CARING FOR SANTA FE COUNTY WETLANDS AND RIVERS

A WETLANDS ACTION PLAN FOR SANTA FE COUNTY

UPDATE 2023

Prepared by:

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Justification and Credits

This 2023 Wetlands Action Plan Update was prepared in partnership with the New Mexico Environment Department's Surface Water Quality Bureau Wetlands Program with additional support from Santa Fe County. The 2023 Wetlands Action Plan Update was written to satisfy the grant objectives of a U.S. EPA CWA Section 319 Sub-Grant with NMED-SWQB (Agreement No. 667-429-2D), as part of the project "Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM."

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In the end, we will only conserve what we love
We will only love what we understand
We will only understand what we are taught
Baba Dioum, Senegalese Poet

Acknowledgements

This 2023 Update of the Wetlands Action Plan (WAP) for Santa Fe County has been made possible thanks to the support of a broad group of people and entities that have a passion for wetlands and streams in general and in Santa Fe County in particular. As with the original WAP of 2012, this plan is based on several years of collaboration between numerous partners and the many lessons learned in the context of the project "Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM." This project and the 2023 WAP Update received funding from an EPA Section 319 grant through the State's Surface Water Quality Bureau. Therefore, we want to express our gratitude to this agency for their support. We especially want to thank Emily Toczek, Tiffany Anders, Abraham Franklin, Emile Sawyer, and Wetlands Program Coordinator, Maryann McGraw for their steadfast support and advice along the way. We would also like to express our gratitude to the current and former staff members of Santa Fe County, Maria Lohmann, Peggy Darr, Adeline Murthy, and Monica Harmon for their passionate support and active participation in the process of this endeavor. Many thanks are also due to Mori Vorenberg Hensley of the Santa Fe Watershed Association for her encouragement and sharing of critical information for the WAP, to Danny D. Naranjo (Santa Clara Pueblo), Ray Martinez (Pueblo of San Ildefonso), Jack Marchetti and Virginia Seamster (NM Department of Game and Fish), Rich Schrader (River Source), Steven Fry (Amigos Bravos), William Mee (Village of Agua Fria), Robert Romero (Acequia de La Cienega), and Paige Grant (Santa Fe County COLTPAC) for their interest, feedback, and suggestions.

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Acronyms

(U.S.) ACE	Army Corps of Engineers (United States Department of Defense)
ACEC	Areas of Critical Environmental Concern
af	Acre feet (equals 43,681 cubic feet)
afy	Acre feet per year
AFVA	Agua Fria Village Association
APFRs	Adequate Public Facilities Regulations
APNM	Animal Protection of New Mexico
BDD	Buckman Direct Diversion
BISON-M	Biota Information System of New Mexico
BLM	Bureau of Land Management (United States Department of the Interior)
BMP	Best Management Practices
BOR	Bureau of Reclamation
CE	Conservation Easements
CFLRP	Collaborative Landscape Restoration Program
CFS / cfs	Cubic feet per second
CWA	Clean Water Act
(NM) DOT	New Mexico Department of Transportation
DUSF	Ducks Unlimited, Santa Fe Chapter
EA	Environmental Assessment
ECR	Ecological Condition Ranking
EMNRD	New Mexico Energy, Minerals and Natural Resources Department
(NM) EMNRD	New Mexico Energy, Minerals, and Natural Resources Department
(U.S.) EPA	Environmental Protection Agency (United States Department of the Interior)
ESA	1973 Endangered Species Act
ET	Evapotranspiration
FEMA	Federal Emergency Management Administration
FONSI	Finding of No Significant Impact
(U.S.) FWS	Fish & Wildlife Service (United States Department of the Interior)
FWS	Fresh Water Surface (evaporation)
GBP	Galisteo Basin Preserve
GIS	Geographic Information System(s)
GCM	General Circulation Models
GWCI	Galisteo Watershed Conservation Initiative
HGM	Hydrogeomorphic
HUC	Hydrologic Unit Code
Hwy	Highway
ILF	In Lieu Fee Service Program
IPCC	Intergovernmental Panel on Climate Change

maf	One million acre feet (1,000,000 af)
MDWA	Municipal Domestic Water Association
MS4	Municipal Separate Storm Sewer Systems
NACD	National Association of Conservation Districts
NAWCA	North American Wetlands Conservation Act
NGO	Non-Governmental Organization
NMBGMR	New Mexico Bureau of Geology and Mineral Resources (New Mexico Institute of Mining and Technology, Socorro, NM)
NMED	New Mexico Environment Department
NM RAM	New Mexico Rapid Assessment Method (of wetlands)
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (United States Department of Agriculture)
NWI	National Wetland Inventory
ONRW	Outstanding National Resource Waters
PRWRF	Paseo Real Water Reclamation Facility
PES	Payment for Ecosystem Services
PET	Potential Evapotranspiration
PQAPP	Project-(specific) Quality Assurance Project Plan
QAPP	Quality Assurance Project Plan
RMP	Resource Management Plan (of BLM)
SA	Sampling Areas
SCOTUS	Supreme Court of the United States of America
SDA	Sustainable Development Area (Santa Fe County)
SF	Santa Fe
SFC	Santa Fe County
SFCOS	Santa Fe County Open Space, Trails, and Parks Program
SFNF	Santa Fe National Forest
SFWA	Santa Fe Watershed Association
SGCN	Species of Greatest Conservation Need
SGMP	Sustainable Growth Management Plan (Santa Fe County)
SLDC	Sustainable Land Development Code (Santa Fe County)
SLO	State Land Office (State of New Mexico)
SWE	Snow-Water-Equivalent
SWReGAP	Southwest Regional Gap Analysis Project
SWQB	Surface Water Quality Bureau (New Mexico Environment Department)
SWANCC	Solid Waste Agency of Northern Cook County (ruling of Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers, 531 U.S. 159 (2001))
TDR	Transfer Development Rights

TMDL	Total Maximum Daily Loads
TNC	The Nature Conservancy
UAA	Use Attainability Analysis
UNM	University of New Mexico
USDA	United States Department of Agriculture
USDHS	United States Department of Homeland Security
USDI	United States Department of the Interior
USFS	United States Forest Service
USGS	United States Geological Survey
WAP	Wetland Action Plan
WAP-SFC	Wetland Action Plan for Santa Fe County
WAP-SFC Update	Updated WAP for Santa Fe County (WAP Update)
WOTUS	Waters of the United States
WQCC	Water Quality Control Commission
WRAS	Watershed Restoration Action Strategy
WWTP	Wastewater Treatment Plant

Executive Summary

Great Progress in the Past Ten Years – The 2023 Wetlands Action Plan for Santa Fe County (WAP-SFC Update) builds on the progress made since the original 2012 WAP. Most importantly, the enabling environment for wetland restoration and protection has been greatly enhanced. Local county and city regulations for wetland protection have been updated and made more explicit, local institutional capacity has grown, there is more funding available, and public involvement has blossomed. Additionally, many wetlands in the county are now included in the online National Wetland Inventory (NWI) and significant progress has been made with assessments, mapping, and restoration work on individual wetlands in Santa Fe County. In the past decade, local partnerships between federal and state agencies, tribal entities, Santa Fe County, and Non-Governmental Organizations (NGOs) have contributed to the restoration of more than 160 acres of wetlands and riparian areas. Despite continued population growth and demand, the City of Santa Fe reduced its water demand through conservation policies. As a result, water levels in the city's wells and the Buckman wells have been rising since 2011 and both well fields have been able to recover after overuse during the 1990s and 2000s. Wetlands that depend on groundwater will likely benefit from these improved conditions.

Purpose – The 2023 WAP-SFC Update provides guidance for the protection and restoration of wetlands in Santa Fe County between 2023 and 2033. The WAP-SFC Update aims to record any available relevant information, analysis, and ideas, stimulate dialogue, coordination, and collaboration, and provide recommendations for future wetland protection and restoration initiatives. Based on the improved capacity for restoration work, this WAP-SFC Update emphasizes the protection and restoration of wetland functions that provide water quality benefits and ecological integrity. It intends to inform and mobilize county residents, land and water management staff and decision makers of city, county and tribal government entities, state and federal agencies, and NGOs as well as community partnerships and multi-party conservation initiatives that are involved in the preservation, conservation, and restoration of wetlands in Santa Fe County.

Needs – There is a need for the 2023 WAP-SFC Update because the previous version from 2012 is outdated. The need for a WAP is still very relevant because many concerns mentioned in the 2012 WAP have not abated. The 2023 WAP-SFC Update is timely, if not urgent, because of the looming decline of water supplies across the state and in Santa Fe County caused by the progressing impacts of climate change and urban development. Furthermore, the May 25, 2023, Supreme Court of the United States (SCOTUS) rule on the protective status of wetlands in relation to Waters of the United States (WOTUS) has eliminated federal protections to many wetlands in Santa Fe County. As a result, wetland protection and restoration in Santa Fe County are more important than ever before, because the threats to wetlands are increasing in speed and severity while important protection mechanisms have been lost.

The need to continue developing plans and implementation initiatives for the restoration and protection of wetlands and riparian areas, river corridors, springs, and seeps in Santa Fe County remains critical (1) to reverse degradation and loss of wetland ecosystems and their important landscape functions; (2) to address the impacts of fragmentation of landscapes resulting from (ex)urban development, possible mineral extraction, and construction of transportation lines; and (3) to guide future development activities that minimize encroachments and impacts on and losses of water resources and important wildlife habitat throughout the County.

The 2023 WAP-SFC Update identifies six major causes of wetland degradation: climate change; catastrophic ecological events; removal or destruction of vegetation; the potential of reduced groundwater flows; cumulative channel erosion; and encroachment by and proliferation of invasive plants. In Santa Fe County, the last four causes are typically related to urban development. Urban development and climate change are the most important causes of wetland degradation in the WAP area. Understanding the causes of wetland degradation helps land stewards identify degradation vulnerability of wetland ecosystems in combination with the susceptibility of landscape values that could be impaired. This helps specify priorities for action in addressing wetland degradation across the landscape. The causes of wetland degradation express themselves in stressors. The most important, ongoing stressors of wetlands and riparian areas in Santa Fe County include urban encroachment; pollution; wetland isolation; degradation of habitat quality; and hydrological changes due to urban, industrial, and/or infrastructure development and other land uses; dwindling water sources; exposure to high temperatures (leading to increased water loss from evaporation); removal or destruction of native vegetation or plants used by diverse wildlife and wetland soils; and encroachment by and proliferation of invasive plants.

It is critical that urban development and land use do not compromise the constant water recharge capacity of wetlands, the uninhibited connectivity to other riparian and wetland systems, and the size of wetlands and riparian ecosystems. Santa Fe County's 2016 Sustainable Land Development Code (SLDC) directs urban development to take place in development areas (SDAs). SDA-1 areas are or will soon be served by drinking water from the municipal system, thus reducing the competition for local groundwater sources with wetland needs for groundwater. SDA-2 areas will remain largely dependent on domestic wells. As a result, growth in the SDA-2 zone may have a considerable impact on groundwater drawdown, which in turn may impair water supplies for wetlands in these areas and downstream.

Wetland vulnerability due to climate change is primarily temperature driven, and climate change impacts on wetlands are expected to occur even if there are no significant changes in annual precipitation. While the anticipated impacts should be considered certain, they are based on modeling, which provides us with projections rather than predictions. Several studies issued in the last decade indicate that the projected impacts of climate change on wetlands are increased temperatures and increased evaporation (leading to plant die off), diminished snowpack (resulting in drier spring seasons and increased general aridity), more extreme precipitation events (which

may result in more extreme flooding events, reduced infiltration, and increased time between events), reduced stream flow (including reduced annual runoff for the Rio Grande area leading to increased need for groundwater pumping for agricultural and urban needs), more severe and more frequent droughts, increases in the total area and frequency of occurrence of bare soil and associated erosion, increased frequency and severity of wildfire and insect infestations, and changes in vegetation communities.

Modeling exercises are unable to definitively predict the location, magnitude, pace, or timing of climate impacts on wetlands. Other uncertainties are related to future greenhouse-gas emissions, human behavior, population projections, energy sources, economic forecasts, and technological changes. The uncertainties in urban development trends, climate trends, and wetland adaptation capacity increase the importance of monitoring urban development in Santa Fe County, including monitoring groundwater extraction associated with development and cumulative impacts on wetlands from development and climate change.

Proposed Interventions – When climate stressors exceed the natural resilience of wetlands, human interventions may bring some relief. Adaptation strategies that could benefit wetlands include forest management interventions that increase snow accumulation and prolong the melt out date of snow in headwater mountain areas; forest management aimed at wildfire risk reduction; management of streams and riparian areas in ways that increase shading and floodplain connectivity; regional soil health campaigns that improve soil health and soil water storage capacity landscape wide; and strategies that stimulate vegetation health and diverse, wildlife-friendly plant cover landscape-wide and the protection and reintroduction of beavers, where appropriate. The effect of these strategies is that they retain more snow over a longer period in the mountains; counter evaporative water losses; help spread, infiltrate, and store water in the soil; and cumulatively moderate local micro-climates and their effect on the water balance in the landscape. Urban adaptation strategies must include continued water conservation, avoidance of construction on or near wetland areas, the development of buffer zones, the creating of permeable structures for water infiltration, and the enhancement and cultivation of a stewardship movement. To achieve meaningful effects through such adaptation strategies that increase wetland resilience to climate impacts and urban development, a landscape-scale approach of such strategies is essential.

Public education and engagement are also essential to achieve these improvements for wetlands over time. Inclusive dialogue may encourage people to participate in stewardship services and in changes of land use behavior that stresses the protection of wetlands.

Goals – The 2023 WAP-SFC Update introduces five new goals for the next ten years.

Goal 1: An effective enabling environment for wetland restoration and protection in Santa Fe County.

Objectives for this goal are to:

a. Encourage all wetland restoration projects and initiatives to support Surface Water Quality Bureau's (SWQB) statewide wetland restoration and protection goals[1].

b. Further wetland assessments, research, and mapping.

c. Sharpen standards and regulations when experience and data show where this is necessary.

d. Enhance public educational outreach about wetland stewardship to raise awareness and understanding of the importance of wetlands and springs in the area.

e. Grow financing options and strategies.

f. Provide effective technical assistance for restoration and stewardship projects.

g. Improve and share monitoring and evaluation protocols for restoration and stewardship activities.

h. Ensure wetland protection according to all county and city planning and development protocols and regulations.

Goal 2: Integration of wetland restoration and protection in landscape-scale initiatives of state and federal agencies and collaborative partnerships.

Objectives for this goal are to:

a. Coordinate wetland and stream restoration activities with and in the context of landscape-scale initiatives of the U.S. Forest Service, NM Forestry Division, NM Department of Game & Fish, Rio Grande Water Fund, NGO conservation groups, Santa Fe County Open Space and Trails Program and the county's Transfer of Development Rights (TDR) program, regional water supply management programs, and regional land conservation programs.

b. Emphasize the importance of (re)establishing surface connectivity of wetlands with WOTUS and ecological linkages at a landscape scale to maintain or restore federal wetland protection and associated wildlife habitat.

c. Establish protection of wetlands in New Mexico without a surface connection to WOTUS by working with state agencies to create and/or promote new legislation.

[1] See https://www.epa.gov/system/files/documents/2022-02/2021-new-mexico-wetlands-program-plan-2021-to-2025.pdf.

d. Realize and document cultural and economic community benefits of landscape-scale conservation of wetlands and streams for the perpetuation of Native American and traditional agricultural practices, ways of life, and access to land.

Goal 3: Wetland restoration and protection projects that maintain or increase the acreage of functioning wetlands in Santa Fe County (no net loss)

Objectives for this goal are to:

a. Implement site-specific wetland and spring protection and restoration projects as well as comprehensive landscape restoration and conservation initiatives to address landscape-wide stressors.

b. Ensure high-quality surface and groundwater discharge into wetlands.

c. Protect wetland vegetation from environmental stressors (e.g., related to climate change impacts) and human-induced damage and removal (e.g., related to urban development and individual land use practices).

d. Ensure that wetland habitats remain connected by maintaining and protecting ecological linkage systems across the landscape for the flow of water, the movement of wildlife, and the dispersal of native plants.

e. Protect wetland soils from pollution, erosion, massive siltation, and drying.

Goal 4: Active groups that support wetland stewardship and advocate strategies and landscape-scale water policies that support wetland health, restoration, and protection.

Objectives for this goal are to:

a. Engage interested parties in formulating and implementing on-the-ground restoration and protection projects (including demonstration sites), project monitoring and evaluation, and small hands-on training workshops.

b. Reach out and engage Native American communities, land grant and acequia, and other traditional communities, and other groups that are interested and may conduct work on their own lands but are not currently “at the table” in broader initiatives that support wetland conservation and restoration.

c. Engage interested parties in other initiatives that indirectly support wetland restoration, such as regional climate change mitigation activities, water policy and conservation, wildfire prevention, (re)establishing ecosystem linkages (corridors) in association with wetlands, soil

health and other improvements related to increased stormwater infiltration, storage and flood management, and sustainable urban development.

Goal 5: Data to action reports, educational outreach media, and data repositories

Objectives for this goal are to:

a. Create a data repository and/or directory of wetland restoration information and institutions to improve access to wetland information for the WAP area.

b. Document and publish success stories and lessons learned.

Strategies and Types of Actions – Five strategies in support of goals and objectives listed above (various strategies apply to multiple goals and objectives) and leading to key actions (listed below the strategies) are:

A. Landscape-scale planning, including:
    a. Clustering project areas.
    b. Partnerships and collaborative initiatives.
    c. (Re)establishing and preserving ecological linkages and corridors.
    d. Regional water supply research, management, and conservation.
    e. Reestablishing natural wildfire regimes.
B. Restoring keystone ecosystems and habitats and helping them adapt to future conditions, including:
    a. Snow accumulation areas and Wetland Jewels in mountain headwater areas.
    b. Stream restoration for water spreading, infiltration, and flood control.
    c. Soil health improvement and erosion control.
    d. (Re)establishing buffer zone along streams and wetlands.
    e. Beaver reintroduction in appropriate areas and beaver habitat protection.
    f. Managing invasive plant species and encouraging restoration of diverse native plants adapted to future climate conditions.
C. Building capacity in communities and institutions, including:
    a. Create support mechanisms for planning and implementation.
    b. Establishing collaborative partnerships to share the burden and leverage resources from a broad network of participating entities.
D. Public involvement and engagement
    a. Establishing equitable public engagement initiatives and strategies by which participants feel fairly represented.
    b. Building trust among interested parties by sharing accurate wetland management procedures and shortfalls.
    c. Expressing specific, localized wetland concerns and solutions in the context of the larger landscape in Santa Fe County and beyond.

d. Identifying funding sources for projects that allow for mutual understanding and common goals among interested parties to drive projects.
e. Expanding public education opportunities through local NGOs
f. Identifying actions that mobilize community support and enthusiasm.
g. Including youth in wetland restoration and protection activities.

E. Prioritizing actions (see below).

Pragmatic Prioritization - All wetlands in Santa Fe County are important and deserve to be protected and restored. Prioritization choices are most practically achieved by identifying (a) the diversity and intensity of stressors that impair the natural functioning conditions of individual wetlands, (b) actions that are urgent and important because they address broadly supported values and will reduce possible future expenses, (c) project feasibility to mobilize short-term spin-off effects; enthusiasm; and learning opportunities through monitoring, training workshops, and demonstrations, and (d) the practical feasibility of implementing certain restoration and protection measures and addressing current and future stressors. Furthermore, engagement from interested parties and contractors is essential in driving implementation priorities. The 2023 WAP-SFC Update includes a list of proposed priority wetlands for restoration based on input from experts and public meeting feedback and an analysis of data about wetland restoration needs.

