. Hard surfaces have a higher value while natural surfaces tend to be lower.

Property Name	Runoff Coefficient	24 hrs 2 year rainfall event amount	Runoff Area (sq. ft.)	Runoff Amount Cubic ft.
Morin	0.8	0.2’	16,900	2,700
King	0.8	0.2’	8,250	1,300
Lippard	0.8	0.2’	2,500	400

Estimated current runoff from home sites

Property Name	Runoff Coefficient	24 hrs 2 year rainfall event amount	Runoff Area (sq. ft.)	Runoff Amount Cubic ft.
Morin	0.3	0.2’	16,900	1,000
King	0.3	0.2	8,250	500
Lippard	0.3	0.2	2,500	150

Estimated runoff from home sites assuming no development

I. These tables show how development affects runoff, increasing erosion. There are mitigation techniques that landowners can use to reduce the coefficient and increase infiltration. Mitigating runoff on site, landowners can reduce erosion and increase available soil moisture for vegetation.

The pace method was used for measuring long horizontal distances. The pace method is based on a persons stride length.

Pace Method:

- Mark a point on the ground. This is your starting point.
- From here take 10 regular walking-type steps in a straight line (5 with the left and five with right foot).
- Mark the spot where you end.
- Measure this distance with a tape measure.
- Divide distance by 10.
- This is your stride (ex. 27 ½ feet in 10 paces equals 2.75 feet per stride)
- Now count all of the steps you take to measure distances

SOIL TYPES NEAR GALISTEO NEW MEXICO

Source: 1975 Soil Survey of Santa Fe County & part of Rio Arriba County

GENERAL CHARACTERISTICS

Code	Name	Slope (%) Min.	Slope (%) Max	Runoff	Erosion	Permeability	Material	Use	Relative Location
AM	Alluvial land, saline	0	3	Rapid	Severe	Slow	loamy sand to silty clay loam	Range	creek basin
LL	Las Lucas loam	1	9	Rapid		Slow	loam	Range	East of AM
PB	Panky fine sandy loam	0	5	Medium	Moderate	Slow	fine sandy loam	Range	West of PN
PN	Pojaque-rough broken l	9	25	Rapid	Severe	Moderate	sandy clay loam	Range	West of AM
ST	Stony Rock land	20	100	Rapid		Moderate	sandstone, limestone, granite	Wildlife	NW of AM
TB	Travessilla-Bernal fine	1	9	Medium	Moderate	Moderate	fine sandy loam	Range	N of TB

RANGE VEGETATION CHARACTERISTICS

Code	Excessive grazing Decreasers	%	Excessive grazing Increasers	%	Major Increasers
AM	alkali sacaton, fourwing saltbush, blu grama, w wheatgrass, vine mesq	65	mat muhly, galleta, shadscale	35	shadscale
LL	alkali sacaton, western wheatgrass	50	blue grama, galleta, ring muhly, broom snake, weed, three-awn	50	3-awn, ring muhly, br. snakeweed
PB	s-o grama, black grama, Indian ricegrass, western wheatgrass	50	blue grama, galleta, ring muhly, s.dropseed, br.snakeweed, 3-awn	50	ring muhly, s.dropseed br.snakeweed
PN	bl grama,s-o grama, little blustem, Ind. ricegrass, w wheatgrass, n&t	55	blue grama, hairy grama, galleta sand dropseed, piñon-juniper	45	piñon-juniper
ST	black grama, side-oats grama, piñon, ricegrass, needle-&-thread	50	piñon-juniper, blue grama, galleta, three-awn, sand dropseed, rabbbrush	50	p-j, rabbrush, s.dropseed, 3-awn
TB	bl. Grama, n&t, side-oats grama, Ind. Ricegrass, little bluestem	60	Bigelow sagebrush, blu grama, sand dropseed, 3-awn, br. snakeweed, p-j	40	piñon-juniper, 3-awn, br.snakeweed

APPENDIX 5. Vegetation Inventories for the Galisteo Watershed

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APPENDIX 5. Vegetation Inventories for the Galisteo Watershed

Compiled by Tracey Williams

Dr. Roger Peterson, a professional ecologist and a New Mexico Native Plant Society member, drafted a report on the plants of the Galisteo Watershed. In April of 2003, Mary Hubby and Prof. George W. Cox contributed information and helpful observations about vegetation in the Ortiz Mountains.

Vegetation of the Galisteo Watershed

The Galisteo Watershed reaches almost 730 square miles, located in central Santa Fe County and western San Miguel County. The headwaters emerge out of Thompson Peak draining down to the Rio Grande at Santo Domingo Pueblo in Sandoval County. The elevation range in the watershed spans from 5,180 to 10,550 feet, however the majority of the land sits between 5,500 and 6,500 feet.

Grassland vegetation with shrubs and scattered junipers (juniper savannah) inhabit the watershed at elevations between 5,500 and 6,500 feet. These grasslands are considered the westernmost extension of the Great Plains in New Mexico. Some plant species reach western limits while others including the greasebush, are eastern outliers from the Colorado Plateau.

Ponderosa pine and piñon-juniper woodlands are found at elevations ranging from 6,500-7,500 feet. These woodlands are interspersed with grasslands in the upper reaches of the Galisteo basin.

1. Higher Elevations. Galisteo Creek in Apache Canyon is the highest tributary in the Galisteo basin. The southwestern slopes of Thompson Peak in the Sangre de Cristo Mountains drain into the creek. Vegetation is dominated by Douglas fir and interspersed with other mixed conifers species, such as ponderosa pine, southwestern white pine, white fir, Rocky Mountain juniper and small stands of bristlecone pine. In higher elevations, aspen groves interrupt the conifer forests. These mixed conifer areas represent the largest plots of plant diversity in the watershed.