It is envisioned that the WAP's lifetime is at least ten years (2023-2033). Given the rapid changes in urban development, climate change, and community capacity, the WAP must be reviewed and updated by 2033 to meet the needs and outlook of that time.

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1. Introduction

1.1. Wetlands: A Definition

For the purpose of this Wetlands Action Plan (WAP) Update, wetlands are defined following the formal definition by Cowardin et al. (1979) used by the NMED Surface Water Quality Bureau (SWQB). "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water." For purposes of this classification wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly un-drained, hydric soil; and 3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year**.**

According to the SWQB 2021 Wetlands Program Plan for New Mexico[2], "(t)he State's regulatory program applies to all surface waters of the State including wetlands. New Mexico's wetlands including isolated wetlands are incorporated within the water quality standards definitions and are considered "surface waters of the State" (20.6.4.7 NMAC). Isolated and ephemeral wetlands (such as playas) are included in the definition. The interests of the state are critically linked both economically, ecologically and culturally to good water quality in all of the state's waters including isolated wetlands. Non-perennial waters make up over 80% of the state's waters and are expressly protected by the State's standards. Currently, the SWQB Wetlands Program is working to protect and restore vulnerable isolated wetlands, and development of water quality standards specific to wetland types including isolated and ephemeral wetlands is ongoing." (SWQB 2021).

1.2. A Wetlands Action Plan: Purpose and Need

A WAP provides guidance for protecting and restoring wetlands. It emphasizes water quality, ecological integrity, preserving wildlife corridors, and conserving habitat. Often a WAP gives a generous background on the landscape it is addressing, such as geology, soil, hydrology, climate, wetlands, and culture. A WAP also describes the ecological functioning and resilience of wetlands along with identified stressors and impairments as well as opportunities for wetland restoration and threats to wetlands. A WAP lists priority actions for wetland restoration and protection and supports organizations and communities in joining together to conserve and restore priority areas of concern. A WAP also recommends associated monitoring protocols. In essence, it creates a foundation to create future projects, gain technical assistance, obtain funding, and track progress toward meeting wetland restoration and protection goals.

This 2023 Update of the WAP for the Santa Fe County area (WAP-SFC Update) includes new information about public perceptions and goals for wetland conservation from an extensive survey among watershed residents of the Santa Fe Watershed compiled between 2021 and 2023 on behalf

[2] https://www.epa.gov/system/files/documents/2022-02/2021-new-mexico-wetlands-program-plan-2021-to-2025.pdf

of the Santa Fe Watershed Association (SFWA). The interested parties in the Santa Fe Watershed constitute the largest population of wetland stakeholders in Santa Fe County and this population may be considered representative of the larger county stakeholder population. However, additional information about and from stakeholders in other county areas that are underrepresented in the Santa Fe Watershed is also included in the WAP, in so far it has been made available.

Purpose: The purpose of this 2023 WAP-SFC Update is to provide guidance for the protection and restoration of wetlands in Santa Fe County between 2023 and 2033, and possibly thereafter. To this end, the WAP-SFC Update aims to update and record any available relevant information, analysis, and ideas; to stimulate dialogue, coordination, and collaboration; and to provide recommendations for future wetland protection and restoration initiatives. This WAP-SFC Update emphasizes the protection and restoration of wetland functions that provide water quality benefits and ecological integrity. The WAP-SFC Update intends to inform and mobilize land and water management staff and decision makers of city, county, and tribal government entities, state and federal agencies, and Non-Governmental Organizations (NGOs) as well as community partnerships and multi-party conservation initiatives that are involved in the preservation, conservation, and restoration of wetlands in Santa Fe County.

Need: Santa Fe County staff and the Ecotone team identified that there was a need for this WAP-SFC Update because the previous version is from 2012 and is outdated at this time. The need for a WAP is still relevant because the concerns mentioned in the 2012 WAP have not abated. The 2012 WAP noted that wetland acreage and wetland functions in Santa Fe County have been in decline for many years and that their preservation is important for the long-term wellbeing of the communities in Santa Fe County due to the natural benefits that wetlands offer.

Wetlands can be considered a public asset to people and are a vital component to ecosystems in Santa Fe County and beyond. As such wetlands are "a commons" because they provide common functions and resources beyond the land ownership conditions of their location and beyond their site-specific biotope. Therefore, wetlands require public protection and stewardship, both through the care of public government agencies and the coordinated stewardship by private actors, both in the form of compensated services and voluntary action. Such public protection and stewardship are necessary because many private and public activities in society and environmental processes remain unchecked and act as degrading stressors to wetlands. As such the plight of wetlands in Santa Fe County is an expression of the classic "tragedy of the commons"[3].

[3] "… tragedy of the commons. The ecologist Garrett Hardin popularized that term in a 1968 essay based on a 19th-century pamphlet by William Forster Lloyd, an English economist. In the pamphlet, Lloyd explained that any individual farmer had an incentive for his cattle to eat as much grass as possible in any field that the community shared. But if all the farmers did so, the field would be ruined. The solution is for the farmers to agree on a set of rules that benefit all of them in the long run." (Leonhardt, D. 2023. The New York Times. The Morning. August 29, 2023. Online news coverage).

This 2023 Updated WAP is timely because of the looming decline of water supplies across Santa Fe County caused by the progressing impacts of climate change and gradual urban development. Furthermore, the May 25, 2023, SCOTUS rule on the protective status of wetlands in relation to Waters of the United States (WOTUS) has eliminated federal protections to many wetlands in Santa Fe County. As in 2012, the need to continue developing plans and implementation initiatives for the restoration and protection of wetlands and riparian areas, river corridors, springs, and seeps in Santa Fe County remains critical (1) to reverse gradual degradation and loss of wetland ecosystems and their important landscape functions; (2) to address the impacts of gradual fragmentation of landscapes resulting from (ex)urban development, possible mineral extraction, and construction of transportation lines; and (3) to guide future development activities that minimize encroachments, impacts, and losses of water resources and wildlife habitat throughout the County.

1.3. Acknowledgment of Native American Heritage Value

Within Santa Fe County are Native American aboriginal lands, land grants and reservations of several Native American communities. Water, springs, wetlands, and rivers are of vital importance to the culture of these communities because these waters and water sources define their historical, present, and future identity, life, survival, and spirituality.

All entities and individuals with responsibilities to take actions that may affect water and water sources such as springs, wetlands and streams are encouraged – if not required by law – to enter into consultation with Pueblo Governments in the area to ensure the protection of tribal relations to water sources. Many of the Pueblos have their own Tribal Historic Preservation Offices or Cultural and Historical Departments that can provide information. The New Mexico Historic Preservation Division also provides information about tribal communities with an interest in land and water in Santa Fe County and about the consultation process.

1.4. Planning Process and Core Team

The impetus for the 2023 WAP Update originates from a New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQB) supported restoration project of the Rio Quemado and its streamside wetlands on Santa Fe County's Los Potreros Open Space in Chimayo. This project with the title "Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM" started in 2021 and was funded under a subaward to Ecotone Landscape Planning, LLC with matching support from Santa Fe County. This project provided the timely opportunity to update the WAP with details about the Los Potreros Open Space wetlands and about other wetlands throughout the county, several of which are on or associated with County Open Space properties.

The 2023 WAP-SFC Update resulted from broad stakeholder contributions and a multi-party Core Team that coordinated the update process. Work on the update of the WAP began in early 2021

after the start of the stream and wetlands restoration project along the Rio Quemado. In accordance with EPA Section-319 funding arrangements, the WAP planning process adhered to a Quality Assurance Project Plan (QAPP) for this project.

The Core Team members who directed the compilation of this WAP included:

- Jan-Willem Jansens, Ecotone Landscape Planning (Project Manager; Data Management Coordinator)
- Erin McElroy, Ecotone Landscape Planning (Project Assistant)
- Adrienne Rosenberg, Woven Web Design and Ecotone Landscape Planning (Project Coordinator)
- Emily Toczek and Tiffany Anders, New Mexico Environment Department Surface Water Quality Bureau (Project Officers; Quality Assurance Officers)
- Abraham Franklin, New Mexico Environment Department Surface Water Quality Bureau (interim project Officer, Program Manager, Watershed Protection Section)
- Maryann McGraw, New Mexico Environment Department Surface Water Quality Bureau (Water Resources Manager -Wetlands Program Coordinator)
- Maria Lohmann, Santa Fe County Open Space Program (former Senior Open Space Planner; currently working with the New Mexico Energy, Mineral and Natural Resources Department, EMNRD)
- Adeline Murthy, Santa Fe County Open Space Program (Open Space and Trail Planning Team Leader)
- Peggy Darr (former Natural Resource Planner with Santa Fe County; currently with Defenders of Wildlife) and Monica Harmon, Santa Fe County Open Space Program (Natural Resource Planner)
- Morika Vorenberg Hensley, Santa Fe Watershed Association (Executive Director)
- Andy Otto, Santa Fe Watershed Association (former Executive Director)

Participants in community meetings and WAP review included:

- William Mee, Agua Fria Village Association (AFVA), Acequia Agua Fria, and the Agua Fria Wellowners' Association (President)
- Carl Dickens, Santa Fe River Traditional Communities Collaborative
- Danny D. Naranjo, Santa Clara Pueblo (Land and Cultural Resources Technician)
- Serafina Lombardi, New Mexico Acequia Association (Director of Education and Outreach)
- Michael Lamb, Acequia del Potrero, Chimayo (Commissioner)
- Dr. Jennifer Lindline, Upper Pecos Watershed (Representative)
- Ray Martinez (Pueblo of San Ildefonso)
- Darrin Muenzberg, La Bajada Community Ditch and Municipal Domestic Water Association (MDWA) (Representative)

- Albuquerque Wildlife Federation
- Amigos Bravos
- Animal Protection of New Mexico
- City of Santa Fe
- Ducks Unlimited
- New Mexico Department of Game and Fish
- New Mexico Environmental Department Surface Water Quality Bureau
- New Mexico Environmental Department Wetlands Program
- Pueblo of San Ildefonso
- Santa Clara Pueblo
- Santa Fe County
- Santa Fe River Traditional Communities Collaborative
- Santa Fe Watershed Association
- All organizations and individuals not listed who have contributed their insights and presence.

Data and observations for the 2012 WAP-SFC were collected largely from project activities between 2007 and 2012. Data for the 2023 WAP-SFC Update were gathered to replace information that was out of date. Nothing in this 2023 WAP-SFC Update has received explicit endorsement or support from the project partners listed above. Ecotone assumes responsibility for all content of this 2023 WAP-SFC Update.

The appendices of this 2023 WAP-SFC Update provide background information on the landscape as well as on social and cultural aspects of Santa Fe County in relation to wetlands, and on wetland types, values, and functions, based on information from the original 2012 WAP.

Appendix A includes information on the county's geology, hydrogeology, climate and climate change, surface hydrology, water quality, soils, ecoregions and vegetation communities, wildlife habitat, occupational history, and land use, (ex)urban development, and water diversion. Appendix B provides background information on the wetland resource analysis of this WAP with details on Santa Fe County wetlands, classification of local wetland types, wetland functions, and wetland values and ecosystem services. Appendix C provides a sample of a wetland stressors checklist from the NM RAM monitoring method. Appendix D describes payment for ecosystem services schemes. Appendix E includes a letter from January 2022 from the Agua Fria Village Association and Santa Fe River Traditional Communities Collaborative concerning the historic view of Santa Fe County wetlands.

1.5. Santa Fe County Geography

1.5.1. Location, WAP Area Boundaries, and Hydrogeology

Santa Fe County is located around 35°37'N 106°5'W, in north-central New Mexico at the southwestern tip of the Sangre de Cristo Mountains, which constitutes the southernmost range of the Rocky Mountains. Clockwise around from the south, neighboring counties include Bernalillo, Sandoval, Los Alamos, Rio Arriba, San Miguel, and Torrance County. The major road systems within Santa Fe County are I-25 (predominantly east-west), US 285/64 (north-south), and I-40 at the southern tip of the county (running east-west). The City of Santa Fe, the capital city of New Mexico, is the largest municipality in the county. The Rio Grande is the geographic boundary to the northwest corner of the county. The Sangre de Cristo Mountains and Glorieta and Rowe Mesa form the eastern boundary (Santa Fe County 2010a).

This 2023 WAP-SFC Update maintains the administrative boundaries of Santa Fe County as the defining boundaries for the WAP area of interest as presented in the original 2012 WAP. However, because the wetlands in Santa Fe County are associated with surface water catchment areas (watersheds) and hydrogeological units that originate or flow outside the administrative boundaries of the county the WAP area boundaries could also be drawn according to the sum of these hydrological boundaries immediately outside Santa Fe County (Figure 1). Yet, under the restrictions of the available time and budget for this WAP Update, the project team decided not to explore a new definition of the WAP area of interest and leave such a WAP area adjustment for consideration at the time of a future WAP update.

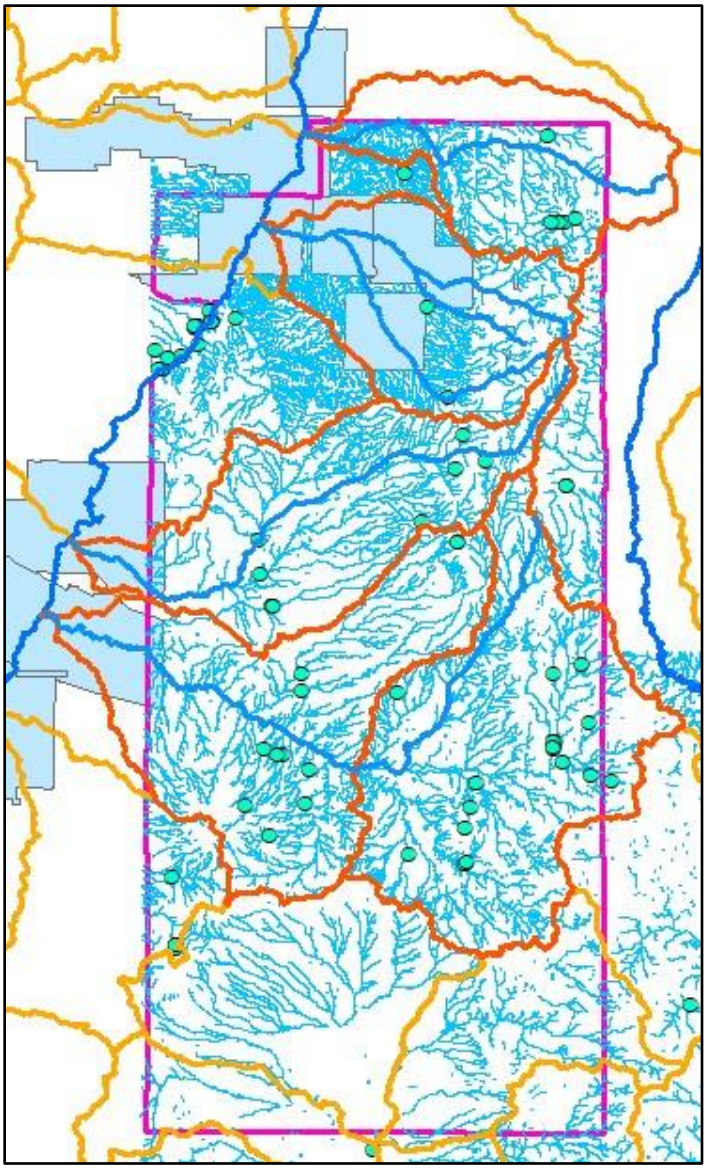

Figure 1. Map of Santa Fe County and the hydrological boundaries of sub-watersheds inside and outside the county area. Courtesy SWQB.

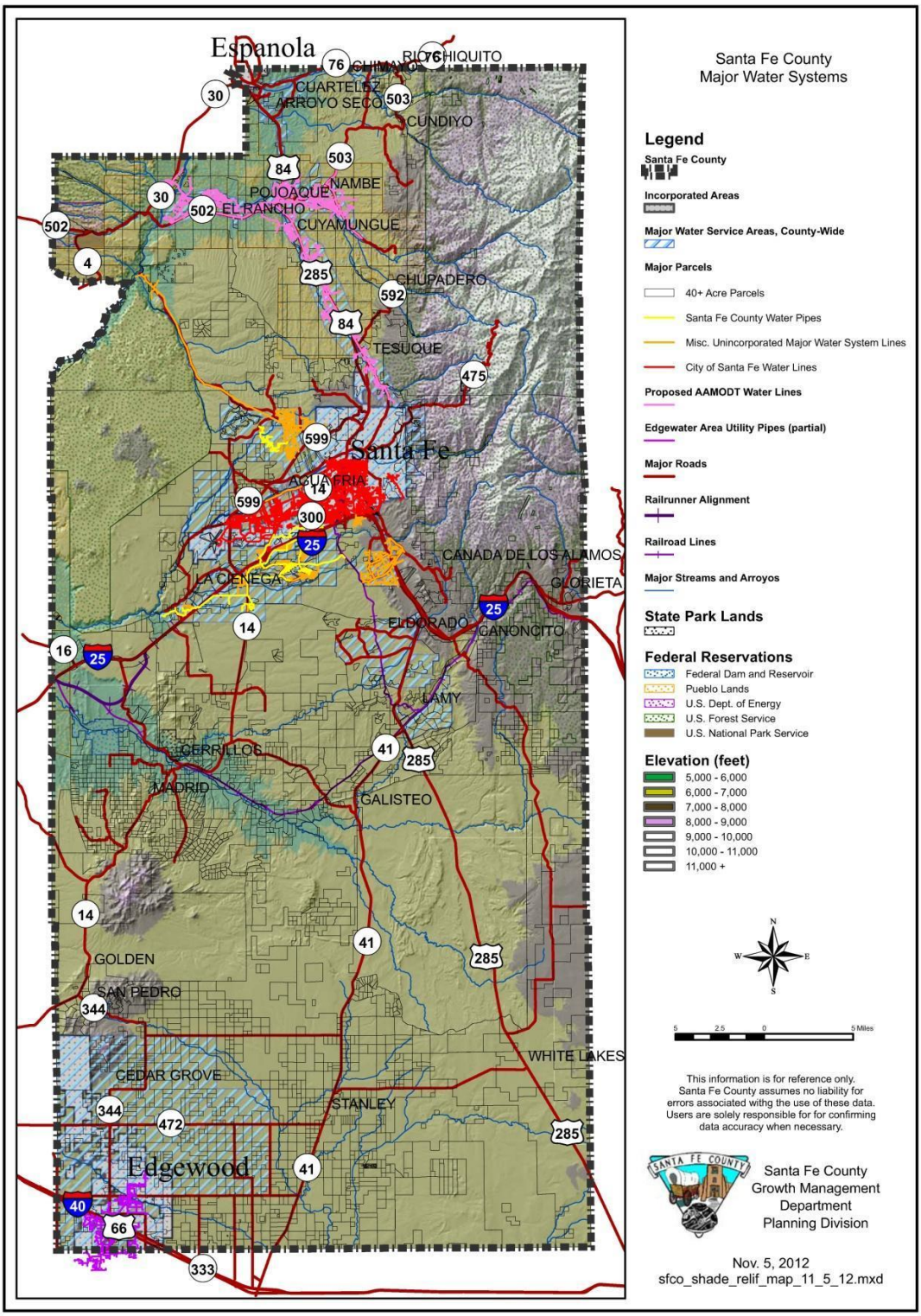

Figure 2. Location map of Santa Fe County with ownership and infrastructure details. Santa Fe County 2012.

The county's topography ranges from the alpine mountain peak of Santa Fe Baldy at 12,622 feet to the river bottoms of Galisteo Creek at I-25 and of the Rio Grande at the boundary with Sandoval County, just east of Bandelier National Monument, both at approximately 5,300 feet (BLM 1994). Located in the northeastern part of the county, the Sangre de Cristo Mountain range creates a predominant aspect of western, southwestern, and south-facing slopes, which drain to the Rio Grande. The Rio Grande runs in a southwesterly direction across the far northwestern part of Santa Fe County (Figure 2).

The slopes of the Sangre de Cristo Mountains are subdivided into a series of watersheds, which from north to south include the Santa Cruz/Cundiyo, Nambe/Pojoaque/Tesuque, Santa Fe River, Galisteo Creek, and the northwestern corner of the Pecos watersheds. South of the Galisteo Creek Watershed in Santa Fe County is the closed basin of the Estancia watershed. On the far northwestern side of the County are west-facing slopes of the Caja del Rio area that drain to the Rio Grande. Across the Rio Grande are the southeast-facing slopes of the Jemez Mountains, which are dissected in several narrow canyon-shaped watersheds and which originate in Los Alamos County and Sandoval County to the west (see Figures 3 and 4).

The slopes between the Sangre de Cristo Mountains and the Rio Grande are dominated by sandstone layers of the Santa Fe Group. The sandstone formation ends in complex volcanic rock formations that line the eastern side of the Rio Grande. Aquifers in the Ancha-Tesuque Formation surface at several places throughout the county and constitute the main water sources for important wetland complexes in Tesuque, Tesuque Pueblo, La Cienega, La Cieneguilla, San Marcos, and the Garden of the Gods area toward Cerrillos.

Based on watershed delineations in Santa Fe County and the geologic formations that determine the location of wetland complexes, wetlands can be grouped geographically in the following nine sub-watershed-based areas:

A. Rio Quemado, Rio Cundiyo-Santa Cruz River
B. Pojoaque Creek-Rio Tesuque-Rio Nambe
C. Rio Grande tributaries
D. Cañada Ancha
E. Santa Fe River
F. Galisteo Creek
G. Upper Pecos headwaters
H. Arroyo Tonque
I. Estancia Basin

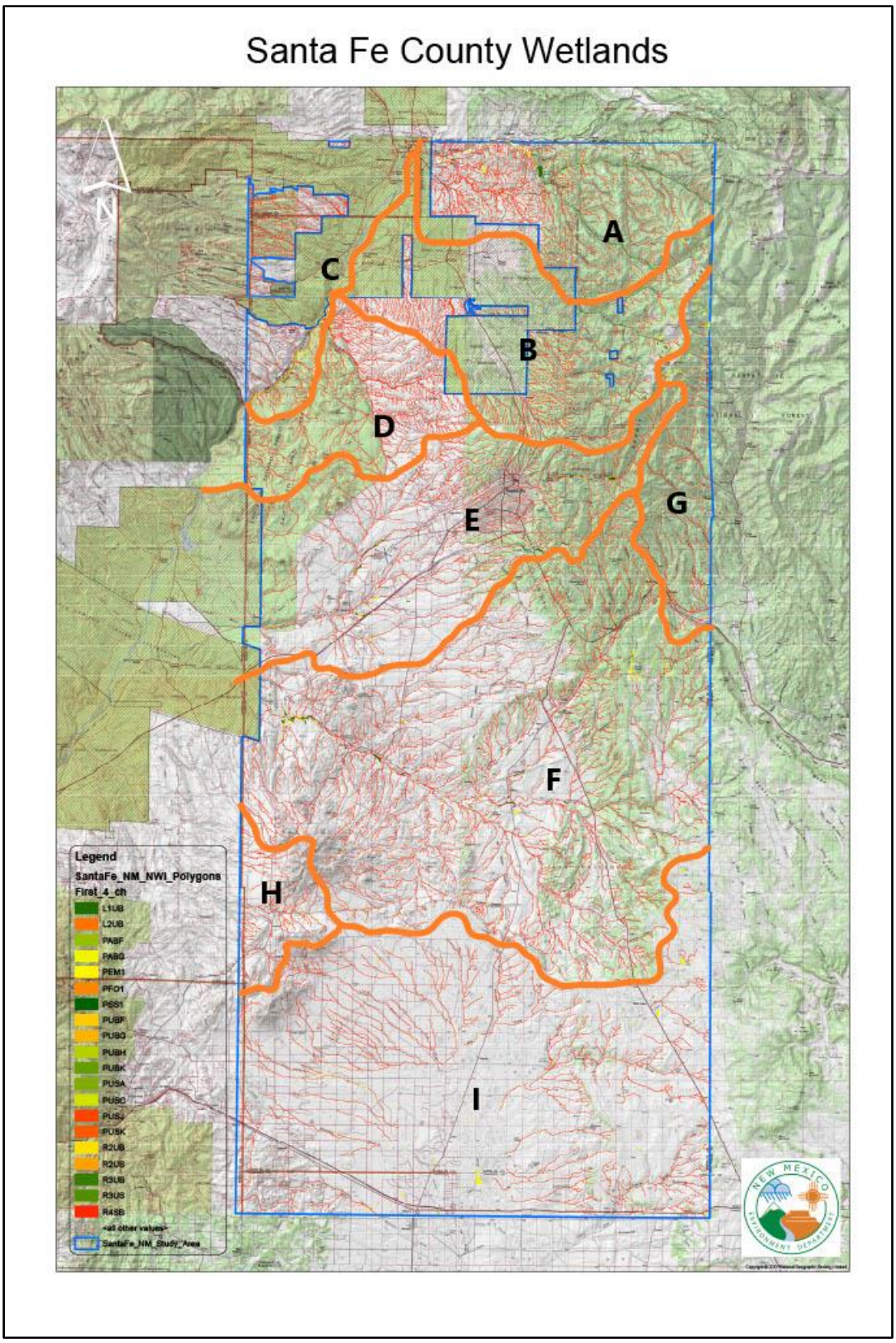

Figure 3. Map of sub-watersheds (orange outlined areas with letters) in Santa Fe County. Courtesy SWQB, 2021.

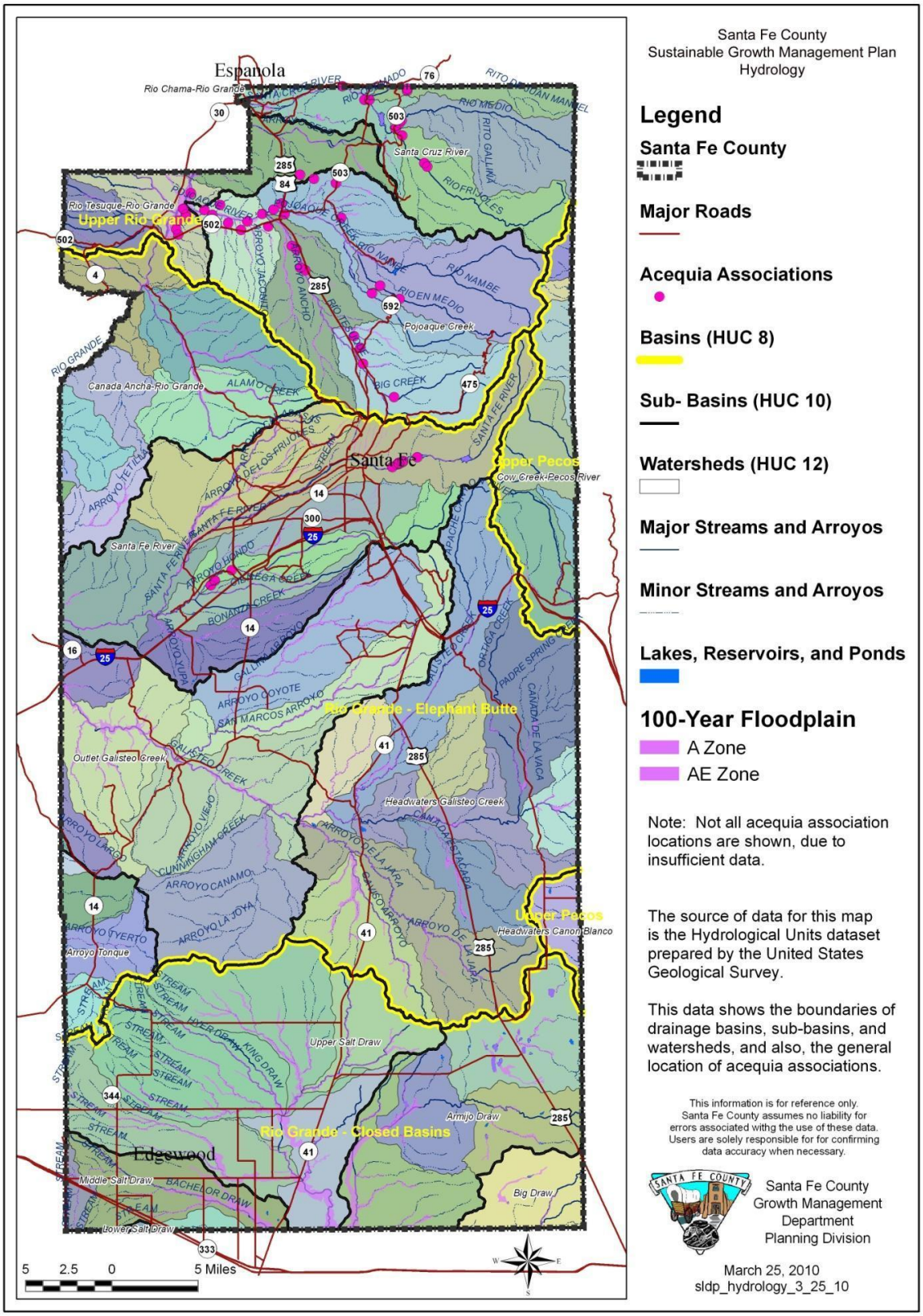

Figure 4. Map of basins, watersheds, flood zones, and water bodies in Santa Fe County. Santa Fe County, 2010.

Most wetlands and riparian areas in Santa Fe County are small in size. However, they are diverse in their ecological functions, geographic distribution, and wetland types. The wetlands associated with high mountain headwaters and streams are lacustrine and riverine in nature. Many lower elevation wetlands are riverine and slope wetlands and *cienégas*. In the southern part of Santa Fe County several large complexes of depressional wetlands (playas) occur. Appendix B explains the characteristics of these various wetland types.

Many slope wetlands and *cienégas* in the central parts of the county are associated with aquifers in the Santa Fe Group that come to the surface. Research by the New Mexico Bureau of Geology and Mineral Resources revealed that groundwater flow conditions in Santa Fe County show a segmented pattern in more-or-less parallel groundwater units (McGraw and Jansens 2012, Johnson et al. 2016). As a result of hydrostatic pressure in the Ancha-Tesuque Formation and the surfacing of the Ancha Formation in certain locations to the north and west of Santa Fe, discharge areas exist of aquifer flows that run generally from the mountain front to the northwest, west and southwest across Santa Fe County. For example, the Tesuque Valley from approximately one mile downstream from the Village of Tesuque to 3 miles downstream from Tesuque Pueblo comprises a significant groundwater discharge zone with depth to groundwater at less than 20 feet. Groundwater flows in another unit trend west-southwest and largely converge in La Cienega. The Santa Fe River from La Cieneguilla down to La Cienega as well as the Arroyo Hondo, Cienega Creek, Guicu Creek, Alamo Creek and Bonanza Creek east of La Cienega comprise a vast groundwater discharge zone consisting of many springs and seeps; hence the name La Cienega (Colonial Spanish for “marsh” or “bog”). Groundwater in a unit beneath the northern part of the Galisteo Basin flows west-southwest toward the Village of Cerrillos. Groundwater from this unit discharges in a series of arroyos with many small but locally significant spring and wetland areas in the Gallina Arroyo, Coyote Springs, San Marcos Arroyo, and a series of unnamed arroyos that run to the west of Highway 14 and downstream to Galisteo Creek (Appendix A, Figures A.3 and A.4).

Groundwater flows more to the south in the Galisteo Basin and the Estancia Basin are not well studied. However, it is likely that groundwater flows in the Galisteo Basin generally follow a westerly direction and converge in the streamside wetlands of the Galisteo Creek west of Cerrillos and in wetlands associated with the Galisteo Dam reservoir and the delta of the Galisteo Creek at Santo Domingo Pueblo. Oligocene and Lower Miocene volcanic intrusions (33.9Ma-5.3Ma), such as those of the Ortiz Mountains and Cerrillos Uplift have left clearly visible cones and volcanic dykes throughout the landscape. The intrusive activity created tilted sandstone layers and rock sills that crisscross the drainage systems, which are responsible for creating numerous isolated seeps and springs, and riverine wetlands, especially in the Galisteo Basin (SWQB 2010a) and also, although geologically different and younger (Mid-Pliocene, 5.3Ma-2.58Ma), around the Caja del Rio area, a.k.a. the Cerros del Rio volcanic field (Aubele 1979).

An overview of landscape characteristics of Santa Fe County, including details on a-biotic, biotic, and wetland resources, and details on land use history, is included in Appendix A.

1.5.2. Climate

Santa Fe County has a semiarid, continental climate with hot, dry summers and clear, crisp winters (U.S. Army Corps of Engineers 2006). Summer temperatures average 68.8 °F with an average daily maximum of 83.9°F. However, summer temperatures are rising due to the changing climate. While the maximum high had been 99°F since June 29, 1998 (matched in July 2003 and in June 2012), July 2023 broke this record with a maximum high of 100°F on July 18 (https://weatherspark.com/s/3506/1/Average-Summer-Weather-in-Santa-Fe-New-Mexico-United-States and https://www.koat.com/article/new-mexico-weather-forecast-july-18-2023/44574609). Related to what may be signs of climate change, the winter minimum extreme was surpassed with a record low of -24°F during the extreme cold in February 2011 (http://weather-warehouse.com/). However, mean winter temperatures are rising as well. While the historic low for January is 16.9°F, the actual minimum temperature in 2023 was 22°F (https://www.wunderground.com/history/daily/us/nm/santa-fe/KSAF/date/2023-1-4). As a result of the rising temperatures, the mean annual evaporation has been increasing, which raises the risk of drought and the chance of reductions in available water to support wetlands.

The average annual precipitation for Santa Fe County is 14.29 inches, of which 8.52 inches fall between May and September. Summer precipitation is mostly due to thunderstorms and light rainfall. Based on reports from local residents, precipitation extremes occur in local micro-bursts of 3 to 5 inches in a few hours. Santa Fe receives an average of 20.7 inches of snowfall a year. Recent snowfall data show record snowfall amounts for January-March 2005 (33.5") and 2010 (45.3") (http://weather-warehouse.com/). However, the snow-water-equivalent (SWE) is usually 10%, which means that the mean SWE in Santa Fe County is approximately 2 inches or 14% of annual precipitation. Tolley et al. (2015) found that SWE is of major importance to water availability in streams and aquifers in the Sangre de Cristo Mountains. Therefore, the relatively low mean SWE in Santa Fe County puts wetlands at risk of drying under the ongoing warming trends.

Annual free water surface (FWS) evaporation and annual potential evapotranspiration (PET) exceed precipitation throughout Santa Fe County, except at the highest elevations. Although the annual FWS evaporation and PET may exceed annual precipitation, precipitation for a given storm may exceed the evaporation and PET during the same time period, thus potentially resulting in recharge (Duke Engineering Services 2001). The estimated annual FWS evaporation rate for Santa Fe County is 45 inches per year. Average annual PET rates for Santa Fe County vary between 16 inches in the high mountain areas, to 18 to 22 inches in the foothills, 22 to 26 inches in most of the lower areas Santa Fe County, and 26 inches and more in the area of the east flanks of Caja del Rio Plateau and La Bajada Mesa, north of I-25 (Duke Engineering Services 2011). Wind speeds in Santa Fe County vary mostly between 0 and 21 mph, with 8 mph being an average low in August

(http://weatherspark.com). Warm temperatures, moderate winds, large daily solar radiation, and dry air contribute to maximum evaporation rates and limit infiltration and recharge of stream flow in the summer period between May and September.

1.5.3. The SCOTUS Decision of May 25, 2023

On May 25, 2023, in Sackett vs. EPA, the Supreme Court of the United States of America (SCOTUS) ruled in favor of a couple in Idaho who wanted to build a home on their private property on top of a wetland area. This ruling changed the legal wording and nature of wetland protections under the Clean Water Act nationwide by reducing the protection of wetlands, stating that a wetland must have a "significant nexus" and "continuous surface connection" with a U.S. navigable body of water.

As this 2023 WAP Update is being written, state and federal agencies are still determining the impact of the ruling. Given the large number of individual stream segments, springs and wetland areas in Santa Fe County, assessment of each wetland area is necessary to evaluate the impacts of the SCOTUS decision on the protection status of each wetland. It is likely that only a limited number of wetlands have a significant nexus through a continuous surface connection with the county's perennial lakes and rivers. It should be anticipated that the ruling will exclude from federal protection the many isolated springs and wetlands, small perennial river reaches, and seepage areas adjacent to streams and wetlands that have lost a continuous surface connection with larger water bodies across Santa Fe County.

1.5.4. Stakeholder Analysis

Stakeholders

Stakeholder (a.k.a. interested party) input is an important piece for the success of this WAP. Interested parties included acequias, non-profit organizations, government agencies, and pueblos. Input via conversations, emails, surveys, meetings, and the prior WAP creation have helped us to craft a document that reflects Santa Fe County stakeholder values and prioritizations for the Wetlands Action Plan. Interested parties also informed us of their restoration and conservation accomplishments since the 2012 WAP.

Demographics

Santa Fe County has a total area of 1,911 square miles (https://www.census.gov/quickfacts/fact/table/US/PST045222?), or 1,223,040 acres. Approximately 1,909 square miles of it (99.92%) consists of land and 2 square miles of it (0.08%) consists of water. Santa Fe County is the 3rd most populous county in New Mexico, after Bernalillo and Doña Ana. The county includes the City of Santa Fe, portions of the City of Española and the Town of Edgewood.

According to the Headwater Economics Demographic Profile, between 2010 and 2021 the population in Santa Fe County experienced a growth of 8.4%, from 141,702 in 2010 to 152,632 in 2021. These numbers are estimates, derived from 5-year averages, using the data from 2006-2010 for 2010, and from 2017-2021 for 2021. Population growth from 2020 to 2021 was around 8%. It is expected that the population increase will continue on this trend for several years to come (https://headwaterseconomics.org/apps/economic-profile-system/35049). A comparison of these population data with those of the 2012 WAP clarifies that the population in Santa Fe County stagnated during the period of 2012-2017 and that as of 2020 the county population has resumed the anticipated growth trend that was projected around 2010. According to the Spotlight NM Legislative Finance Committee's State Population Trends document in April 2021, the projected population for Santa Fe County begins at 153,311 for 2025, 255,641 in 2030, 257,291 in 2035, and 158,420 in 2040. This government report used the Geospatial and Population Studies Department as its source for these numbers (https://www.nmlegis.gov/Entity/LFC/Documents/Program_Evaluation_Reports/Policy%20Spotlight%20-%20State%20Population%20Trends.pdf). Consequently, wetland stressors related to population growth and urban development were of lesser intensity during the past ten-year planning period than predicted in the original 2012 WAP. However, it appears that these population impacts were merely delayed and continue to be of concern as they were in 2012.