In the mountains north of I-25 (20-25 square miles) below 9,000 feet elevation, the forest becomes predominantly ponderosa pine, gambel oak and juniper. White fir is found in valleys and aspens continue to grow in this "Transition Zone".

The Ortiz Mountains on the south side of the watershed have Douglas fir and white fir in areas above 8,900 feet (near Placer Mountain). The Ortiz range is less diverse in species than the Sangre de Cristos; dominated by ponderosa pine and gambel oak with a variety of shrubs, cacti, forbs, grasses, and sedges.

Galisteo Watershed Plants listed by K. J. Davis, 1956 Masters Thesis

Davis, K. J. 1956. Central New Mexico seed plants exclusive of trees and cacti. Master of Arts thesis, New Mexico Highlands University. 215 numbered pages plus figures.

1. pp. 28-29. "Galisteo, Santa Fe, and Lamy in Santa Fe Couty are in the Upper Sonoran Zone and provide as habitats rolling hills covered with piñon-pine, juniper, and blue grama grass. There are 21 more conspicuous plants within their boundaries:

Polygonum aviculare L.
Chenopodium album L.
Mirabilis multiflora (Torr.) A. Gray
Abronia elliptica A. Nels.
Lepidium montanum Nutt. ex Torr.
Rosa fendleri Crepin
Medicago sativa L.
Melilotus officinalis (L.) Lam.
M. alba Desr. in Lam.
Astragalus nuttalianus DC.
Gaura coccinea Nutt. ex Pursh
Cymopteris fendleri A. Gray

Verbena wrightii A. Gray
Solanum eleagnifolium Cav.
Chamaersaracha coronopus (Dunal.) Gray
C. coniodies (Moric.) Britton
Verbascum thapsus L.
Chrysothamnus nauseous (Pall.) Britt.
Ratibida columnaris (Sims.) D. Don
Bouteloua gracilis (H.B.K.) Lag.
Stipa neo-mexicana (Thurb.) Vasey"

Species in the thesis are keyed out and their collection locales listed, but only 10 of the above species are confirmed for Galisteo or Lamy.

Plant species collected were all listed by family. Dr. Peterson added the collection locales from a selection of the tables that were in the thesis. The following species are listed for Galisteo (5,900 feet elevation) and Lamy (6,200 feet elevation). His notes on taxa are in italics.

Hilaria jamesii
Stipa neomexicana
Bouteloua gracilis
Bouteloua procumbens *(B. barbata)*
Agropyron smithii
A. spicatum *(?)*
Eriogonum nudicale
Polygonum aviculare
Salsola pestifer
Amaranthus blitoides
A. retroflexus
Mirabilis multiflora
Portulaca oleracea
Lepidium medium
Dityriea wislizenii
Physaria newberryi
Capsella bursa-pastoris
Descurainia pinnata
Astragalus beckwithii *(= ??)*
Oxytropis lambertii
Tribulus terrestris
Oenothera albicaulis
Phlox kelseyi *(= ??)*
Verbena wrightii
Marrubium vulgare
Solanum elaeagnifolium
Cucurbita foetidissima
Grindelia squarrosa
Chrysopsis villosa
Chrysothamnus teretifolius *(= ??)*
C. nauseosus
Ambrosia psilostacha
Ratibida columnaris
R. tagetes
Helenium hoopesii
Cirsium undulatum
Tragopogon dubius
Verbesina encelioides
Taraxacum laevigatum

APPENDIX 6. Historical Time Line of the Galisteo Watershed

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TIMELINE OF THE GALISTEO BASIN

Sources: SAN CRISTOBAL, Christina Singleton Mednick
Interviews: William Baxter, Cerrillos Hills Park Coalition
James Snead, George Mason University
Jan-Willem Jansen, Earth Works Institute
Lucy Lippard, writer

various New Mexico websites

PRE HISTORY

12,000 BC Indians reach the Galisteo Basin – Clovis Culture: first confirmable people on the Galisteo River 10,500 years B.P.

After 6,000 BC Megafauna (bison, elk, sloth, bighorn sheep) disappear.

By 5,500 BC Archaic Culture (as Oshara Tradition) appears in N. Rio Grande, small bands of small game & gatherers use Basin, no evidence of habitations until about 3,000 BC (postholes)

Near the current Galisteo Village the land is an alluvial fan that was created from sediments that spilled over the opening in the volcanic ridge north of Galisteo. The water built up behind the volcanic ridge provided the fan with a permanent trickle. Alluvial fans are typically well drained, allowing for deeper ground water.

About 1500-1000 BC – intrusion of Cochise Tradition into northern Rio Grande; farming, seasonal activities, small hut clusters

About 1000 BC – *zea mays euerte* (chapalote = popcorn), arrives from central Mexico, 1st seriously cultivated food crop (Cochise Tradition)

About 400 AD ceramics technology (pottery) arrives (from W and SW) in the area

500-600 bow & arrow arrives in Anasazi region from Mogollon; displaces spear thrower (atlatl)
frijol (*P. vulgaris*) arrives
pavo [turkey] (*Meleagris gallopavo*) domesticated

700-900 AD Turquoise exploitation begins; becomes most significant at what would later be called Cerro Chalchihuitl – Cerrillos Hills

1125 AD Drought

1200 First evidence of more long-term habitations; small pit house villages, near Lamy 1285

1276-1299 Great Drought

1300 Chaco and Mesa Verde empty – major influx of people to Galisteo Basin

1300s – 1500s GREAT PUEBLOS

1300 Record Wet in N. Rio Grande for the next 80 years

1300s Initially conflict with small villages. Burnt Corn burnt. Lots of transition. Early settlements disappear, development of the enormous Pueblos San Cristóbal, Colorado, Largo, Shé, Colina Verde, Blanco, Galisteo, San Lázaro, San Marcos

By the Spanish Era [1540] Colorado, Largo, Shé, Verde & Blanco have been abandoned

1320s first use of galena for lead glaze decorated pottery; becomes an extremely popular trade item

1400-1500 approx Diné influx – Athabascan speakers (Apache & Navajo) appear in numbers that impact existing Puebloan populations

ca1525 – Galisteo Basin pueblos attacked by Plains Indians (Casteñada says Teya, who Riley1995 equates to Garza complex/Jumano, but might have been Querecho/Apache or Edwards complex/Caddoans); Blanco, Shé, & Colorado abandoned

1540-1598 SPANISH COLONIAL

1540-42 Coronado comes in search of Tenochtitlan-like El Dorado, cities of gold, doesn't find any.