Water Needs for Wetlands

Water sources for wetlands in Santa Fe County include atmospheric water (precipitation and dew), surface water, and groundwater. The surface water sources include discharge flows from the City of Santa Fe Paseo Real Wastewater Treatment Plant (WWTP) and numerous small springs and seeps on slopes and in river channels.

However, these water sources are also serving urban, industrial, agricultural, and water compact delivery beneficiaries. As a result, a large portion of the water source volume in Santa Fe County is not available to wetland ecosystems and availability varies between seasons and with the variability of discharge volumes between different water sources. Increasing diversion and use of water may gradually contribute to a reduction of the volume of water available to some or all wetlands in Santa Fe County.

The present "conjunctive use" approach in the City of Santa Fe and Santa Fe County balances out shortages in surface water flows with the use of groundwater resources. As a result of the conjunctive use approach and water conservation policies in the last few decades, groundwater has been saved and ground water levels have been accumulating, which increases water security for many uses in Santa Fe County. It is likely that the increased groundwater supply also has beneficial effects on water sources for some of the wetlands in the county. More detailed research will be necessary to specify which wetlands benefit from the increases in groundwater.

In recent years, the City of Santa Fe has sought to divert water from the WWTP to the Rio Grande to earn return flow credits. This might have benefited some riverine wetlands along the Rio Grande but would have greatly starved wetlands in the Santa Fe River below the WWTP. However, in 2023, an agreement between the City of Santa Fe and Wild Earth Guardians has secured that a minimum volume of water from the WWTP will be made available for riverine wetlands and agricultural communities downstream from the WWTP. While ongoing water allocation changes will likely benefit certain wetlands and negatively impact others, the agreement for the lower Santa Fe River indicates that compromises could benefit both wetlands and other uses.

1.5.5. Key Partners

There have been several entities that have helped form and contributed to the original and/or updated version of the WAP. The following organizations have been key partners in this process:

- Acequia de La Cienega
- Acequia del Potrero, Chimayo
- Agua Fria Village Association
- Albuquerque Wildlife Federation
- Amigos Bravos
- Animal Protection of New Mexico
- Audubon Society
- Defenders of Wildlife
- Ducks Unlimited
- La Bajada Community Ditch and Mutual Domestic Water-users Association (MDWA)
- New Mexico Acequia Association
- New Mexico Bureau of Geology and Mineral Resources
- New Mexico Department of Game and Fish
- New Mexico Water Resources Research Institute, New Mexico State University
- Pueblo of San Ildefonso
- Santa Clara Pueblo
- Santa Fe County Planning Division and Open Space & Trails Program
- Santa Fe Traditional Community Collaborative
- Santa Fe Watershed Association
- Soil and Water Conservation Society
- The City of Santa Fe
- The Nature Conservancy

We would like to recommend a few organizations that have the capacity to carry this forward into action. Our recommendations should not be taken as limitations or as obligations but as suggestions. We recommend that Amigos Bravos, the Albuquerque Wildlife Federation, the New Mexico Water Resources Research Institute, Santa Fe County, Santa Fe Watershed Association,

and the Soil and Water Conservation Society consider utilizing the WAP for future projects. We also recognize that this WAP could be carried forward by several partners simultaneously for specific local projects or county wide projects. This may be an advantage for smaller entities, such as acequias that do not have the carrying capacity but have the urgent need for watershed management; entities, such as conservation organizations or pueblos that have the person power and structure; and larger entities, such as government agencies, that have the funding but not the person power or time.

2. Resource Analysis

2.1. Santa Fe County Wetlands

This 2023 WAP-SFC Update includes new information which reflects that many Santa Fe County wetlands are now included in the online National Wetland Inventory (NWI[4]), and that significant progress has been made with assessments, mapping, and restoration work on individual wetlands in Santa Fe County. Table 2.1 provides an updated overview of known wetlands in Santa Fe County for each watershed area. However, information gaps remain.

The biotic ecosystems of Santa Fe County wetlands express themselves in specific wetland types. The Cowardin (1979) wetland classification system, which also supports the NWI, includes three wetland ecosystem types present in Santa Fe County: riverine, palustrine, and lacustrine ecosystems. In layman's terms these are respectively (a) wetlands and riparian areas along streams, (b) non-tidal marshland or swampland with trees, shrubs, and other plants that are rooted below the water, and (c) lake-side wetlands. Brinson's Hydrogeomorphic (HGM) wetland classification (Brinson 1993), often used by the NMED Surface Water Quality Bureau's wetland program as well, identifies four types of wetlands that occur in Santa Fe County: depressional wetlands (such as playas), lacustrine fringe wetlands (lake edges), slope wetlands (such as seeps, springs, *cienégas*, and perched wet meadows) and riverine wetlands (rivers and riparian zones). Appendix B describes in more detail the various definitions of wetlands and some local examples of each of these wetland types according to Brinson.

Of all four NWI and HGM types, riverine wetlands are most prevalent and have the largest acreage in Santa Fe County, probably followed by palustrine wetlands. Depressional wetlands, another type classified by NWI as palustrine, and lacustrine fringe wetlands are smaller and more isolated. Many individual and stream-side wetlands in the county identified in the NWI system are listed as emergent palustrine wetlands. These are marshes with saturated soil during most of the year because they are seasonally inundated. They are characterized by sedges, rushes, cattails, and grasses. In contrast, freshwater forested or shrub wetlands are also palustrine wetlands but are dominated by woody plant species, such as cottonwoods and willows as well as alder or ash. Such wetlands are locally known as "*bosques*" and *cienégas*. It should be noted that *cienégas* have a considerable herbaceous and shrub component besides a tree component. In the last century, exotic trees such as saltcedar (or tamarisk; *Tamarix chinensis*) and Russian olive (*Elaeagnus angustifolia*) have invaded many riverine and palustrine wetlands. In many wetlands, these trees now often dominate the wetland vegetation because they are more adapted to drought and saline soil conditions.

[4] The NWI wetlands maps can be viewed at https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/ and https://gis.web.env.nm.gov/oem/?map=wetlands.

The May 2023 SCOTUS rule that revoked federal protection to isolated wetland types disproportionately jeopardizes many small, isolated wetlands in Santa Fe County. These include the depressional wetlands in the southern part of Santa Fe County, certain springs, seeps, and small depressional wetlands in the vicinity of but not connected to the lakes with any surface flows, any slope wetlands that do not have a surface flow connection to a larger water body, and riverine wetlands that have become separated from the adjacent river.

The NWI wetland mapper, which users can navigate to find wetlands in the Santa Fe County area, is available at https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/. The NMED Surface Water Quality Bureau (SWQB) Wetlands Program worked with St. Mary's Geospatial Services to map wetlands in Santa Fe County and beyond in a large effort to complete NWI mapping for New Mexico. SWQB also created a high-resolution static map based on the NWI information which is included in Figure 3. Map data in the SWQB map are based on the NWI data set. Table 2.1. provides a listing of known wetlands in Santa Fe County for each of the nine major watershed areas. The NWI data set is too large to reflect wetlands for each of the nine watershed areas in Santa Fe County in partial maps. Including such wetland maps for each watershed (as per Table 2.1) would not offer enough resolution to depict the wetlands adequately. Please visit the NWI online map to explore the extent of wetlands in Santa Fe County. More information about Santa Fe County's landscape characteristics is included in Appendices A and B.

Table 2.1. Listing of known springs, wetlands, and wetland areas for each watershed in Santa Fe County with details on wetland ownership, wetland area, wetland type (after Brinson 1993), and geo-coordinates (for select underlined wetland sites only).

WATERSHED AREA	KNOWN WETLANDS	WETLAND OWNERSHIP AND STATUS	APPROX. WETLAND AREA	TYPE OF WET-LAND	WETLAND GEO-COORDINATES & ELEVATION
Rio Quemado-Rio En Medio-Rio Frijoles-Rio Santa Cruz Stream System	Freshwater emergent wetlands along Santa Cruz River, at Los Potreros Open Space (Chimayo), and of the Rio Frijoles (Cundiyo); riverine wetlands, headwaters wetlands, and springs	SF County Open Space USFS	>10 acres at LPOS and >15 acres at other sites (cumul-atively)	Riverine + Slope	35°59'24.31"N, 105°55'47.33"W, 6140 ft
Pojoaque-Tesuque-Nambe watershed, incl. Rio en Medio and Rio Chupadero	Nambe Lake Big Tesuque Creek – spring and wetland Springs and wetland areas along Rio Tesuque (downstream past Pueblo)	FWS/Forest Trust preserve Tesuque Pueblo	<1 acre TBD	Slope Slope + Riverine	35°44'21.39"N, 105°54'01.60"W, 7190 ft 35°48'54.30"N, 105°58'46.99W, 6301 ft

WATERSHED AREA	KNOWN WETLANDS	WETLAND OWNERSHIP AND STATUS	APPROX. WETLAND AREA	TYPE OF WET-LAND	WETLAND GEO-COORDINATES & ELEVATION
Galisteo Creek watershed	Wetlands in Valencia	USFS, Private	<1 acre	Slope	35°34'09.28"N, 105°47'59.30"W, 7169 ft
	Deer Creek	USFS, Private	<1 acre	Slope	
	Apache Canyon	Private	>10 acres	Slope + Riverine	35°33'18.57"N, 105°49'43.41"W, 6988 ft
	Apache Ridge wetlands	ECIA	<1 acre	Slope	
	Cañoncito wetlands	ECIA	1-2 acres	Slope + Riverine	35°31'50.65"N, 105°50'41.84"W, 6829 ft
		Private	>50 acres	Riverine	
	Galisteo Creek San Cristobal playa	Private	1-2 acres	Depressio-nal	35°22'37.55"N, 105°56'15.54"W, 6028 ft
		Private, SLO	1-2 acres	Slope + Riverine	35°27'45.88"N, 105°57'36.12"W, 6344 ft
	Galisteo Springs and other GBP wetlands	Private	1-2 acres	Slope + Riverine	35°31'53.02"N, 105°43'35.00"W, 7652 ft
	Glorieta Mesa springs & wetlands: Padre Springs, Arr. Salado				
		Private	<1 acre	Riverine	
	San Cristobal Arroyo	Private	1-2 acres	Riverine	
	Arroyo de la Jara	Private	<1 acre	Slope	
	Finger Lakes	Private	<1 acre	Slope	
	Coyote Springs	Private	<10 acres	Slope + Riverine	
	Cañada de los Alamos	Private, State of NM	<10 acres	Slope + Riverine	35°27'33.84"N, 106°04'17.04"W, 6006 ft
	San Marcos Arroyo,	Private	1-2 acres	Slope	
	Gallina Arroyo and	SF County	<1 acre	Slope	35°27'03.51"N,
	Hwy 14 springs	US ACE	TBD	Slope	106°07'27.73"W,
	Cerrillos Hills springs	Private	<1 acre	Slope	5905 ft
	Galisteo Reservoir				
	Mailbox Rd Arroyo				
Cañada Ancha watershed	Spring at Caja del Rio Canyon	USFS/BLM	TBD	Slope	35°48'24.03"N, 106°08'47.15"W, 5795 ft
Rio Grande tributaries of Caja del Rio	Springs	USFS	TBD	Slope	35°48'31.33"N, 106°10'48.60"W, 5435 ft

WATERSHED AREA	KNOWN WETLANDS	WETLAND OWNERSHIP AND STATUS	APPROX. WETLAND AREA	TYPE OF WET-LAND	WETLAND GEO-COORDINATES & ELEVATION
Santa Fe River watershed	Santa Fe Lake; Upper Santa Fe River; Two Mile Pond at Santa Fe Canyon Preserve	City of SF, Santa Fe National Forest, TNC	1-2 acres	Riverine	35°41'18.46"N, 105°53'33.32"W, 7354 ft
	SF River wetlands below WWTP	SF County	TBD	Riverine	35°37'23.39"N, 106°06'10.91"W, 6228 ft
	Upper Arroyo Hondo; La Barbaria; Arroyo Hondo wetland above dam; Arroyo de los Chamisos	SF County	4-5 acres	Riverine + Slope	35°37'11.45"N, 105°55'23.63"W, 7120 ft
	Cienega Creek, Alamo Creek, Guicu Creek, Bonanza Creek	Private	TBD	Riverine + Slope	35°34'32.17"N, 106°05'55.32"W, 6087 ft
Upper Pecos River watershed	Lake Katherine; lakes around SF Baldy	All USFS	TBD	Slope	35°46'57.04"N, 105°45'00.71"W, 10793 ft
	Doctor Creek, Indian Creek, Macho Canyon, Dalton Canyon, Alamitos Canyon, La Cueva Canyon, Hagen Creek, Glorieta Creek	USFS and private			35°37'03.32"N, 105°44'13.41"W, 7605 ft
Arroyo Tonque watershed (San Pedro Creek)	Arroyo Tonque, Cañon del Agua, Arr. Cuchillo, Tuerto, Valverde, and San Pedro Creek	All private (and some BLM)	TBD	Slope	35°16'50.93"N, 106°12'55.63"W, 6471 ft
Estancia Basin	Big Lake (playa)	Private	TBD	Depressio-nal	35°10'42.52"N, 105°47'56.94"W, 6811 ft
	White Lakes (playas)	Private	TBD		

2.2. Wetland Functions

Like any other wetlands, and as described in general scientific investigations about wetland functions (Mitsch and Gosselink 2007; Johnson 2005), wetlands throughout Santa Fe County perform many different important environmental functions. Furthermore, different types of

wetlands perform different functions or the same functions to various degrees. Wetland functions are defined as a process or processes that take place in a wetland (Novitski et al. 1993). Wetland ecosystem functions are processes that are necessary for the self-maintenance of a wetland ecosystem. Examples of wetland ecosystem functions are primary production and nutrient cycling (Kleindl 2005). The many wetland ecosystems also enhance regional biodiversity and are of great importance to many species of wildlife and plants.

Wetland ecosystem functions also influence adjacent ecosystems. For example, riverine wetlands can modify flooding along a river's course, or nitrogen, sulfur, methane, and carbon cycles in wetlands can affect air quality. Wetlands can also exhibit variability because of climatic conditions, species composition, soil type, biogeochemistry, and other factors. However, regardless of how they are defined, wetlands within a class (or type) share the most common functions. Key functions of wetlands in Santa Fe County include:

Hydrologic Functions:

1. Maintenance of runoff volume
2. Energy dissipation
3. Surface water storage
4. Groundwater recharge

Water Quality and Biogeochemistry Functions:

5. Sediment retention
6. Phosphorus retention
7. Nitrogen removal
8. Heavy metals and hydrocarbon removal
9. Carbon cycling and sequestration

Biological Functions:

10. Vascular plant production
11. Macro-invertebrate and fish production
12. Wildlife habitat
13. Habitat diversity and complexity
14. Biodiversity

2.3. Wetland Values and Ecosystem Services

Wetlands and wetland functions are of value to people and society. Each wetland function and/or the aggregate of functions constitutes specific values for humans, because wetland ecosystem functions deliver a wide range of valuable ecosystem services that contribute to human well-being. Linking ecosystem conditions and functions to services and human well-being, predicting the

effects of changes in ecosystem services on human well-being, and improving the identification, quantification, and communication related to functions and ecosystem services will help identify why it is important to restore and protect wetland functions in Santa Fe County. SWQB has been modeling wetland functions with their mapping data, which has informed Amigos Bravos in generating a story map for Santa Fe National Forest Wetland Jewels. This WAP- SFC assists in offering a first step toward the goal of identifying the mentioned linkages.

It remained beyond the scope of this WAP Update to conduct an assessment of wetland ecosystem conditions or a detailed assessment of ecosystem functions for each wetland area identified in Santa Fe County. However, as observed in 2012, wetlands in Santa Fe County are scattered and most wetlands seem to continue to decline in size and ecological functions. Monitoring data have shown that ecological restoration work has improved wetland conditions and functions of several wetlands, such as the riverine wetlands of the Galisteo Creek in the village of Galisteo and the Los Potreros wetlands in Chimayo (Ecotone 2020 and Ecotone 2022).

Field assessments of some of the listed wetlands generated a deeper insight into the ecological functions these wetlands provide and how these functions offer natural benefits to people. These benefits of nature, or ecosystem services, are listed in Table 2.2 for each of the studied wetlands along with three different categories of wetland functions.

How people value these ecosystem services depends on people's awareness and use of these ecosystem services and on the functionality of each wetland in performing these ecosystem services. The population in Santa Fe County appears to be aware of only certain wetland functions as expressed in their use of the wetland areas and water resources and as expressed in behavior, stewardship, and protective measures. Clearly, the presence of cattle tanks near springs and the (often primitive) protection of the spring head areas (e.g., with sumps), the association of acequias with springs, the many campsites around the high mountain lacustrine wetlands and lakes, and the development and protection of public open space areas around wetlands for recreational, educational, and scientific activities in connection with historical and cultural preservation[5] and scenic or night-sky appreciation activities express people's values of the wetlands that provide these services. In some cases, government agencies and landowners have also made use of flood control functions of wetlands, of wildlife habitat and pathway conservation functions, or of groundwater infiltration and storage capacities of wetlands. Comments in recent public meetings about infrastructure projects, such as the highway bridges in Galisteo or the opposition to diverting water from Two Mile Pond, have shown that communities and individuals are concerned about impacts on wetlands for reasons of property values and spiritual and other personal or community values.

[5] Please see Appendix E for a letter from the Agua Fria Village Association recounting the historical wetlands and bosques along the Santa Fe River.

Table 2.2. Wetland Functions and Ecosystem Services Observed or Suspected for Selected Wetlands that Underwent Ecological Restoration Work between 2013 and 2023.

Wetland Site (and Type)	Hydrologic Wetland Functions	Water Quality & Bio-Chemistry Functions	Biological Functions	Ecosystem Services Performed and Impact on Human Wellbeing
Los Potreros Open Space (riverine and palustrine-emergent)	Runoff volume and energy buffered; ground water recharged	Sediment retention; carbon and nutrient cycling & sequestration	Vascular plant production; wildlife + bird habitat; expanded beaver habitat and activity; Biodiversity	Flood control; water supply for acequias; scenic quality for visitors and residents; cultural resource values for Santuario de Chimayo
Galisteo "bosque" (riverine)	Runoff volume and energy buffered; ground water recharged	Sediment retention; carbon and nutrient cycling & sequestration	Vascular plant production; wildlife + bird habitat; biodiversity	Water supply for the Galisteo Mutual Domestic Water Consumers Assoc.; scenic quality for visitors and residents; flood control
Santa Fe River: Cam. Carlos Rael – Siler Rd (riverine)	Runoff volume and energy buffered; erosion control	Sediment retention; carbon and nutrient cycling & sequestration	Vascular plant production; wildlife + bird habitat; biodiversity	City park-scape: scenic quality for visitors and residents; education
Wetland Jewels (lacustrine)	Runoff volume and energy buffered; ground water recharged	Sediment retention; carbon and nutrient cycling & sequestration	Vascular plant production; wildlife + bird habitat; Biodiversity	Scenic quality for visitors; cultural (spiritual) values

A stakeholders assessment conducted by the Santa Fe Watershed Association between 2021 and 2022 revealed that respondents interested in water and watershed issues value the natural benefits of stream and wetlands related to climate change, drought mitigation, native species and habitat conservation, stormwater absorption and purification, and wildfire management, especially in the (upper) Santa Fe Watershed. Community feedback on wetland values related to several projects conducted in the last ten years shows that other values are related to the scenic quality of wetlands and the way wetlands enhance the scenic quality of the adjacent landscape and cultural sites. Examples are the high mountain wetland jewels in the context of the mountain landscape, Los Potreros wetlands behind the Santuario de Chimayo, and the Santa Fe River in association with acequias in Santa Fe and La Cienega.

Related, but separate, people mentioned the functional value of wetlands and streams in support of cultural landscape elements and practices, such as acequia agriculture in Chimayo and along the Santa Fe River in Santa Fe, Agua Fria, La Cieneguilla and La Cienega, and Indigenous ceremonial relationships with wetlands such as Lake Katherine and the springs in the Caja del Rio (see Appendix E). Certain wetlands are also valued for wildlife viewing, including bird watching, and general nature conservation purposes, such as those of the Santa Fe River, Galisteo Bosque, Two Mile Pond, Rio Quemado, and the Wetland Jewels in the mountains. Finally, county residents are well aware of the public safety values related to flood and sediment control provided by wetlands, such as along the Rio Quemado, Santa Cruz River, and Galisteo Creek.

3. Threats and Stressors to Wetlands in Santa Fe County

Wetlands and riparian areas in the Santa Fe County area continue to be threatened by the impacts of the following six major causes of wetland degradation:

a. **Climate change**, expressed in the cumulative effects of extreme weather events, such as periods of extreme drought, events of high intensity rainfall, and increased exposure to high temperatures.

b. **Catastrophic ecological events**, such as periods with extremely high temperatures and an absence of precipitation, or events such as mass wasting, destructive flooding, channel and bank erosion, and wildfire.

c. **Removal or destruction of vegetation** and soil structure due to grazing, fire, off road vehicle use, foot traffic, or deliberate vegetation removal.

d. **The potential of reduced groundwater flows** due to groundwater diversion in the region and reduced surface water inflow due to land degradation and climate impacts.

e. **Gradual, cumulative channel erosion** (channel degradation and bank failure) due to the combined impacts of the threats listed above.

f. **Encroachment by and proliferation of invasive plants** and the gradual depletion of habitat qualities, ecological resilience, and biodiversity.

The future of wetlands in Santa Fe County depends on whether they continue to receive water, support hydrophytes, and/or maintain hydric soils. In other words: whether they stay wet, remain green, and/or have typical wetland soils. There is a concern that for many years proper functioning of most wetlands in Santa Fe County has been severely under siege by the forces of a changing climate and urban development pressures, combined with inappropriate land use and inadequate stewardship practices and the cumulative effect of centuries of land and water use impacts across the County. Most recently, the May 25, 2023 SCOTUS rule on wetland protection adds the concern that many isolated, groundwater-fed, or intermittent wetlands have lost federal protection status. Without a suite of ongoing interventions, many wetlands in Santa Fe County may degrade further and some may disappear altogether in the next decade, and with their demise the community will lose the many natural benefits these ecosystems provide.

Additionally, wetlands and riparian areas in Santa Fe County could be considered “early warning” ecosystems (in layman's terms “canaries in the coal mine”) that offer signals of dwindling wetland functionality due to declining surface water and groundwater discharge into the wetlands and/or water quality impairments. Decline of water supply and water quality is of general concern to the wellbeing of the community in Santa Fe County, because such declines will have serious implications for available drinking water, public health and sanitation, and area-wide ecosystem

stability and productivity. As a result, and as a corollary to wildfire risk assessments, the risk of wetland decline and disappearance consists of the scale, intensity and speed of wetland degradation and the impacts on the larger ecosystem and on community wellbeing. The risk of wetland degradation can, therefore, be described as the risk of decline of wetland ecosystems and the impacts of this decline on landscape values, such as the surrounding landscape and human communities. Identifying degradation vulnerability of wetland ecosystems in combination with the susceptibility of landscape values that could be impaired helps specify priorities for action in addressing wetland degradation across the landscape.

SWQB uses a "Stressors Checklist" developed for the assessment of wetland conditions as part of the New Mexico Rapid Assessment Method (NM RAM Field Guide Version 2.5.) in Montane Riverine Wetlands (Muldavin et al. 2022). This WAP has adapted and referenced the stressor checklist (Worksheet 15) from the NMRAM to create an overview of potential stressors for a selection of wetlands to help with the identification possible restoration strategies. Table 3.1 provides an overview of specific wetland threats and stressors for selected wetlands in Santa Fe County.

Key to Codes for Stressors Listed in Table 3.1:
A box colored red [ ] means that a particular threat or stressor for that wetland area could be expected but cannot be verified at this time.
A box colored blue [ ] means that no threats or stressors of a kind are present or likely for a wetland area due to current management, ownership, or ecological conditions.

Landscape Context Stressors:
AR = Active Recreation
IA = Intensive/row-crop Agriculture, including Orchards, Nurseries, etc.
ID = Industrial and Infrastructure Development
RA = Ranching (low intensity or moderate)
UD = Urban/residential Development and Groundwater Diversion

Vegetation (Biotic Condition) Stressors:
x = stressors present or highly likely

Physical Structure (Soil/Substrate) Stressors:
C = Various Climate stressors
EV = Evaporation (presence of open water and/or bare soil)
CE = Catastrophic/Excessive Erosion
CF = Catastrophic/Excessive Flooding
MW = Mass Wasting
TI = Temperature increase
WF = Wild Fire

Hydrologic Condition Stressors:
x = stressors present or highly likely

Table 3.1. Estimated present and future threats and stressors to wetlands in Santa Fe County.

Watersheds and Wetland Areas	Categories of Threats to Wetlands						Time Scale of Threats	
	1: Encroach-ment, pollution, isolation, hydro-modification	2: Reduced surface inflow & groundwater recharge	3: Increased temperature exposure and EV losses	4: Removal of vegetation	5: Invasive plant encroachment	6: Catastrophic ecological events	2023-2032	2033-2042
Rio Cundiyo-Santa Cruz								
headwater springs	AR					WF risk	x	x
Los Potreros wetlands			C/TI/EV	x (beaver)	x	CF	x	x
Pojoaque-Tesuque-Nambe								
Big Tesuque Creek	RA, UD	less snow	C	x	x	WF risk	x	x
Rio Tesuque wetlands	AR	less snow	C	x	x	CF	x	x
Rio Grande tributaries								
Black Mesa-Buckman	AR		C		x	MW risk	x	x
Caja del Rio springs	AR		C		x	MW risk	x	x
Canada Ancha								
Caja del Rio Canyon		x	C	x	x	CF, CE risks	x	x
Santa Fe River								
Twomile reservoir		x	ET				x	
SF River below WWTP		being mitigated	C	x	x		x	
La Cieneguilla	IA, RA, UD		C	x	x		x	x
Arroyo Hondo	AR	x	C			WF risk	x	x
Cienega Creek Area	RA, UD	x	EV	x	x		x	x
Bonanza Creek	ID, RA, UD	x	C		x		x	x
Galisteo Creek								
Valencia wetlands	ID, RA, UD	x				CF, MW risk	x	x
Deer Creek	AR	x			x	WF, MW risk	x	x
Apache Canyon		x	EV			WF, MW risk		x
Apache Ridge	AR	drought	EV	x	x	WF risk	x	x
Cañoncito wetlands		x	EV		x	CF, CE risks	x	x
Galisteo mainstem		drought	C		x	CF, CE, WF risks	x	x

Watersheds and Wetland Areas	Categories of Threats to Wetlands						Time Scale of Threats	
	1: Encroach-ment, pollution, isolation, hydro-modification	2: Reduced surface inflow & groundwater recharge	3: Increased temperature exposure and ET losses	4: Removal of vegetation	5: Invasive plant encroachment	6: Catastrophic ecological events	2023-2032	2033-2042
San Cristobal playa	RA		C				x	x
Galisteo Springs			C		x	CF, CE risks	x	x
Other GBP wetlands			C		x	CF, CE risks		x
Arroyo Salado	IA, RA, UD		C		x			x
Padre Springs			C			CF, CE, WF risks		x
San Cristobal Arroyo	RA		C		x	CF, WF risks		x
Arroyo la Jara	RA		C		x			x
Finger Lakes			ET		x	WF risk	x	x
Coyote Springs			C		x			x
Cañada de los Alamos	AR, UD		C	x	x	CF, CE, WF risks	x	x
San Marcos Arroyo			ET		x	WF risk		x
Hwy 14 springs			C		x			x
Cerrillos Hills springs	AR		C		x			x
Galisteo reservoir	RA		C		x			x
Mailbox Rd Arroyo	UD		C		x			x
Upper Pecos headwaters								
various headwaters						WF risks	x	x
Glorieta Creek	UD			x	x	WF risks	x	x
Arroyo Tonque								
various springs	RA		C	x	x			x
San Pedro Creek							x	
Estancia Basin								
Big Lake Playa	RA		C				x	x
White Lakes	RA		C				x	x

The most important, ongoing stressors of wetlands and riparian areas in Santa Fe County include:

1. **Encroachment, pollution, isolation, and hydrological changes** due to urban, industrial, and/or infrastructure development, resource extraction industries, and/or specific land use in and around wetland areas (such as agriculture, recreational uses, waste management), and associated surface water diversion and groundwater extraction.

2. **Dwindling water sources** due to irregular surface water inflow and/or uncertainty about future groundwater recharge.

3. **Exposure to high temperatures,** leading to increased water loss from evaporation and ultimately to plant mortality.

4. **Removal or destruction of vegetation and wetland soils** due to catastrophic events, such as fire, mass wasting, destructive flooding, gully erosion, etc. and human behavior, such as off-road-vehicle use, vandalism, or deliberate vegetation removal.

5. **Encroachment by and proliferation of invasive plants.**

These stressors and their main causes will be discussed in more detail in the following sections in the context of urban development and land use processes and climate change as the key drivers of the stressors.

3.1. Wetland Vulnerability due to Urban Development and Land Use

The impacts of urban development, generally driven by population growth, typically constitute wetland stressors if they are not mitigated. Water diversion for new human uses (residential drinking water and commercial or industrial uses) have gradually reduced available water in streams, seeps, and groundwater sources. The allocation of water rights for designated uses and the diversion of groundwater and surface water has also led to reduced water available for communities along and downstream of the Santa Fe River.

Wetlands and riparian areas are very sensitive to direct encroachment by urban development and other land use processes. In many cases, urban development in a wetland or riparian area alters the ecological conditions of the area to the extent that it is irreparably destroyed. Federal regulations under Sections 401 (state certifications), 402 (NPDES) and 404 (U.S. Army Corps permits) of the Clean Water Act offer some protection of wetlands through permitting procedures that regulate pollutant discharge and dredge and fill in wetlands. Wetlands that are isolated or that lack sufficient connection to navigable waters and tributaries have become entirely unregulated with the May 25, 2023 SCOTUS ruling. In practical terms, small and isolated wetlands now run the risk of being dewatered or damaged if no other protections or individual care are provided.

Encroachment up to the edges of a wetland or riparian area may not destroy the wetland or riparian ecology per se, but often has significant deleterious effects on wetland functions due to urban runoff volumes, energy, and pollution, and due to potential fragmentation and isolation of wetland/riparian habitat from other ecosystems and water sources that are supportive of species survival in the wetland. Wetlands are so sensitive because they require a presence of water, water-logged soils, and/or water-dependent plant species. Wetland functions in support of wildlife are important because approximately 80% of all dryland vertebrate species depend for one or more phases of their life cycles on wetland or riparian areas. Moreover, connectivity of wetland and riparian habitat is essential for recharge of water sources for wetlands and for plant and animal species movement patterns and regeneration, which support overall biodiversity and resilience of the wetland ecosystem. If urban development causes fragmentation of wetland and riparian ecosystems, these ecological support functions of wetlands tend to degrade.

Urban development also generates a permanent exposure of wetlands to deleterious effects of urban stormwater volumes, their energy, and pollutants, unless urban stormwater is properly managed and the wetlands are flanked with adequate buffer zones (Environmental Law Institute 2008). Additionally, urban development also increases the exposure of wetlands to the indirect effects of development and land use, such as wildfire, off-road-vehicle use, vandalism, deliberate vegetation removal, encroachment and proliferation of invasive or noxious plants, destructive flooding, and gully erosion.

Exposure of wetlands to urban runoff and indirect development impacts on wetlands can be lessened if urban planning has anticipated such impacts with proper design and mitigation measures, if developers and the community practice good stewardship, and if enforcement of protective regulations is adequate. Santa Fe County's 2015 Sustainable Growth Management Plan (SGMP) Update proposes to develop a series of policies regarding the capture and reuse of storm water, including aquifer recharge, storm water pollutant management, and the minimization of flooding. These policies will help protect wetland functions in the face of development (Santa Fe County 2015).

Urban development often leads to groundwater extraction from municipal and domestic wells. Additionally, sub-surface impacts of construction activities are typically inadequately researched and one may be concerned about the interruption of groundwater flows in shallow aquifers. Exposure to disruption or reduction of groundwater flows is a potential death sentence to wetlands and riparian areas. Slope wetlands (springs, seeps, and other groundwater dependent wetlands) in particular are sensitive to reduced groundwater recharge and obstructions in surface water inflow. Reduced or interrupted groundwater recharge often cannot be mitigated by any land management, stewardship solutions or buffer zones. Within a short period of time, slope wetland conditions would perish under an enduring shortage of groundwater.

However, urban development does not have to be a direct threat or stressor for wetland health and in some cases may lead to wetland protection and wetland development. The permanent flow of treated effluent flowing from the Santa Fe Wastewater Treatment Plant (WWTP) along Paseo Real constituted a water source that has supported wetland development along the Santa Fe River downstream. Urban populations, such as in Santa Fe, care about the natural environment, which has generated financial support and initiatives that help restore and protect wetlands and streams. As a result of an initiative of The Nature Conservancy and the Santa Fe Watershed Association, in collaboration with the Santa Fe National Forest and the City of Santa Fe, the City adopted an ordinance in 2012 (Resolution no. 2012-28) that allocates 1,000 acrefeet a year of in-stream flow in the Santa Fe River. Activism also led to the recent agreement between the City of Santa Fe and Wild Earth Guardians for the continued flow of effluent from the WWTP to guarantee the health and restoration of the wetlands. Furthermore, construction of parks, golf courses, dams, irrigation ditches, and water management works can create new wet areas that over time develop into naturalized wetlands that support waterfowl and other aquatic life forms and provide the multiple benefits of natural wetlands.

3.1.1. Future Wetland Exposure to Anticipated Urban Development

Since 2020, Santa Fe County has seen an increase in urban development many times larger than in previous years. After a slowdown of population growth between 2000 and 2010 and a trend of very slow growth for the following ten years, the county population increased again as of 2020, which stimulated the urban growth. According to the Headwater Economics Demographic Profile, between 2010 and 2021 Santa Fe County experienced a population growth of 8.4%, from 141,702 in 2010 to 152,632 in 2021. These numbers are estimates, derived from 5-year averages, for 2010, using the data from 2006-2010, and for 2021, using 2017-2021 (https://headwaterseconomics.org/apps/economic-profile-system/35049). The same source reported a population growth of around 8% for the period 2020 to 2021. In April 2021, the State Population Trends document of the Spotlight NM Legislative Finance Committee, projected population numbers for Santa Fe County to begin at 153,311 for 2025, 255,641 in 2030, 257,291 in 2035, and 258,420 in 2040. This government report used the Geospatial and Population Studies Department as its source for these numbers (https://www.nmlegis.gov/Entity/LFC/Documents/Program_Evaluation_Reports/Policy%20Spotlight%20-%20State%20Population%20Trends.pdf).

Urban development in Santa Fe County largely follows the guidelines laid out in the updated Sustainable Growth Management Plan (2015 SGMP Update) and the updated Santa Fe County Sustainable Land Development Code (SLDC, adopted by Ordinance 2016-9, December 13, 2016). Future urban development should therefore be expected to take place in the target areas indicated in the 2015 SLMP and 2016 SLDC. The 2016 SLDC builds on the earlier version of 2013 and confirms the original plans for expanded urban development through infill in the City of Santa Fe, by annexation of areas at the city fringes, and by construction in areas to the northwest, southwest,

and south of the city. These areas are identified in the 2015 Sustainable Growth Management Plan as “Most Suitable” and indicated in the Code as Sustainable Development Areas 1 and 2 (SDA-1 and SDA-2) (Figure 5). SDA-1 and -2 are the County’s target growth areas where development is likely and reasonable to occur within a 20-year period through 2035 and beyond. (Santa Fe County 2015). SDA-1 encompasses an area north of La Cieneguilla and west of the Aldea subdivision, the build-out of the Rancho Viejo subdivision (or Community College District), the adjoining area along State Highway 14 north of Alamo Creek and Bonanza Creek, and a small strip along Highway 41, north of Moriarty (Santa Fe County 2016). Projected development along the Santa Fe River north of La Cieneguilla and upstream of the Alamo Creek and Bonanza Creek may affect sensitive wetland areas downstream along these stream systems and in La Cienega.

SDA-2 covers a larger area around SDA-1 as well as infill areas in the currently developed urban area. The SDA-2 areas are expected to develop at lower urban intensities until public and private facilities are installed, which is expected to occur after 2035. Analysis of the SDA-2 zone on the Sustainable Development Areas map (Santa Fe County 2015) reveals that development in SDA-2 areas may affect wetlands along the Tesuque Creek and Pojoaque River, in the fringes of the Santa Fe National Forest near Chupadero and Rio en Medio, along the Santa Cruz River, the Cañada de los Alamos, Galisteo Creek between I-25 and Lamy, Cañoncito Arroyo in the Eldorado Community Preserve, Arroyo Hondo, Gallina Arroyo, Coyote Springs, San Marcos Arroyo, the village of Galisteo, and the La Cienega area (see Figure 5). While SDA-1 areas are or will soon be served by drinking water from the municipal system, SDA-2 area will remain largely dependent on domestic wells. As a result, growth in the SDA-2 zone may have a considerable impact on groundwater drawdown which in turn may impair water supplies for wetlands in these areas and downstream.

Wetlands in development areas could particularly be affected by increased stormwater runoff from the developed land as this would likely increase the acreage of hardened surfaces with reduced water infiltration capacity. In addition, urban development usually increases local air temperature which leads to increased evaporation rates. Furthermore, despite protection measures in the city and county codes, urban development after the Army Corps determination of the May 25, 2023 SCOTUS decision on wetland protection could lead to increased construction in small, isolated wetland areas that have lost their federal protection.

Other forms of development, such as local mineral extraction (aggregate quarrying), possible mining in the Pecos Watershed, and road building in SDA-1 areas may degrade and fragment wetlands located downstream from these development areas as well as related headwater ecosystems upstream.