1581 First Spanish identification of lead-silver deposits in "Sierra de San Mateo" (Cerrillos Hills)

1598 The Spanish come to stay. Don Juan de Oñate & colonists settle at San Juan & San Gabriel

First Longhorn cattle brought from Mexico to el Norte – into Texas and New Mexico

1610 Peralta lays out Santa Fe (at a location with much prior use) as the capital of New Mexico

1626-1660 Missions built at Galisteo, San Marcos, [both with resident Franciscans] San Cristóbal, San Lázaro

Climate changes and demand for goods by the Spanish may have pushed the already marginal environment beyond its capacity to support both Pueblos and Spanish.

1660-70 Drought

Many Pueblos (Tompiro, Manzano, Salinan) abandoned due to drought, Plains Indians raids, and economic and religious pressures from the Spanish.

1680 Pueblo Revolt

1692-93 Spanish Reconquest of El Norte led by Diego de Vargas; finds Galisteo Basin depopulated

Late 1600s Tewas/Tanos/Keres leave the Basin for Hano, Santo Domingo, etc. Drought, small pox, raids. Effective end of regular Indian turquoise and galena mining, though intermittent Indian turquoise mining, and the Spanish continue to mine galena (lead-silver).

1696 Drought

1706 Attempt to repeople Pueblo de los Tanos with reassembled Tanos

1709 The earliest well-documented Spanish mine claim was registered by General Don Juan de Ulibarrí. This mine was previously owned by Pedro Rodriquez Cubero, so it was in existence before 1709. Ulibarrí 'denounced' (to report as unoccupied or abandoned, giving the denouncer the right to claim and work it) this mine, called Santa Rosa, located in Los Cerrillos de San Marcos and he promised to pay the 'fifths of

the reales' to the King if he found the silver he hoped God would give to him. [WPA Translations of the Spanish Archives of New Mexico #1018. No exact location was recorded, though the "Old Spanish" Sta Rosa is equivalent to the Territorial "Bottom Dollar" claim SSW and adjacent to the Tom Payne mine; north end of Cerrillos Hills.]

1718 December 3-13 – Valverde y Cossio, auto, request for delegation of Tano Indians from Galisteo to visit Tanos at Mogui. [SANM 5:822:292] – evidence the 1706 repopulation of Galisteo Pueblo worked.

1739-43 Manuel Sáenz de Garvizu, born in Spain, *alcalde mayor* for Galisteo & Pecos = Gal Pueblo still has people (but there are no other settled Indian populations in the Basin?)

1744-1748 don Juan José Moreno, born Spain 1703, *alcalde mayor* of Pecos and Galisteo

1746, June 23 first organized Comanche attack on Pecos

1747 August – all Rio Chama settlements on west side of Rio Grande attacked by Comanches; 23 women & children captive

1748 January 21-22 Comanches attack; Codallas and the battle of Pecos

Petition by residents of Ojo Caliente, Abiquiú and Pueblo Quemado to abandon their settlements due to Indian hostilities. [SANM 1:263:028] – denied until that summer, when they were given 8 days to move to Sta Cruz

1749-1752 – Fray Damian Martínez reports some placer gold mining (near Galisteo River?)

1749-56 Tomás Antonio de Sena, blacksmith and armorer, is *alcalde mayor* of Galisteo & Pecos Pueblos

December 12 Comanches kill 8 men in raid on Galisteo

1750 March 8 (letter to MexCity by NM Gov Cachupin); "(the Comanches), always, whenever the occasion offer for stealing horses or attacking the pueblos of Pecos and Galisteo, they do not pass it up. Indeed, during the five-year term of don Joaquín Codallos, my predecessor, the number of Pecos who perished at their hands reached 150. They have such a grudge against these two pueblos that I find it necessary to garrison them with 30 presidial soldiers and to keep scouts out, so that by detecting them in time they can warn me and I can sally to meet them… I have fortified these two pueblos of Pecos and Galisteo with earthworks (*trincheras*) and towers (*torreones*) at the gates capable of defending them against these enemies, since the presidio cannot always keep the garrison there because it has many places to cover." [Kiva,Cross&Crown p.357]

1751 November 3 Comanches suddenly appear before Galisteo; 2 attacks, 6 Comanche killed

1754 San Marcos Land Grant made 1,895 acres; confirmed for 1895.44acres in 1892; patented 1896 [see 1892]

Vélez Cachupín in a novel experiment places a number (34?) of *genízaros* at Abiquiú under padre Félix Ordóñez y Machado (d.1756) – first NM use of genizaro settlement as buffer against hostiles

1756-1760 don Bernardo de Miera y Pacheco, map maker, *alcalde mayor* of Pecos & Galisteo; remained in NM after term

ca1760-62 Cayetano Tenorio *alcalde mayor* of Galisteo & Pecos; possibly son of Manuel T.1725

1762-69 Tomás Antonio de Sena (again) *alcalde mayor* of Galisteo & Pecos; registered N.S. de los Dolores