It must be noted, however, that in contrast to the looming water shortage in Santa Fe County described in the 2012 WAP, water source projections have dramatically improved. Despite the urban development increase, Santa Fe County appears to be prepared to respond to the rising water

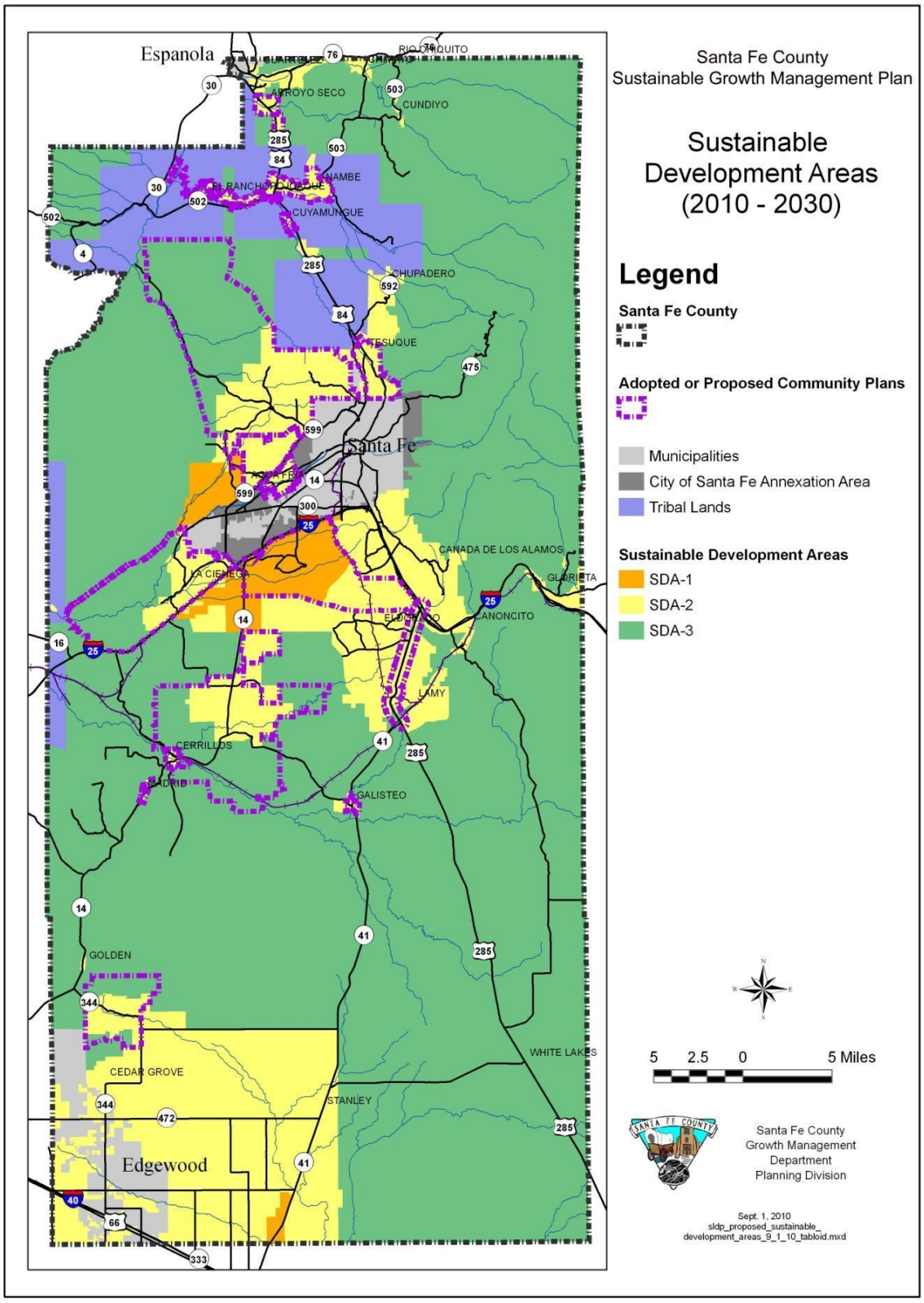

Figure 5. Santa Fe County Sustainable Development Areas Map (Santa Fe County 2010b).

need. Water levels in the city's wells and the Buckman wells have been rising since 2011 and both well fields were able to recover after overuse during the 1990s and 2000s. In 2011, when the city gained access to the San Juan-Chama water, began "a period of surface water dominated production" that relieved the pressure on the wells (https://santafenm.gov/SantaFe2021AnnualReport.pdf). As a result, by 2021, the city wells had regained 60 feet and the Buckman wells 510 feet of water after having dropped by 150' for the city wells and 600' for the Buckman wells by 2010.

Through the San Juan-Chama Project, the city and county have contracts that allow the Buckman Direct Diversion (BDD) to divert 5,605 acre-feet per year to Santa Fe. Around 56% of Santa Fe City and County potable water comes from the Buckman Direct Diversion and the San Juan-Chama Project (https://bddproject.org/history/san-juan-chama-project/). Despite continued population growth and demand, the City of Santa Fe has reduced its consumption through conservation policies since demand peaked in 1995 (City of Santa Fe Water Annual Report 2021).

Mountain water collected in the Santa Fe Watershed's McClure (3,257 AF) and Nichols (554 AF) reservoirs also provides water to the area population. However, these storage facilities are rarely at capacity because the watershed area seldomly receives enough snow or rain to reach the reservoir limits (https://santafenm.gov/SantaFe2021AnnualReport.pdf).

Despite the effectiveness of water conservation and the increase in groundwater levels in the county, the projected demand for surface water and/or groundwater resulting from projected urban development will continue to be a direct conflict with water needed to sustain wetlands, the Santa Fe River ecosystem, local agriculture, recreation, and other watershed needs. Additionally, the federal mandate to care for nationally listed endangered species in the Rio Grande, such as the Rio Grande silvery minnow and the southwestern willow flycatcher, for example by allocating water from the San Juan-Chama Project which is under federal control, may compound water shortage risks to all Rio Grande surface water users, and may further increase water supply stresses on wetlands outside the Rio Grande corridor, because providing adequate water and habitat in the Rio Grande corridor may reduce available surface water supply for all other uses in the basin (City of Santa Fe 2011b).

During dry years, diversion of ground water will likely affect flows to area wetlands. As climate change increases the chances of reduced river water in the Rio Grande and Santa Fe River and increased forest fire and pollution levels in rivers, there is a greater chance of using groundwater resources beyond the estimated minimum annual levels (Julie Ann Grimm, Santa Fe New Mexican, July 4, 2012). This is particularly a concern because established water conservation practices in households have little elasticity left in people's conservation options.

3.1.2. Adaptation Strategies to Urban Development

Wetland vulnerability to urban development and land use is dependent on the adaptive capacity of wetlands to the urban development and land use impacts. While wetlands are resilient ecosystems, the nature, severity and duration of the exposure to impacts, the sensitivity of individual wetland components, and the cumulative effects of repetitive impacts may negatively influence the adaptive capacity of wetlands to urban development impacts. Critical is that urban development and land use do not compromise the constant water recharge capacity of wetlands, the uninhibited connectivity to other riparian and wetland systems, and the size of the wetland and riparian ecosystems.

The natural adaptive capacity of wetland ecosystems can be enhanced with the establishment of planned and/or engineered adaptation strategies. Such strategies may include the reintroduction of beaver and the development of buffer zones around the wetlands, including peak flood absorption zones that reduce the volume, energy, and pollution from sudden urban storm water floods into wetlands (Environmental Law Institute 2008). Other strategies include urban storm water management and induced water infiltration systems in urban and natural uplands. Since the 2012 WAP, many entities, such as the BLM, the City of Santa Fe, and Santa Fe County have put in place or detailed their regulations and guidelines to encourage such strategies (BLM 2012, City of Santa Fe 2011a: http://clerkshq.com/default.ashx?clientsite=Santafe-nm, Santa Fe County 2015, Santa Fe County 2016). The new regulations and local regulatory protections will serve as a boost to the human-supported adaptation capacity of wetlands in Santa Fe County.

The complexity of urban development impacts on wetland conditions and the many variables in the planning processes, mitigation options, and wetland sensitivity, leave a large degree of uncertainty in adaptive responses of wetlands to urban development impacts. Coupled with the projected impacts caused by a changing climate and changing regional ecosystems, the uncertainty of the adaptive responses of wetlands to urban development is further increased. The uncertainties in urban development trends, climate trends, and wetland adaptation capacity increase the importance of monitoring urban development in Santa Fe County, including monitoring of groundwater extraction associated with development, as well as monitoring of cumulative impacts on wetlands of development and climate change.

3.2. Ecological and Climate Change Vulnerability Assessment

Climate and weather trends are affecting wetlands in association with topographic conditions, groundwater and surface water flows, soil health, vegetation, and animal life. Climate change is a driving factor in the other ecological conditions that work together with weather to support or fail the health of wetlands.

The following ecological and climate change vulnerability assessment describes resource sensitivity, exposure, and adaptability to ecological and climate impacts that could force change

or deterioration of wetlands resources based on the approach described by Glick et al. (2011). Vulnerability to climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as "the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change" (Pg. 783 of IPCC, chapter 19, Schneider et al. 2007, Lewis et al. 2012). The purpose of defining wetland vulnerabilities to climate change is to assess how to make wetlands less vulnerable and, thus, more resilient and adaptive to systemic change.

3.2.1. Future Wetland Exposure to Climate Change

Wetland vulnerability due to climate change is primarily temperature driven, and climate change impacts on wetlands are expected to occur even if there are no significant changes in annual precipitation. While the anticipated impacts should be considered certain, they are based on modeling, which provides us with projections rather than predictions. The models can tell us about threats to general areas in certain time frames. However, they are unable to definitively predict the location, magnitude, pace or timing of climate impacts on specific wetlands. Other uncertainties are related to future greenhouse-gas emissions, human behavior, population projections, energy sources, economic forecasts, and technological changes.

According to a number of studies for the Southwest (Gutzler and Robbins 2010, Gutzler 2012, DeBuys 2011, Moeser et al. 2020, Moeser et al. 2021, Dunbar et al. 2022, Mankin et al. 2022), and for the Rio Grande Basin and the Santa Fe Watershed, as described by Lewis et al. (2012), the projected impacts of climate change on wetlands include, among others:

- **Aridification**
- **More extreme precipitation events and increased wildfire risk**
- **Changes in vegetation communities**

Aridification: Global climate models project a transition to a much more arid climate in the Southwest by the mid-21st Century, primarily due to increasing rates of evaporation and increasing water use by plants, which will result from the projected higher temperatures (Lewis et al. 2012, DeBuys 2011, Dunbar et al. 2022). The 2017 U.S. Climate Science Special Report projects that if yearly emissions continue to increase rapidly, as they have since 2000, global temperature will be at least 5°F warmer than the 1901-1960 average and possibly as much as 10.2°F warmer. If annual emissions increase more slowly and begin to decline significantly by 2050, models project temperatures would still be at least 2.4°F warmer than the first half of the 20th century and possibly up to 5.9°F warmer. Furthermore, 2020 surface temperature, averaged across lands and oceans, was 1.76°F (0.98° Celsius) warmer than the twentieth-century average of 57.0°F (13.9°C) and 2.14˚F (1.19°C) warmer than the pre-industrial period (1880-1900) (Lindsey and Dalhman 2021). Evaporation and plant water use are directly related to surface temperature, as warmer air holds

more moisture. Hence, the projected changes in temperatures will significantly increase evaporation, leading to plant die off and increasing drought conditions on the ground.

Trends in climate change for the Rio Grande Basin are projected to lead to increases in average annual temperatures of 5° to 7°F between 2022 and 2072 (Dunbar et al., 2022). The greatest change in temperature would be an increase in average winter temperatures, leading to reduced snowpack, reduced number of days with snow on the ground, and earlier and heavier snowmelt runoff. As a result, annual runoff for the Rio Grande area is expected to decrease by approximately 10% by 2050, for both December-March runoff as well as for April-July runoff (USDI, 2011, and Moeser et al., 2021). However, under more aggressive runoff models, the annual cumulative runoff could also increase later this century (Moeser et al., 2021). Due to temperature increases in the summer, the potential evaporation rate would increase, extracting more moisture from the soil and water bodies.

More extreme precipitation events and increased wildfire risk: Climate models for the Southwest project that long-range precipitation volumes would not change much from current volumes, but the intensity and variability of precipitation is projected to increase (USDI 2011, Dunbar et al. 2022, Mankin et al. 2022). Overall, weather patterns and weather phenomena are expected to become more erratic, less predictable, and more extreme. In general, the changing climate will lead in the next few decades to reduced stream flow due to greater water losses due to evaporation and less runoff, including reduced annual runoff for the Rio Grande area. This may lead to an increased need for groundwater pumping for agricultural and urban needs and potential depletion of aquifers that support springs and wetlands. The more extreme weather conditions are likely to lead to more severe and more frequent droughts.

The climate models also predict that winter snowpack will diminish, accompanied by earlier spring snowmelt of existing snowpack, earlier peak snowmelt runoff, and heavier snowmelt runoff. This will likely result in drier spring seasons and increased general aridity. Peak storm flows from summer storms and snowmelt runoff are likely to increase with an accompanying potential for more sediment transport and erosion and declining aquifer recharge in between periods of prolonged drought.

However, a recent study for New Mexico mentions that, averaged over 20 climate models, in winter the northern mountains are on a trend to receive a little more precipitation (Dunbar et al. 2022). While this may potentially be beneficial for wetlands, increasing evaporation and plant water use due to higher temperatures and decreasing average surface runoff and groundwater recharge are likely to counteract or exceed any winter precipitation increases if no measures are taken to increase the effectiveness of snow accumulation in the mountains and water infiltration across the landscape. It can be expected that irrigation water demand and riparian water consumption will increase, which will most likely result in non-irrigated vegetation becoming

increasingly water stressed (Lewis et al. 2012). As a result, there will be an increase in the total area and frequency of occurrence of bare soil and erosion.

Additionally, Dunbar et al. (2022) document that there is a projected tendency for the monsoon season to shift toward later dates, both in terms of its onset and its end. This may mean that the spring season will be longer and hotter, causing greater and more prolonged evaporative losses and declining soil moisture (Dunbar et al. 2022).

A hotter, drier, and longer spring season will increase stresses on cool season plants and lead to more prolonged and more intense fire risk in the spring. As a result, the risk of wildfire in dry woody biomass along wetlands can be expected to increase in drying wetlands with many woody plants.

The vulnerability of groundwater supply to climate change is less well understood than surface water vulnerabilities because the mechanisms and timing of groundwater recharge are more difficult to quantify. Climate change projections suggest future precipitation would be delivered in fewer, more intense events, giving the above-ground flow less time to infiltrate into the aquifer. Potential reductions in groundwater recharge coupled with an increase of people's dependency on groundwater resources due to a reduction in runoff volumes in rivers, lakes, and reservoirs, may thus lead to increased water shortages in wetlands.

Climate change impacts on wetlands would affect nearly all wetlands in Santa Fe County (see Table 2.4). The Montane Forest wetlands in the Sangre de Cristo Mountains would be affected by reduced snow fall, more rapid snowmelt, and the potentially devastating effects of catastrophic wildfire. Riverine wetlands along the Tesuque Creek, Santa Fe River, Arroyo Hondo, and Galisteo Creek would be affected by greater periods of low-flow or no flow and by more frequent overbank flood events. While flooding is important to riparian habitat function, excessive peak flows may undermine and destroy wetland ecosystems that lack sufficient buffers for flood attenuation. More frequent severe drought periods would be particularly damaging to many riverine wetlands. Depressional wetlands may also be impacted by sedimentation from eroding uplands and increased evaporation losses. Slope wetlands, such as the springs in the La Cienega area and many springs in low mountains and hills across the County, would most likely be impacted by reduced groundwater recharge, which, along with continued pumping of the aquifer, could reduce the flow into many of the area's wetlands (Lewis et al. 2012).

Changes in vegetation communities: The trend toward increased aridification will include greater stresses on water supplies in wetlands and riparian areas. As a result, wetlands sensitive to the increased evaporation losses may dry up, wetland vegetation may die and disappear, and wetland ecosystems will show reduced habitat functions for aquatic and terrestrial species of plants and animals.

The projected climate trends constitute a greater exposure of wetlands in Santa Fe County to evaporative water losses from open waters. Variability of water inflow from precipitation, runoff, or overbank floods into wetlands would increase, leading to longer periods of minimal water inflow and to occasional flood events with higher energy and volumes of water. As a result, in certain areas, wetlands may thrive, while in other areas wetland vegetation may shift from obligatory wetland species to facultative species and even a mixture of upland species that are tolerant to occasional flooding.

Projected climate change effects would impact biodiversity and many wildlife and plant species associated with or dependent on wetlands. Increasing transpiration rates would over time put greater stress on wetland plants when transpiration exceeds water availability. Non-native, invasive plants, such as Russian olive and saltcedar (tamarisk), that are adapted to drought conditions will gradually increase to the detriment of native obligate wetland plants, such as cottonwoods, willows, sedges, and rushes.

Riparian areas and wetlands are vital to many species, especially many federally listed endangered species, and many Species of Greatest Conservation Need (SGCN) and the State Wildlife Action Plan (SWAP; NMDGF 2016). As free roaming opportunities for animals are increasingly curtailed by fragmentation of riparian areas and wetlands due to (ex)urban and infrastructure development, local effects of a changing climate are likely to lead to greater competition for access to water, food, and shelter among individual animals. As temperatures rise, the number of hours in a day when an animal may be active will likely be reduced, thereby reducing their ability to forage and hunt (Lewis et al. 2012). If habitat area diminishes due to vegetation loss and ecosystem degradation as a result of warmer temperatures and human activities, migration pathways (i.e., the connections between habitats) become smaller or disappear, placing an additional burden on animals already stressed by development and changing climatic conditions.

A more detailed review of climate change impacts on wetlands is included in Section 2.5.2. and Appendix B.

3.2.2. Adaptation Strategies to Climate Impacts

The capacity of wetlands to adapt to climate change is limited under climate change projections that involve increasing losses of effective water availability due to evaporation, reduced groundwater supplies, more irregular surface water in-flows, and longer periods of drought between flow events. Some riverine wetlands may be able to adapt to and even thrive as a result of increasing ecological dynamics caused by flooding and sediment deposition. However, bank erosion, channel degradation, and sediment deposition will in many cases lead to the drying or alteration of the soil profiles in wetlands and riparian areas and the decline of hydrophytes.

When climate stressors exceed the natural resilience of wetlands, human interventions may bring some relief. Adaptation strategies that could benefit wetlands include forest management

interventions that increase snow accumulation and prolong the melt out date of snow in headwater mountain areas (Moeser et al. 2020), forest management aimed at wildfire risk reduction, management of streams and riparian areas in ways that increase shading and overbank flows (i.e., flood plain connectivity), regional soil health campaigns that improve soil health and soil water storage capacity landscape-wide, and strategies that stimulate vegetation health and cover by diverse communities landscape-wide. The effect of these strategies is that they will likely retain more snow over a longer period in the mountains; counter evaporative water losses; help spread, infiltrate, and store water in the soil; and cumulatively moderate local micro-climates and their effect on the water balance in the landscape. To achieve meaningful effects through adaptation strategies that increase wetland resilience to climate impacts, a landscape-scale approach is essential. In the near future, ongoing research will help confirm where and how forest landscape treatments could influence forest structure in ways that increase snow water resources and regulate water availability for downstream water users (https://www.sciencebase.gov/catalog/item/6000c395d34e592d8671f605 and https://www.sciencebase.gov/catalog/item/637682b3d34ed907bf6d8712).

4. Current Status of Wetland and Riparian Resource Management

4.1. Recent Accomplishments in Wetland Protection and Restoration

In the period between 2012 and 2023, several accomplishments have been made in protecting and restoring Santa Fe County wetlands. The accomplishments include gains in increased restoration and protection capacity and in tangible improvements of ecological and hydrological conditions of a considerable number of wetlands and rivers in the county.