1762 - Tomás Antonio de Sena, Alcalde of Galisteo and Pecos Pueblos in 1749-56 and again in 1762-69, requestors for the Nuestra Señora de los Dolores Mine Grant, which is probably what we call the Castilian mine on Turquoise Hill. This mine grant and a transfer of partial ownership of it in 1764 are the only mining grants that have survived in the New Mexico Archives for the Cerrillos Mining District between the 1709 Santa Rosa Mine Grant and the U.S. Period.

early1770s Vicente Armijo is *alcalde mayor* of Galisteo & Pecos

1776 José Herrera is *alcalde mayor* of Galisteo & Pecos

1780 spring-81 major smallpox epidemic hit the Rio Grande valley (at SD in 5 wks in Feb+Mar 1781 at least 230 died; May 1, 1781 report by de la Concha gives 5,050 deaths, which = ca. ¼ total pop; Galisteo Pueblo is not mentioned after this event, survivors probably going to SD and Pecos). Pueblo population never exceeded 9-10k thereafter for rest of colonial era

1788 April 20 Los Cerrillos (1,479 acres) and Sitio (572 acres) de Los Cerrillos Land Grants made.
Jose(f?) Miguel de la Peña requested a piece of land called Los Cerrillos, which formerly belonged to Don Antonio Rael de Aguilar, who was the grandfather of Peña's wife, Maria Rael. It was left unoccupied for so many years that Don Alonzo lost the right to it and it was given to the applicant and other heirs of Don Alonzo. [Twitchell 1914 Archive #14]
"…said piece of land at Los Cerrillos having been abandoned for so many years and said Don Alonso having lost the right he had to it, now sir I ask Your Excellency for the same in the name of his Majesty with all its entrances and exits, pastures and watering places, uses and customs, for me, my children, and heirs…" Done by Governor Fernando de la Concha. [cited in Turquoise and Six Guns, Marc Simmons, p7]

1791 Josef Miguel de la Peña sold the Los Cerrillos property to Don Cleto de Miera for $450. This property later belonged to Colonel Manuel Delgado. The mine known as Mina del Toro [Tiro] was located on this property. [Twitchell 1914 Archive #14]

1799 Ojito de Galisteo land grant given – Ojito was probably 2 mi S of Pueblo, in the vicinity of the current village; an attempt in the late 1800s to have it confirmed was not pursued. This is elsewhere referred to as "the grazing permit" for the first Hispano settler, Juan Aragon

1810 The San Marcos Grant was denied to Francisco Ortiz, who, along with Captain Manuel Delgado, was admonished not to graze their herds on this and adjoining pasture. The San Marcos tract was reserved for the poor of Santa Fe, so they might have a place to graze their cattle. [WPATSA #1081] (Unknown if this is the same José Francisco Ortiz who ultimately controlled the Ortiz gold mine.) [This is the same Manuel Delgado who bought the Cerrillos Ranch (two Los Cerrillos Land Grants) about 1804 -HM]

1814 Galisteo Land Grant made 260 acres

1815 San Cristoval Land Grant made 81,031 acres

1816 Village of Galisteo born, 19 Hispano families

Galisteo Village has always been a cross roads because of the water and the grassland fed by the water spilling over the volcanic ridge and absorbed by the alluvial fan. The Village had made small dams and acequias near the volcanic ridge to divert the water to terraced fields on the hills west of current Galisteo (the location of the old village). This probably controlled the flow even more so that they could grow hay without having to deal with the creek jumping left and right in big floods. (Dams buffered the flows.)

1821 April 18 Gov Melgares announces the "minority" of the Native Americans was ended; they would now be regarded as Spaniards in all things [SpanGov in NM p.213]

1821 August24 (Jan6'22 StaFe celebrates)**-1846 MEXICAN INDEPENDENCE**

1821 Restrictions lifted on foreign visitors to New Mexico. Visitors bring goods for trade.

1821-22 Santa Fe Trail - Quest for mineral wealth begins in order to conduct trade with the Americans results in Ortiz Gold Rush

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1820-30 Beaver trapped out of all streams in the Sierra Madre (approx 50yrs later Sierra Madres would be called Sangre de Cristo)
Major changes in the hydrology and soils of the upper watershed as more water rushed down. Forests began drying up from lack of infiltration and dropping water table as streambeds and gullies began to deepen.

1825 Gertrudis Barceló (Doña Tules) of Oro (Dolores) is fined for running a gambling house without a license (first record of Dolores)

1827 Mexican San Cristóbal Grant given

By the 1830s during winter up to 10% of New Mexico population in the Ortiz seeking gold

1830 Real de Dolores del Oro land grant given; confirmation of land grant rejected in late 1890s
ca1830 – The earliest Cerrillos smelters (lead smelters) whose locations are given; one of which was built on the Galisteo River bank east of eventual Cerrillos village; later destroyed when the ox bow was filled in, and the other at the Delgado Ranch house, which is now the Bonanza Creek ranch house. The smelters built during the Onate Era as well as the smelters built by Governor Cubero in 1697 for use by Cerrillos miners do not give a description of their location in the Cerrillos Hills. [HM]
Gotera Land Grant made; unconfirmed

1831, December 30 – Luis Lovato sells 3 varas and the right to work a mine site to Dolores Palomo, who had denounced it; Mina del Santo Niño south of Oso Springs (Dolores) ; earliest gold lode mine in present Western US

1835 – report of coal mining at Coal Bank, in what would later be named Waldo & Miller Gulches (3 mi. S of latter-day Waldo)

1838 Pecos Pueblo abandoned, 17 or 20 remaining led to Jemez by Juan Antonio Toya

1842 Ygnacio Chaves and others, petition for the lands of the old pueblo of Galisteo. [SANM 2:130:223]

1846-1912 TERRITORIAL

1846 Jose Albino Chacon is the judge (*Juz de Paz*) for the Placers or Reales de Oro
1846-1869 - All of the Cerrillos Hills were claimed as part of the Baca y Delgado Family Land Grant and at least one mine was leased from them. In 1870, the U.S. Government rejected their grant claim and opened the area up for public purchase.

1848 Treaty of Guadalupe Hidalgo leads to stealing and manipulation of land grants for Anglo purchase

1850-62 US Army under Captain Marcy set up a camp for horses at the old Spanish/Mexican fort in Galisteo. Galisteo is the closest area to Santa Fe with good drinking water and grass cover for grazing.

1853 December 26; Jose Francisco Ortiz's widow, Maraquita Montoya, sells 2/3 interest in Santa Rosalia Mine Grant to Territorial Secretary John Greiner, who along with others is listed as owner of Santo Niño Mine (no record survives)

1857 February 21 – Mexican/Spanish silver peso ceases to be US legal tender

1858 the Galisteo area is first surveyed

(re Chalchihuitl) "…struck with astonishment at the extent of the excavations…it appears to be 200 feet in depth and 300 feet or more in width… This great excavation is made in the solid rock, and tens of thousands of tons have been broken out…" [W.P.Blake, American Journal of Science and Arts, 1858]

1860s-80s Cattle boom

1861 March 1 (<date of approval) – by special act of Congress NMMC is quit claimed the Ortiz Mine Grant; 10mi sq or 69,453acres. Promoted by Acting Secty of Interior Moses Kelly, who was also a stockholder in NMMC. Patent on 69,199.33acres issued 1876

1862 March 28 Civil War battle at Glorietta Pass

1870 – The U.S. Government rejects the Cerrillos Hills Land Grant claim 1846-1869 by the Baca y Delgado Family and opens the area to public purchase.

1871 – Steven B. Elkins purchases land from Government 606 acres (future Cerrillos) @ $2.50/acre where he assumed a town could be built following the arrival of the railroad. He or Tom Catron, whom he left in charge of developing the town about 1876, probably chose the name Cerrillos without the article "Los" for the projected town.

The supply of free milling ore runs out; NMMC Ortiz Mine closes

1877 Major flood at Galisteo. Dumps sediment in Galisteo Creek. Creek moves! Ruins acequia system.

1879-84 Cerrillos Hills mining boom

1879 L. Leopold notes Galisteo Creek not yet incised in Village (it ran at the location of Hwy 41)
Overgrazing and deforestation cause major erosion

1880 February Arrival of the railroad: full scale trade & migration, cattle ranching industry, Galisteo Junction is renamed Lamy

1880s RR cattle loading stations on Galisteo Creek create areas of major overgrazing and erosion
RR tracks cut flood plain in half, accelerates run-off, erosion, and down cutting

Small villages on Galisteo Creek
Irrigated agriculture
Bean farming

Cerrillos and Carbonateville are boom towns; Lamy, Ortiz, Cerrillos (again) are RR stops

1882 July 6 – A. Bandelier first journeys south of Santa Fe across the "treeless plain" of Galisteo to Galisteo & San Cristobal Pueblos (<question; Gal village or pueblo?)

Church at Galisteo built

1892 Madrid founded

1892 April – AT&SF constructs dam on San Marcos Arroyo NNE of Cerrillos

Summer; Those who had not been in Madrid long enough to have squatters rights were forced out at this time with guns if they would not sign leases. Elkins's henchmen went to the mines and planted dynamite at the entrances when the miners were inside and gave them the choice of burial alive or getting out of the area. [HM]

September – Cerrillos School built; teachers are John M.Barnhard(-t) (En) & Flavio Silva (Sp)

Cerrillos Land Co develops 1,000 Cerrillos lots [Otro Lado], they sell briskly at $40 ea [T&6G]

Waldo townsite designated and named for Chief Justice of Territorial Supreme Court Henry L. Waldo – originally named Twitchell?

6.5 mile long standard-gauge (56.5") RR spur, Cerrillos Coal Rail Road Company, constructed from Waldo up Waldo Gulch to Coal Gulch. Thus the town of Rodgers preceded Madrid. When Madrid was developed the building that had been hauled up in three pieces from Carthage, NM, were taken apart a second time and shipped over to build Madrid. On the old houses you can still see the two vertical saw lines. The November 1892 Cerrillos Coal Railroad Map shows Madrid as just a siding. [part HM]

Pecos River Forest Preserve created; later evolves into SF Natl Forest

San Marcos Pueblo Land Grant confirmed for 1895.44acres; patent issued 1896

American Turquoise Company (NJ) organized; controlled by Tiffany & Co NY

1893 American Turquoise Co (Tiffany NY) does 63% of total US turquoise production @ Turquoise Hill; turquoise is more valuable than gold per carat

Real de Dolores pop 100, per Miss Belle Sweet

Rich shallow placer deposits discovered on Cunningham Mesa, Ortiz Mtns; worked by 125-150 men; exhausted within a year

PO opens @ Galisteo; closed 1959, then mail to Lamy

Caja del Rio community land grant confirmed for 66,849.78acres; patent issued 1897

1894 town of Madrid NM officially founded

Los Serrillos community land grant confirmed for 1,478.81acres; patent issued 1897

Town of Galisteo community land grant confirmed for 260.79acres; patent issued 1927

Santa Fe community land grant for pasturage and water of 1715 superceded by Congressional grant of all lands not in other confirmed grants and not already used by US within 4sq leagues of grant

Sitio de Juana López confirmed for 1108.61acres; patent issued 1897

Sitio de Los Serrillos confirmed for 572.04acres; patent issued 1897

1896 AT&SF leases Madrid coal operations (since 1880) to Colorado Fuel & Iron Co of Pueblo CO

Approx. start for 50 beehive coking ovens @ Waldo by Colorado Fuel & Iron; deactivated in 1930s