Important accomplishments in relation to the goals of the 2012 WAP include:

Pertaining to the overall goal of the 2012 WAP: *... the development of County regulations and local and regional implementation projects for the establishment of buffer zones for wetlands, storm water infiltration, stream and floodplain restoration (e.g., through beaver reintroduction), and reduction of the County population's dependency on groundwater, as well as local regulations and actions to protect habitat and connectivity between wetland ecosystems.*

- The City of Santa Fe and Santa Fe County have made significant progress with water consumption reduction and groundwater recharge through their collaboration on conjunctive use strategy of its water sources and groundwater levels have risen again.
- Santa Fe County has completed seven open space management plans, specific riparian resource management plans, and a Strategic Open Space Management Plan that help the county direct wetland and stream restoration and protection on all its open space properties.
- The updated 2016 SLDC of Santa Fe County includes additional wetland protection measures.
- Santa Fe County has developed a Transfer of Development Rights (TDR) program that removes development rights from a piece of land. This mechanism could benefit wetland protection.

Pertaining to Goal 1: *Complete the information baseline about wetlands for Santa Fe County.*

- Completion of online NWI mapping by the U.S. Fish & Wildlife Service and the production of a wetland map for Santa Fe County by SWQB has aided in identifying many wetlands and streams with wetland qualities in Santa Fe County.
- In association with several wetland restoration projects, SWQB and partners implemented several baseline wetland assessments and project monitoring activities, for example, for several high mountain wetlands ("Wetland Jewels"), the wetlands at Los Potreros Open Space, the riverine wetlands of the Galisteo Bosque, certain riverine wetlands along Galisteo Creek between Galisteo and Cerrillos, several isolated wetlands in the Galisteo Basin, and wetlands along San Pedro Creek.
- New Mexico Forestry Division conducted mapping of springs and wetlands and completed the 2020 New Mexico Forest Action Plan, which provides baseline information and

guidelines for forest restoration and wildfire prevention planning that will help protect wetlands.

Pertaining to Goal 2: *Establish a monitoring program for data upkeep on status and trends of existing wetlands in Santa Fe County and share and disseminate findings.*

- SWQB developed the NMRAM methodology, and several partners have used the NMRAM for baseline assessments and follow-up monitoring of wetland conditions, such as for the wetlands at Los Potreros Open Space and several Wetland Jewels in mountain headwaters.

Pertaining to Goal 3: *Identify Santa Fe County as the pilot area to adopt statewide procedures and strengthen processes that protect wetlands through regulatory measures.*

- According to the 2021 Wetlands Program Plan, the "SWQB nominated, and the Water Quality Control Commission (WQCC) adopted all naturally occurring wetlands within US Forest Service Wilderness Areas in New Mexico as Outstanding National Resource Waters (ONRW) in 2009." These wetlands include the isolated mountain wetland and lacustrine fringe wetlands (identified as "Wetland Jewels") in headwater catchment areas in the Sangre de Cristo Mountains (SWQB 2021).
- Santa Fe National Forest with support from Amigos Bravos updated the Santa Fe National Forest Management Plan to protect and restore keystone wetlands on the national forest.
- In 2020, the Carson National Forest, Cibola National Forest, Santa Fe National Forest, and Kiowa National Grasslands completed an Environmental Assessment (EA), followed in July 2021 by a Decision Notice and Finding of No Significant Impact (FONSI) for restoration initiatives in riparian, aquatic and wetland areas on each of the three national forests.

Pertaining to Goal 4: *Support federal, state, tribal, and local government agencies in the enforcement of regulations and in offering comments during public review processes of proposed actions that potentially impact wetlands in Santa Fe County.*

- Several regional conservation organizations and citizen activists have shared public comments on proposed actions, mostly related to initiatives on national forest lands, regarding the need to protect streams and wetlands.

Pertaining to Goal 5: *Achieve restoration and protection of high priority wetlands by 2020.*

- Wetland meadows at Los Potreros Open Space in Chimayo (Santa Fe County Open Space; approx. 10 acres of emergent palustrine wetlands)
- Riverine wetlands and riparian areas along the Rio Quemado at the Los Potreros Open Space in Chimayo (Santa Fe County Open Space; 2.5 acres of riverine wetlands)

- Riverine wetlands and riparian areas along the Santa Cruz River at the Los Potreros Open Space in Chimayo (Santa Fe County Open Space; 1.2 acres of riverine and emergent palustrine wetlands)
- Headwater "wetland jewels" on the Santa Fe National Forest, including the Lake Katherine area with 54 acres of wetlands, the Rito Oscuro area (spanning Santa Fe, San Miguel, and Mora Counties) with 63 acres of wetlands, many of which are located in Santa Fe County (such as Johnson Lake and the headwater wetland of Rito Oscuro), and the Santa Fe Baldy area with 71 acres of wetlands, such as Nambe Lake (Amigo Bravos; see also https://www.amigosbravos.org/wetland-jewels-protection-and-restoration/ and https://smumn.maps.arcgis.com/apps/MapSeries/index.html?appid=70a492acfe8b415dba825a7866bb5afb)
- River and wetland restoration of the Upper Santa Fe River above Two Mile Pond (approx. 0.5 miles)
- Restoration of the Santa Fe River between Camino Carlos Rael (Frenchie's Field) and Siler Road and erosion control, revegetation, and rain garden development along this reach and several other riparian areas of the Santa Fe River (approx. 2 miles)
- Arroyo cleanups and rain garden development along various arroyos in the City of Santa Fe by the Santa Fe Watershed Association and partners (>5 miles)
- Restoration of pond vegetation at the Marty Sanchez Links de Santa Fe Golf Course
- Restoration and invasive vegetation removal at Leonora Curtin Wetland Preserve in La Cienega (approx. 2 acres)
- Wetland and riparian area restoration in a tributary of the Arroyo de los Angeles, at the Conservation Homestead near Lamy (Santa Fe Conservation Trust; approx. 0.2 miles; <1 acre of wetlands)
- Restoration of the Galisteo Creek Bosque Wetlands in the Village of Galisteo (0.9 miles on private properties in Galisteo; 24 acres of wetlands)
- Restoration of a Galisteo Creek meander on a private property along General Goodwin Road (approx. 0.125 miles).
- In early 2023, an agreement between the City of Santa Fe and Wild Earth Guardians safeguarded water flows in the Santa Fe River below the WWTP to protect and restore wetlands along the Santa Fe River (see below).

Pertaining to Goal 6: *Further develop and support the institutional capacity for wetland restoration and protection in Santa Fe County.*

- The 2023 Legislature of the State of New Mexico established the Land of Enchantment Legacy Fund and the Conservation Legacy Permanent Fund. As of 2025, these funds will provide permanent state funding for river stewardship, protection of listed fish and wildlife species and their habitat, forest and watershed health, soil health, noxious weed management, cultural resource protection, and outdoor recreation programs.

- The 2023 Legislature also established additional funding for the State's Strategic Water Reserve.
- Santa Fe Conservation Trust has expanded its capacity for accepting conservation easements that could protect wetlands.
- Three national forests (Carson, Santa Fe, and Cibola National Forests) have completed an Environmental Assessment (EA) that facilitates protection and restoration measures for riparian and wetland areas on national forest lands under their jurisdiction.
- The Nature Conservancy and a large group of partners established the Rio Grande Water Fund for the protection of watersheds, streams and forests in the Upper Rio Grande Basin.
- The Santa Fe National Forest, in collaboration with the Greater Santa Fe Fireshed Coalition, prepared and completed an EA for The Santa Fe Mountains Landscape Resiliency Project, which aims to protect and restore forest and watershed health in the mountain forests between Glorieta/La Cueva and Rio En Medio.
- Many local and regional institutions and organizations have developed studies, plans, and strategies in response to climate change impacts which are likely to have positive protective and restorative effects on rivers and wetlands.

Pertaining to Goal 7: *Educate the public and develop public support, buy-in, and a donor base for wetland restoration, and develop wetland stewardship through an Adopt-a-Wetland program.*

- In early 2023, the Santa Fe Watershed Association, in collaboration with Utah State University, completed a comprehensive stakeholder survey about goals, preferences and priorities regarding the protection and restoration of water sources and watersheds in the greater Santa Fe area.

Pertaining to Goal 8: *Develop water quality standards for wetlands with those in Santa Fe County as a case study for meeting this goal across the State of New Mexico.*

- No information available about accomplishments

4.2. Current Status of Wetland Assessments, Mapping, Monitoring, and Regulations

4.2.1. Status of Assessments, Mapping, and Monitoring

Monitoring of wetlands in Santa Fe County is limited to monitoring activities associated with individual wetland or stream restoration projects and implemented through individual project teams. When funded through the SWQB with EPA funding, monitoring is guided by a Quality Assurance Project Plan (QAPP).

In the last decade, the SWQB in collaboration with the Natural Heritage New Mexico Division of the Museum of Southwestern Biology at UNM Wetlands Program and SWCA Environmental Consultants developed and tested a series of systematic assessment and monitoring protocols for

New Mexico's wetlands, the New Mexico Rapid Assessment Method (NM RAM). Several guides for specific wetland types are available on the NMED website (https://www.env.nm.gov/surface-water-quality/wetlands-rapid-assessment-methods/). In 2023, the NMED Wetlands Program made the NM RAM for Montane Riverine Wetlands version 2.5 available. A NM RAM for Montane Riverine Wetlands (v.2.4) has been used to assess the wetlands at Rio Quemado in 2021 and will be used in a final assessment in 2023.

After 2011-2012, SWQB undertook a wetland mapping project for topographic map quadrangles in northern New Mexico, including the Aspen Basin, McClure Reservoir, and Glorieta quadrangles, and quadrangles in Rio Arriba and San Miguel Counties that overlap with Santa Fe County. Recently, other quadrangles have been completed, such as Sierra Mosca, covering the Outstanding National Resource Waters in Santa Fe County (an interactive map with wetlands mapped in Santa Fe County can be viewed at: https://gis.web.env.nm.gov/oem/?map=wetlands).

In 2015, NMBGMR updated and expanded a 2012 mapping project of wetlands in the La Cienega area (U.S. Fish and Wildlife Service 2011, McGraw and Jansens 2012, Johnson et al. 2016) and implemented a groundwater monitoring network around La Cienega (Figure 6). The many years of groundwater data in the region show that the groundwater feeding the wetlands is highly susceptible to regional influences such as pumping, drought, and land use changes. NMBGMR continued groundwater level monitoring in years following and has published its results (https://geoinfo.nmt.edu/geoscience/research/home.cfml?id=33).

4.2.2. Status of Wetland Management Responsibilities and Regulations

Wetland protection, management, and restoration responsibilities are spread over all levels of government. As a result, wetlands throughout Santa Fe County have protected status based on federal and state law, county and city codes, tribal regulations, and depending on landownership and the discretionary determination of protections provided by the U.S. Army Corps of Engineers.

Wetlands are surface waters of the State of New Mexico, and as such are protected under 20.6.2 NMAC (Title 20 Environmental Protection, Chapter 6 Water Quality, Part 2 Ground and Surface Water Protection), and included in 20.6.4 NMAC, New Mexico's Water Quality Standards. The State of New Mexico provides technical and financial incentives programs to encourage landowners, NGOs (e.g., watershed groups), and local government agencies to document, restore, protect, and monitor wetlands.

Physically and/or legally protected wetlands in Santa Fe County occur also on federal lands especially in Wilderness Areas (such as the Pecos Wilderness), as Outstanding National Resource Waters, and in BLM Areas of Critical Environmental Concern (ACEC). Federal wetland protection extends to all natural wetlands in Waters of the United States, as defined by the U.S. Army Corps of Engineers (ACE), that are delineated as jurisdictional or that are potentially

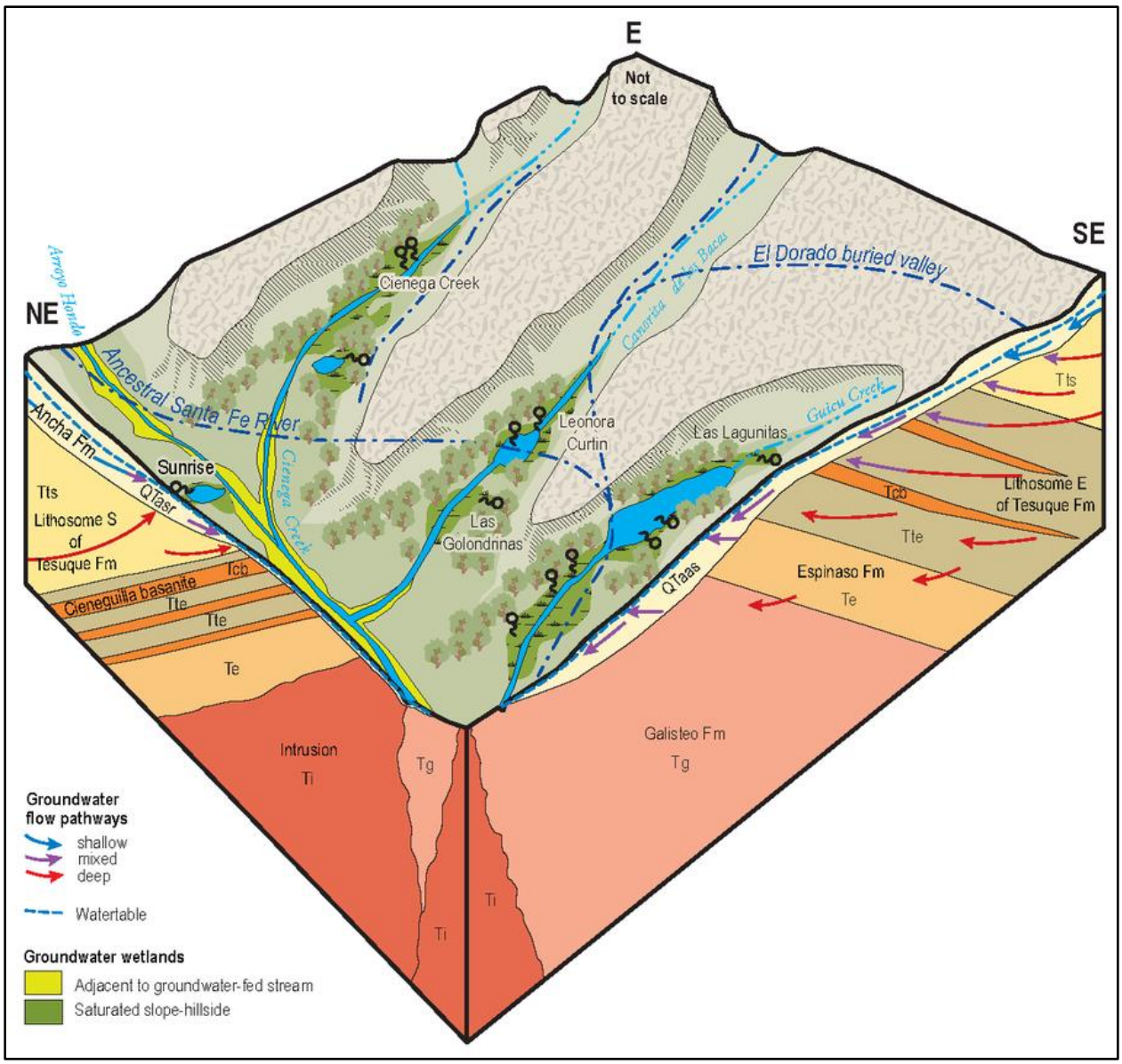

Figure 6. Block diagram depicting the groundwater system that feeds the wetlands in and around La Cienega, New Mexico (NM Bureau of Geology and Mineral Resources 2016).

jurisdictional (but not yet delineated) (Jones 1997) under the Clean Water Act and as amended by SCOTUS on May 25, 2023.

The majority of wetland acreage in Santa Fe County is located on private lands (see Table 2.1) and are only protected if specific covenants exist that limit development, such as those governing the Eldorado Community Preserve, or if the U.S. Army Corps has determined its protective status under its discretionary interpretation of the law. Additionally, wetlands are protected in Santa Fe County Open Space areas and in areas covered by conservation easements.

It goes beyond the scope and scale of this 2023 WAP Update to determine the exact number of jurisdictional wetlands or the acreage of wetlands in Santa Fe County. However, from field observations, it becomes clear that many wetlands in Santa Fe County are rather small (a few acres) and scattered across the landscape. Due to the largely rural and wilderness character of Santa Fe County, few wetlands have been officially delineated to determine their jurisdictional status. Most jurisdictional wetlands in Santa Fe County have been documented as a result of urban development and infrastructure projects and a few ecological restoration projects.

Federal Wetland Management in Santa Fe County

Federal agencies that have some regulatory responsibility or terrain management responsibility for wetlands in Santa Fe County include:

- U.S. Army Corps of Engineers: regulatory oversight of Clean Water Act Section 404 permitting regarding dredge and fill in waters of the United States, including wetland protection and mitigation of destruction brought upon wetlands due to public and private development and infrastructure projects (see below)

- USDI Bureau of Land Management (BLM): terrain management responsibility for wetlands and riparian areas on BLM lands (see below)

- USDI Bureau of Reclamation: terrain management responsibility for certain water bodies and water conservation initiatives, including initiatives under the Landscape Conservation Cooperatives program pertaining to Santa Fe County

- USDHS Federal Emergency Management Administration (FEMA): regulatory oversight of floodplains and disaster management support to insured local government entities (see below)

- USDI Fish and Wildlife Service: terrain management responsibility for wetland and riparian habitat, especially for habitat of threatened and endangered species

- USDA Forest Service: terrain management responsibility for wetlands and riparian areas on national forest lands

- USDA Natural Resources Conservation Service: terrain management responsibility for wetland restoration on private agricultural land

Army Corps of Engineers (ACE) – Section 10 of the 1899 Rivers and Harbors Act gives the ACE authority to regulate certain activities in navigable waters. Section 404 of the 1972 Clean Water Act and its amendments authorizes the ACE to issue permits regulating the discharge of dredge and fill material into wetlands and streams. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency (EPA), while the U.S. Fish and Wildlife Service has

review and advisory roles. Section 401 grants to states and eligible Indian tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effect on the water quality of a wetland (Jones 1997). Many activities that affect small acreages or that involve particular kinds of construction or development activities are authorized under generic Section 404 "general permits" or "nationwide permits" with minimal scrutiny and standard conditions (Environmental Law Institute 2008).

In Santa Fe County, ACE manages the Galisteo Dam and Reservoir, west of the Village of Cerrillos. This flood and sediment control dam was completed in 1975 to prevent sediment caused by accelerated soil erosion in the Galisteo Basin to pollute waters of the Rio Grande. The dam also helped stem accelerated channel degradation in Galisteo Creek. The dam was remodeled in 1998. The Galisteo Dam Reservoir includes several small wetlands at its southern fringes. Between 2008 and 2012, ACE removed several hundreds of acres of salt cedar in the Reservoir using goats and herbicide and protected the wetlands from stray cattle grazing impacts with fencing.

BLM - In May 2012, BLM issued the Taos Resource Management Plan (RMP) for its management area that covers north-eastern New Mexico including Santa Fe County (BLM 2012). This RMP does not specify any specific goals, targets, policies, or strategies (or "general management guidance" in terms of the RMP) regarding wetland restoration or protection in BLM's multi-county management area. However, the RMP addresses wetland management and protection measures in various sections regarding other resources and land uses. For example, in relation to fish and wildlife management, the RMP lists goals, objectives, and general management guidance for stream management. In relation to the management of vegetation communities, wetlands are addressed in relation to riparian areas with goals, objectives, and general management guidance that specify that BLM aims to maintain healthy watersheds and landscapes and plans to manage wetlands in ways that move toward or maintain Proper Functioning Conditions of wetlands for wildlife species. In relation to water management, the RMP specifies that BLM will maintain highly functioning water conditions regarding physical, chemical, and biological parameters. The RMP also states that BLM will "restore, maintain, and preserve natural water fluctuations of floodplains", which typically are essential for healthy wetland functions.