24 men killed in Madrid mine explosion

Madrid PO opens 1896; closes 1906

1900 Edison mill at Dolores built & abandoned; a failure

1906 Forest Service enforces forest reserves. Cattle removed. Grazing permits issued.

1911-12 Barbed wire fencing takes over. End of free range. (mass b-wire production started 1873; 1877 use was 15x that of '76; usage doubled in every subsequent year)

Russian Olives and saltcedars planted to stabilize stream beds

1912-today STATEHOOD

1920s 3-years drought: Dust Bowl
The automobile invigorates New Mexico tourism (since 1880 via the RR)

1920s-30s In the Depression people move out of Galisteo to find work
New Deal : Rural electrification
Local market disappears

1926-34 Major railroad restoration works using concrete including dams and levees in Galisteo River
40-foot dam build in the Creek at McKee Ranch
Outdoor infrastructure created by CCC
More stream erosion of banks opposite hardened banks
Galisteo Creek dumped sediment in Rio Grande. Combined with sediment from northern NM caused sand banks and flooding at Santo Domingo and south to Albuquerque
1926 Lamy-SF rail link abandoned for buses
AT&SF buys NMCentral Railway (was SFCentral) [see 1929]

1929 – AT&SF abandons NM Central RR between StaFe and Kennedy

1940s-50s Galisteo Village nearly deserted
Small ranchitos consolidated by Ortiz y Pino family
Larger ranches transformation – McKee to Cook to Ford Thornton

1942 US Army scopes out watershed to build Army training facility east of Cerrillos. Not enough water to support Army camp or base (Theiss Report 1942)

1950s Drought

1955 January – AT&SF sells its Cerrillos water system to a Madrid resident
August 12, 9:20am – Modified Mercali scale V earthquake at 37.5°N 106.5°N = N of Cochiti
First St. Bridge in Cerrillos washed out; Highway 10 (now SR-14) relocated ½ mile east with new bridge (in turn replaced in 2004)

1959 – last shipment of commercial coal from Madrid
Cerrillos school closes (diminished enrollment & for economy)
Galisteo PO [since 1893] closes, mail then goes to Lamy

1960s Wet cycle begins
Increased runoff and erosion

1960 – Madrid RR spur abandoned; Madrid pop '2 families'

1960-70s paving of Hwy 14 and Hwy 41

1965 Flood Control Act passed

1967 March 24 – construction begins on Galisteo Dam (ACoE), requires reroute of RR; finished September 1970; to retain floodwater & sediments; results in salt cedar forest

1968 J.W. Eaves begins to build a movie set at Rancho Alegre for "The Cheyenne Social Club"

1970-75 Dam built in Canada de los Alamos Creek

1970s Fingerlakes and other lakes and springs still have water, but dry up in this period
Salt cedar and Russian olive begin to dominate some microenvironments
Major thinning and logging in the upper Galisteo watershed

1974-75 new four-lane freeway designated I-25

1975 Simpson Ranch out of business
Plans made for El Dorado of Santa Fe

Ortiz Mine Rehab. Swales built to manage storm water runoff. Goes into Cunningham and Dolores Creek. Contaminated with sulfates and cyanide.

1977, January 21 – Oxymin sets off 50-ton TNT test blast in Cerrillos Hills; site later to become CGP
March 15 – the Tiffany Saloon-Restaurant-Theater in Cerrillos burns
December 10 – Oxymin puts Cerrillos project "in mothballs"

1980-85 Canada de los Alamos dam dug out. Fills again quickly.

1979-86 Gold Fields Ltd. opens Cunningham Gold Mine in Ortiz Mtns.; 250,000 oz in 8 years.

1980 Construction of El Dorado begins

1981 First development in Galisteo Ranchitos

1988, February – the Village of Cerrillos acquires San Marcos water supply

1990 June – Placer Dome US Inc applies to explore for gold on Cerrillos Sand & Gravel lease; CDRC shelves action until expiry of moratorium
August 13 – 6 month moratorium on new or expanded mining in SF Co, approved July 10, takes effect
September 7 3am – CDRC denies Placer Dome US Inc permit to mine for gold in Cerrillos Hills
November 16 2:30am – BCC denies Placer Dome on appeal

1990 Greater Eldorado Area pop.=2,600

1990s Rowe Mesa being slowly developed

1995-96 Rehabilitation of Ortiz Mine begun

1996 End of wet cycle

Enormous erosion on Rowe mesa

1996 Singletons buy San Cristóbal for cattle ranch. (800 head of cattle in good years, 400 in bad)

1997 Thornton Ranch taken out of production – slated for development and open space

1998 I-25 La Bajada median paved
I-25 storm water evacuated with large concrete drop structures and box culverts. Creates 20 foot deep gullies on south side of hwy in one year.

Army Corps increases height of Galisto Dam – adds large spillway
Forest Service recognizes erosion from roads and trails – redesigns roads and trails
Erosion of the sediment in the Galisteo reservoir begins. Salt Cedars die and fall in the creek. Costs increase.

1999 Beneficial Farm builds dam in Arroyo Salado
Cerrillos Gravel Products found in significant violation of permit; suspends operations

2000, January 28 – Santa Fe County purchases 1100 acres for Cerrillos Hills Historic Park

2001, April; StaFe Botanical Garden receives 1345acres of Ortiz Mtns Educational Preserve

Upper part of Arroyo Salado completely owned by gated community. Many houses and road built cause erosion and heavy runoff
Lots of erosion from CR42
Bad grazing practices and mine impact on Cunningham Creek and Arroyo Chorro drainage basin. Dumps large loads of sediment into Galisteo Creek causing it to go underground.
Bad grazing practices on Thornton Ranch cause major erosion along Arroyo de los Angeles drainage – dumps largest amount of sediment in Galisteo Creek

2000-04 EWI starts watershed restoration projects, stream restoration, erosion control, grazing treatments, wildfire management

120 Years water table down
Cryoturbation
Defluocculation
Creek downcutting

2000-02 As WIPP Route Hwy 285 divided between I-25 and Lamy
Eldorado's southside built up
Rancho Viejo development begins
Hwy 14 increased development

2001-02 State MMD completes mine tailings projects in Madrid
Mining halted in Santa Fe County except gravel

2003 Cerrillos Hills Historic Park opened to the public
Army Corps proposes to spray salt cedars in Galisteo Creek – large public outcry
Santo Domingo sprays hundreds of acres with Arsenol

APPENDIX 7. Implementation Zones and Communities in the Watershed

Communities and ranches corresponding to Lower, Middle and Upper Watershed Sub-Area designations

LOWER WATERSHED	MIDDLE WATERSHED	UPPER WATERSHED
Madrid	San Marcos	Canada de los Alamos
Cerrillos	Lamy	Canoncito
Rogersville Rd	Eldorado	Apache Canyon
Goldmine Rd.	Galisteo	Ojo de la Vaca
Mail Box Road.	CR 55-A/General Goodwin Rd	Seton Village
Santo Domingo Pueblo	Thornton Ranch	Sunlit Hills
I-25 corridor	Rancho Viejo (partially in watershed)	Glorieta Mesa Area to Rowe Mesa
	San Cristobal Ranch	Thompson Peak USFS land

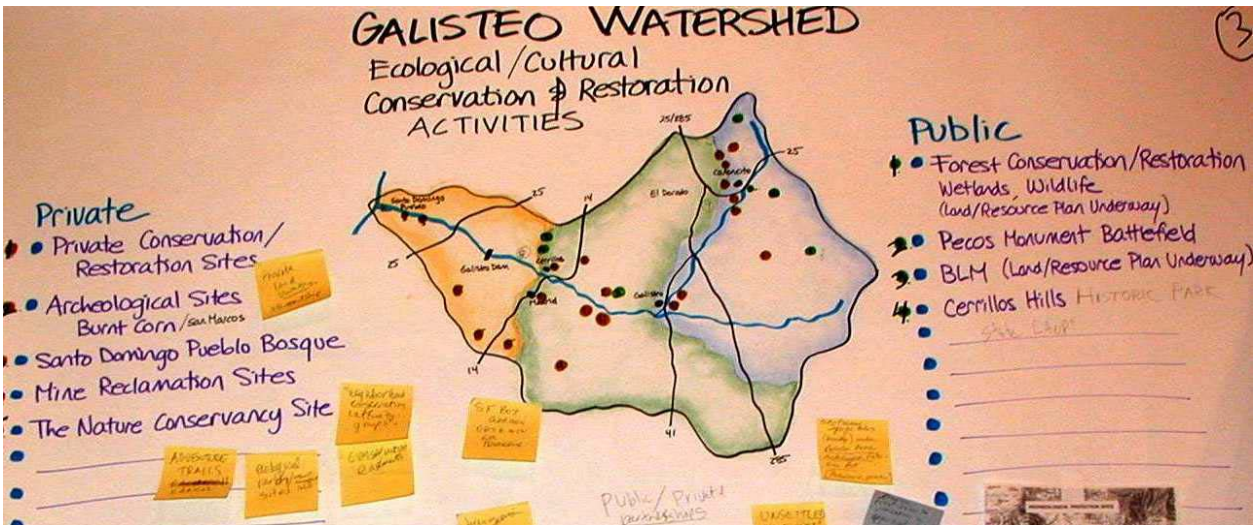
A work in progress list of community organizations, government agencies and businesses in the Galisteo watershed by location in the watershed.

LOWER WATERSHED	MIDDLE WATERSHED	UPPER WATERSHED
Concerned Citizens of Cerrillos	Eldorado Community Improvement Association	Canada de Los Alamos Association
El Vadito de los Cerrillos Community Water System	San Marcos Neighborhood Association	Apache Canyon Roadowners Association
Madrid Landowners Association	Eldorado Wilderness	Apache Creek Ranch
Cerrillos Hills Park	55-A Electrical Co-op	San Miguel County
Turquoise Trail Association	Galisteo Village Planning Committee	Valle Grande Grass Bank (Rowe/Glorieta Mesa)
Madrid Water Cooperative	Galisteo Volunteer Fire Department	Ojo de La vaca/Rowe Mesa Community group
Madrid Volunteer Fire Department	Lamy Community Association	Valencia
Ortiz Mountain Educational Preserve, SFBG	Lamy Water Users Association	Lower Canoncito community garden group
Santo Domingo Pueblo	10 neighborhood associations in Eldorado	Canada de Los Alamos Association
Sandoval County	Eldorado Sanitation & Water District	Beneficial Farms
Turquoise Trail Preservation Association	Turquoise Trail Volunteer Fire Department	Santa Fe National Forest
Nature Conservancy-Ball Ranch conservation easement	Santa Fe Conservation Trust	Arroyo Salado Roadowners Association
Thornton Research LLC	San Cristobal Ranch	
LAC Minerals	Vista Clara Ranch	
Army Corp of Engineers-Galisteo Dam	Eldorado Utlities, ECIA	
Concerned Citizens of Cerrillos	Bureau of Land Management	
Bureau of Land Management	State of New Mexico	
	Ranchitos de Galisteo Residents' Association	
	Ranchitos de Galisteo Water Association	
	Galisteo Water Association	
	Galisteo Community Association	
	Madrid Food Co-op	

Work-in –progress of population statistics for the Galisteo watershed region by community. (2000 Census figures, 1996 figures from Santa Fe County in parentheses) Santa Fe figures not by zip code, not available. Beth: population for each section watershed.

LOWER WATERSHED		**MIDDLE WATERSHED**		**UPPER WATERSHED**	
Madrid	149 (320)	San Marcos		Canada de los Alamos	358 (171)
Cerrillos	229 (460)	Lamy	137 (160)	Canoncito	
Rogersville Rd		Eldorado	5,799	Apache Canyon	
Goldmine Rd.		Galisteo	265 (440)	Ojo de la Vaca	
Mail Box Road		CR 55-A/General Goodwin Rd		Seton Village	
Santo Domingo Pueblo	2,550	Thornton Ranch	NA	Sunlit Hills	
I-25 corridor	NA	Rancho Viejo (partially in watershed)		Glorieta Mesa Area to Rowe Mesa -USFS	859 (Glorieta)
		San Cristobal Ranch	NA	Thompson Peak USFS land	NA
		CR 42			

**Santa Fe County population (2002 Est. Figure, U.S. Census) 134,525*
** Galisteo watershed population (2004 Santa FE County estimate) 17,000*



Map of the Galisteo Watershed showing the locations of the Lower, Middle and Upper Watershed (from left to right), as a theme map for ecological and cultural conservation and restoration activities in the watershed. Vista Clara Initiative, June 19, 2004.

APPENDIX 8. Additional Resources & Citations

Cultural and Archaeological Resources

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MUSTAFA D. CHUDNOFF, Senior Hydrologist, Glorieta Geoscience *Estancia Basin Models--Two-layer and three-layer models of the Estancia Basin and southern Galisteo basin encompassing approximately 4500 square miles in central New Mexico*. Model development included history matching (calibration) and predictive scenarios. Groundwater continuity between contiguous alluvial, limestone, sandstone and shale aquifers modeled. Pumping effects on the Rio Grande and its tributaries also included.

Galisteo Ecology: Vegetation and Wildlife Management

New Mexico Department of Fish and Wildlife. http://www.fw.vt.edu/fishex/nmex_main. Animal Species counts; contact: Mark Watson: 505-476-8115

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N. Edmund Kelley, 1980, *The contemporary ecology of Arroyo Hondo, New Mexico* (School of American Research Press, Arroyo Hondo Archaeological Series vol. 1) describes shortgrass plains vegetation. Arroyo Hondo Pueblo was 0.3 miles north of the Galisteo Watershed, but the plains described are mostly within it.

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A Guide to Watershed Projects: The Watershed Protection and Flood Prevention Act (Public Law 83-566). National Association of Conservation Districts in cooperation with the National Watershed Coalition.

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  http://www.nmenv.state.nm.us/gwb/GWQ%20Atlas/Santa_Fe_County.html
- New Mexico Environment Department Surface Water Quality Bureau
  http://www.nmenv.state.nm.us/swqb/index.html
- The Santa Fe County GIS Center: http://www.co.santa-fe.nm.us/giscenter/giscenter.html
- Sangre Y Jemez Regional Water Plan (in its entirety): www.dbstephens.com
- Think New Mexico: http://www.thinknewmexico.org/
- The Earth Data Analysis Center at the University of New Mexico: http://edac.unm.edu/
- The Office of the State Engineer of New Mexico/ Interstate Stream Commission:
  http://www.seo.state.nm.us/

EPA SITES ON THE WEB:

- EPA Polluted Runoff Nonpoint Source Pollution: Capacity Building Resources (pdf file)
  http://www.epa.gov/owow/nps/capacity/index.htm
- EPA Watershed Initiatives (2003)
  http://www.epa.gov/owow/watershed/initiative/capacity-rfp.html
- EPA/ Watershed Initiatives 2003 & Grantee Listings
  http://www.epa.gov/owow/watershed/initiative/

- EPA: Watershed Academy: Catalog of Federal Funding Sources for Watershed Protection http://cfpub.epa.gov/fedfund/
- EPA/ Community Stewardship Assistance & Links http://www.epa.gov/Region8/community_resources/steward/estlink.html
- EPA 319 Funding Success Stories Vol. IIV: http://www.epa.gov/owow/nps/Section319III/
- EPA Section 319 Success Stories Vol. III, Glossary of Terms: www.epa.gov/owow/nps/Section319III/glossary.htm
- EPA Nonpoint Source Pollution Links/Other recommended Sites on the Internet: http://www.epa.gov/owow/nps/capacity/tools.htm#calendars
- EPA/ Polluted Runoff: Non Point Source Pollution Appendix A: http://www.epa.gov/OWOW/NPS/npsguid3.html
- EPA/National Water Quality Inventory 2000: http://cfpub.epa.gov/surf/locate/index.cfm

WRAS EXAMPLES on the Internet:

- Santa Fe Watershed WRAS: http://www.nmenv.state.nm.us/swqb/Santa_Fe_WRAS-2002.pdf
- Conodoguinet Creek Watershed, (Pennsylvania): http://www.ship.edu/~cjwolt/ccwa/WRAS-07B.pdf

Restoration Resources & Organizations on the Web:

- The Society for Ecological Restoration International: http://www.ser.org/
- The Center for Watershed Protection: http://www.cwp.org/
- National Rural Water Association: http://www.nrwa.org/
- The Conservation Foundation of Du Page County, Illinois (an example of group structure, function and history): http://www.theconservationfoundation.org/tcf/wp/drc.html
- EPA/Surf Your Watershed: Locate Your Watershed Tool: http://cfpub.epa.gov/surf/locate/index.cfm http://cfpub.epa.gov/surf/state.cfm?statepostal=NM (specific to New Mexico Resources)