The RMP provides a basis for the development of restoration plans with Environmental Assessments to guide actions. BLM plans to maintain and develop partnerships to develop and implement watershed restoration projects and pursue funding opportunities to complete projects. Specifically, the RMP aims to have BLM reduce channel instability by 50% over the life of the RMP, although no planning timeline is given. The RMP also includes specific general management guidance that will benefit wetlands regarding the removal of invasive species, livestock management, forest management, and the procedures for environmental assessments and impact statements. For example, the RMP states that BLM will where possible maintain livestock exclosures along streams and riparian and wetland areas. Additionally, BLM plans to maintain and establish "no surface occupancy", i.e., buffer zones, of 200 m (more than 600 feet) of the outer

edge of the 100-year floodplain or potential riparian and wetland edges. For specific management areas, the RMP specified that wetlands will remain unavailable for livestock grazing. Wetlands must be considered and described in BLM's environmental assessments and environmental impact statements for projects such as land exchanges and forest management and thinning programs. Furthermore, the RMP states that "Bureau policy is to retain wetlands in Federal ownership unless Federal, state, public and private institutions and parties have demonstrated the ability to maintain, restore, and protect wetlands and riparian habitats on a continuous basis (BLM Manual 6740)" (BLM 2012).

Bureau of Reclamation (BOR) – BOR operates a Riparian and Wetland research program located at Reclamation's Technical Service Center in Denver, CO, that combines numerous scientific and engineering disciplines to help understand and manage natural riparian and wetland ecosystems. These teams of experts are also involved in the design, construction, and operation of constructed wetland systems to provide for both water treatment and wildlife habitat. This program involves, and is not limited to, activities in (1) understanding and management of large water delivery and related systems for the protection of riparian plant and animal communities; (2) evaluation of environmentally sound techniques for wetland vegetation eradication or restoration; (3) proper design and operation of constructed wetlands for the improvement of water quality to non-point source pollution and wastewater effluent; and (4) proper selection of vegetation, planting schemes, and habitat features that are suitable for important wildlife and waterfowl species. The riparian and wetland research program includes cooperative efforts with other agencies including the U.S. Geological Survey's Fort Collins Science Center, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, state fish and game agencies, water resource agencies, universities, city and local departments, and private contractors. (http://www.usbr.gov/pmts/eco_research/eco3.html).

In addition, BOR's WaterSMART program mobilized several entities within Santa Fe County to submit applications and complete projects that likely support wetland protection and restoration in Santa Fe County. Since 2010, the city and county received several WaterSMART grants for research and feasibility studies on surface water storage, water conservation, stormwater management and use and treated effluent use in the city and county. In 2014, the city and county produced a feasibility study to optimize the use of regionally reclaimed wastewater. In 2020, the Santa Fe Watershed Association received a WaterSMART grant and produced two reports in 2022 and 2023 with findings of a stakeholder assessment on their perceptions, needs and wishes regarding key watershed concerns. In 2021, the City of Santa Fe received funding for a water reclamation and reuse program in association with the construction of an aquifer storage and recovery system based on the San Juan-Chama Diversion as part of its long-term water supply planning process.

Federal Emergency Management Agency (FEMA) – Federal regulations overseen by FEMA also require local governments that have established FEMA endorsed flood management plans,

such as the City of Santa Fe and Santa Fe County, to follow procedures for construction, including grading and ecosystem restoration activities, in nationally recognized and mapped floodplain areas (FEMA 2011).

Fish and Wildlife Service (FWS) – FWS oversees federal regulations for the protection of federally listed species and their critical habitat. FWS also operates grant programs that offer support to landowners for the restoration and protection of critical habitat, which often constitutes wetlands and riparian areas. FWS supports other federal and state agencies with expertise, mapping, and technical support for species and habitat protection. In the past decade, FWS has been instrumental, in collaboration with the NMED Surface Water Quality Bureau (SWQB) Wetlands Program, in mapping wetlands in Santa Fe County that have been included in the online NWI map database. In Santa Fe County, FWS is specifically involved in the protection of wetland habitat for federally listed threatened or endangered species, such as the Southwest willow flycatcher and yellow-billed cuckoo. FWS has also been supporting a series of wetland and riparian habitat improvement projects in Santa Fe County under its Partners for Wildlife Program.

Forest Service (USFS) – USFS is responsible for the restoration, protection and day-to-day management of wetlands and riparian areas on national forest lands. In Santa Fe County, these include the mountain streams in the Sangre de Cristo Mountains and Jemez Mountains and the streams and wetlands on the Caja del Rio Plateau and Glorieta Mesa on the Santa Fe National Forest. Several of these streams located in USFS Wilderness Areas, such as the Santa Cruz River, have been designated in 2010 as Outstanding National Resources Waters (ONRW). ONRW streams and wetlands represent, for example, waters that are a significant attribute of the State's gold medal trout fishery, are in a designated wilderness area, are part of a designated wild river under the federal Wild and Scenic Rivers Act or are of otherwise ecological significance. ONRW streams and wetlands are entitled to the highest protection under the New Mexico Water Quality Act and the surface water quality standards of the New Mexico Water Quality Control Commission (WQCC) and receive special protection from USFS under this title.

In 2020, the Carson National Forest, Cibola National Forest, Santa Fe National Forest, and Kiowa National Grasslands completed an Environmental Assessment (EA), followed in July 2021 by a Decision Notice and Finding of No Significant Impact (FONSI) for restoration initiatives in riparian, aquatic and wetland areas on each of the three national forests. The three national forests worked together to increase the pace and scale of riparian, wetland, and aquatic ecosystem restoration by identifying a broad range of projects. Projects covered by the EA range from channel reconstruction and streambank restoration to planting riparian species and restoring beaver habitat. The EA and Decision Notice and FONSI provide a more efficient process to accelerate project implementation using well-established tools and project-specific design criteria for five main types of projects, including projects to improve passage for aquatic species, instream, side-channel and floodplain projects, riparian vegetation treatments, road and trail erosion control, and restoration of seeps and springs (USFS 2020 and USFS 2021).

Furthermore, in line with the model of the Rio Grande Water Fund and other programs elsewhere in the nation, the US Forest Service has introduced landscape scale planning through the Collaborative Forest Landscape Restoration Program (CFLRP), the Shared Stewardship Initiative in collaboration with State Forestry Divisions, and the Shared Stewardship Priority Landscape Initiatives (Enchanted Circle Priority Landscape), coupled with a focus on forest management for long-term water security. As a result, national forest management in northern New Mexico currently includes a new CFLRP initiative for the Chama River basin and a recently completed one for the Southwest Jemez Mountains, the recently approved Santa Fe Mountains Landscape Resiliency Project, and forestry activities in association the Rio Grande Water Fund which all contribute to enhanced surface- and groundwater supplies and water quality by preventing landscape-wide, high-severity wildfires.

State Wetland Management in Santa Fe County

Several State agencies have some regulatory responsibility or terrain management responsibility for wetlands in Santa Fe County based on the State's role in the CWA Section §404 permit/§401 certification process. State agencies involved in wetland restoration and protection include:

- New Mexico Environment Department, Surface Water Quality Bureau (NMED/SWQB), Wetlands Program: Wetlands program management and development as part of the state's activities regarding water quality standards development and watershed protection activities (see below).

- New Mexico Energy, Minerals and Natural Resources Department (EMNRD): the EMNRD Oil Conservation Commission oversees regulations that limit the impacts of oil and gas operations on water quality and wetlands in the State.

- New Mexico Department of Transportation (NM DOT): responsible for avoidance, minimizing, and mitigation of impacts on wetlands as a result of infrastructure development.

- New Mexico Department of Game & Fish (NMDGF): responsible for management of protected species, both harvested and not, which can include conserving crucial habitats and connective linkages, such as wetland and riparian areas.

Surface Water Quality Bureau, Wetlands Program

According to the 2021 Wetlands Program Plan for New Mexico (EPA Approval May 2021), the mission of the SWQB Wetlands Program is to protect, restore and increase self-sustaining and naturally functioning wetlands and riparian areas (SWQB, 2021)[6]. The Wetlands Program

[6] https://www.epa.gov/system/files/documents/2022-02/2021-new-mexico-wetlands-program-plan-2021-to-2025.pdf.

emphasizes the role of wetlands in preventing and reducing water quality impairments and providing habitat and life requirements for wildlife. To this end the Wetlands Program has formulated the following long-term objectives:

1. Promote wetland protection and restoration as a goal of established watershed groups and other partnerships.
2. Increase wetland area (no net loss) as well as restore wetland functions and ecological services and develop a system for tracking gains and losses by wetland type.
3. Assist communities, agencies, tribes, stakeholders, local governments and others with wetlands technical information, project design and planning, training and other guidance.
4. Develop protection, adaptation and mitigation strategies for wetland resources threatened by the effects of a drying climate in the west, including drying of wetlands in the landscape, loss of mountain snowpack, increased large-scale catastrophic fires and subsequent flooding, scour and sediment delivery.
5. Develop and refine narrative water quality standards for wetlands and for specific wetland types and use these standards to promote more effective CWA §401 Certification.
6. Develop a toolbox of successful restoration techniques that are specific to wetland types and ecoregions.

The Wetlands Program works to implement its mission and objectives through effective partnership with other agencies, contractors, and non-governmental (NGO) conservation entities. The 2021 five-year Wetlands Program Plan state that the "principal goal which informs the work of the SWQB Wetlands Program and its many public and private partners is a desire to restore and maintain wetlands, allowing them to fully function as natural systems." The program aims to accomplish this goal through collaborative partnerships that contribute to completing large-scale major restoration projects and to restoring numerous wetlands within a watershed an acre at a time.

A second overarching goal in the plan is to create a sustainable wetlands plan of action by developing sustainable funding sources. The Wetlands Program and its partners are considering ways to achieve sustainability through potential funding, programs, and management activities such as wetlands banks, in lieu fee programs, state-sponsored programs such as the River Stewardship Program, participation in NGO-sponsored programs such as the Rio Grande Water Fund, through partnerships associated with the New Mexico Mapping Consortium, Geospatial Advisory Committee, and Northern and Southern Wetlands Roundtables, by continuing to obtain matching grants through foundations, by organizing and assisting voluntary programs, and by obtaining in-kind resources and assistance through the efforts of watershed groups, NGOs and their volunteers.

The priority technical goals within the next five years are to identify and maintain simple, effective and efficient methods for monitoring wetlands, to work with partners towards a complete inventory and baseline assessment of New Mexico's wetland resources, and to share these data for the benefit

of wetlands. Partnerships can aid in the protection of wetlands on the regional and local level. SWQB Wetlands Program can assist partners in the implementation of wetlands protection on the regional and local level by providing information, training and data that supports local efforts to protect wetlands (NMED, 2021).

Local Government Wetland Management in Santa Fe County

The City of Santa Fe and Santa Fe County have authority to regulate land uses in order to conserve and protect wetlands in the areas under their respective jurisdictions. Both City and County have staff and technical and mapping capabilities to conduct assessments and planning necessary for implementation of wetland restoration and protection measures.

Local government institutions that have some regulatory responsibility or terrain management responsibility for wetlands in Santa Fe County include:

- Santa Fe County: regulatory oversight based on ordinances and enforcement of County code regarding wetland and riparian area protection in Santa Fe County (see below)
- City of Santa Fe: regulatory oversight based on ordinances and enforcement of City code regarding wetland and riparian area protection in the City of Santa Fe (see below)
- City of Española: regulatory oversight based on ordinances and enforcement of City code regarding wetland and riparian area protection in the City of Española
- Town of Edgewood: regulatory oversight based on ordinances and enforcement of Town code regarding wetland and riparian area protection in the Town of Edgewood
- Santa Fe-Pojoaque Soil and Water Conservation District: management oversight of programs and projects undertaken under its responsibility for soil and water conservation and management in its service area
- Acequia Associations: management oversight of programs and projects undertaken under its responsibility for acequia infrastructure and water delivery in its service area
- Buckman Direct Diversion (BDD): management oversight of programs and projects undertaken under its responsibility for water delivery in its service area

Santa Fe County

Santa Fe County's current regulations regarding wetland restoration and protection are described in the updated 2016 Santa Fe County Sustainable Land Development Code (SLDC, adopted by Ordinance 2016-9, December 13, 2016). The original Flood Prevention and Stormwater

Management Ordinance of 2008-10, and a series of additional ordinances were repealed and absorbed into the SLDC.

Santa Fe County has several general management goals, policies and guidelines for wetlands restoration and protection. They are included in the January 2019 Santa Fe County Open Space, Trails, and Parks Strategic Management Plan, the 2010 Water Conservation Plan, and the 2015 update of the Sustainable Growth Management Plan. In 2020, Santa Fe County and the City of Santa Fe started a science-based, community informed five-year planning cycle to develop long-range water resource management plans. The plan cycle will be complete by the end of 2024. After that, the plan cycle will be repeated every ten years.

The 2015 update of the Santa Fe County Sustainable Growth Management Plan (SGMP) expresses in general terms the County's goal to support programs that restore waterways and riparian areas. The Resource Conservation Element (Section 5) states as a planning principle for the County (in "Keys to Sustainability") that "open space, riparian areas, vegetative and wildlife habitat areas and corridors must be protected to support biodiversity. Wildlife habitats provide food, water, space and cover for the protection, hiding and reproduction of individual species" (Santa Fe County 2015). In the same section, the 2015 SGMP observes that "floodplain and stream connectivity are major elements in maintaining healthy riparian habitat and off-channel habitats for the survival of fish species and conveyance of floodwaters. If rivers, floodplains and other systems are not viewed holistically as biological, geomorphological units, this can lead to serious degradation of habitat and increase flood hazards, which, in turn, can contribute to listing of various fish species as threatened or endangered and result in extraordinary public expenditures for flood protection and recovery. Frequently flooded areas, including the 100-year floodplain and the floodway, are mapped on Flood Insurance Rate Maps, or FIRMs. Many areas of the County are inadequately mapped, and improving mapping data is critical to supporting preservation of important environmental areas and preventing natural hazards."

The 2015 SGMP also observes that "buffer zones should be created along riparian corridors and significant topographical and cultural features that are susceptible to the negative impacts of soil erosion. Development sites must include features to limit stormwater run-off during construction and operation, such as vegetative buffers and limited site disturbance. Improvements to all roads should employ strong erosion control measures during construction and use."

Furthermore, the 2015 SGMP states that "preservation of connected open space and riparian corridors is a key element of wildlife protection." The 2015 SGMP formulated specific policies regarding this point: Policy 20.3 states that Santa Fe County must preserve and protect wildlife habitat, migration corridors, riparian areas and surface water resources that support wildlife health. The 2015 SGMP's Water Element (Section 10) includes Policy 42.29: "Protect and preserve riparian areas and recharge zones" and "coordinate with the county water conservation program

and conservation groups to monitor and protect the flow of water in perennial and intermittent rivers and streams". (Santa Fe County 2015).

The 2016 SLDC aims to enact regulations that ensure the implementation Santa Fe County's goals for the protection of wetlands and riparian areas. This code states that an applicant may need to create an Environmental Impact Report for a particular project involving wetlands and stream corridors. Moreover, wetlands are listed as "No Build Areas" that must be identified on a plat or site development plan. The plan also offers special protection of riparian areas and endorses restoration and enhancement of these areas if it does not negatively impact existing water rights. Gravel and sand extractions, landfills, and junkyards must all identify, map, and address wetland and riparian area viability. Wetlands are considered within the Adequate Public Facilities Regulations (APFRs) as a Sustainable Development Area (SDA) (Santa Fe County 2016).

The City of Santa Fe

The City of Santa Fe regulates wetland restoration and protection in Chapter 14 (Land Development) of the Municipal Charter and Code of Ordinances for the City of Santa Fe, New Mexico (the "land use code"), which was updated in late 2022 and will be comprehensively re-written by 2025 as the City begins the process of updating its General Plan (https://library.municode.com/nm/santa_fe/codes/code_of_ordinances?nodeId=CH14LADE). Specific code is spread over several articles and sub-sections, such as Article 14-5 Overlay Zoning, 14-7.5 Open Space Standards, 14-8.2 Terrain and Stormwater Management, 14.8.3 Flood Regulations, 14-8.4 Landscape and Site Design, and 14-8.15 Dedication and Development of Land for Parks, Open Space, Trails, and Recreation Facilities. Together this body of code is meant to offer guidelines that call for respect for, and protection, maintenance, and restoration of groundwater recharge, wildlife habitat, linkages between areas of ecological importance, drainage ways, wetlands, bosques, riparian areas, floodplains, and steep slopes, among other areas of concern. Several sections of the code also mention buffers and setbacks to allow for protective areas between development and flood zones, wetlands, and arroyos. However, no details on specific buffer zone dimensions are provided. Much of the implementation details and applicability of the code is left to the discretion of the City Engineer and City Planning staff. For example, the Code states that the City Engineer may require development setbacks for arroyos, water courses, and streams of less than 100 cfs in at least a 1 percent chance event[7]. The Code also offers guidelines for the application of water conservation measures, such as xeriscaping, drought tolerant landscape design, and water harvesting. Therefore, in principle, the City Code is set up to implement and enforce many necessary wetland restoration and protection measures and to accommodate more stringent wetland restoration and protection measures through staff discretionary action and/or through more detailed regulations, terrain management requirements,

[7] This statement may be an error in the City Code; it probably should read: "…and streams of **more** than 100 cfs in at least a 1 percent chance event."

and possible future code amendments, if needed, to prevent future deleterious impacts from climate change and urban development on wetlands.

The City of Santa Fe also regulates water delivery to wetland areas on a case-by-case basis through special actions. For example, a settlement agreement between the City of Santa Fe and Wild Earth Guardians in May 2023 has created some safeguards for the conservation and restoration of the constructed riverine wetlands and natural springs in La Cieneguilla below the Paseo Real Water Reclamation Facility (WWTP). The settlement includes that a minimum monthly flow will be maintained below the WWTP to ensure connected streamflow downstream to the natural springs in La Cieneguilla and that the City of Santa Fe will implement restoration activities in riparian areas along the river to enhance water quality and habitat conditions. In addition, the City will lease portions of its surface water rights for environmental, instream flow purposes in the Rio Grande, which supports the river's aquatic life and riparian habitat conditions (https://wildearthguardians.org/press-releases/wildearth-guardians-and-city-of-santa-fe-reach-deal-to-keep-the-santa-fe-river-flowing/).

4.3. Information Gaps

Since the inception of a more systematic approach to wetland restoration and protection in New Mexico and in Santa Fe County 35 years ago, much has been accomplished, as described in previous sections. However, much remains to be done. There still are considerable gaps in information for effective wetland restoration, protection and management in Santa Fe County. Some of the most important information gaps include:

Wetland Assessments

Few wetlands have been documented with a formal wetland assessment, such as the NM RAM approach supported by SWQB. There is a great need for additional assessments of riparian areas and wetlands throughout the county. Ongoing work is needed to document detailed ecological conditions, specific wetland functions, protected status, ownership, restoration work performed, wetland acreage, buffer zone conditions, surrounding land use, planned land use in the area, and the need and feasibility of restoration and protection of wetlands throughout the county. Very little information appears to be available about wetlands in the following areas:

1. Rio Cundiyo
2. Rio Santa Cruz
3. Rio Grande tributaries between Black Mesa and Buckman
4. Cañada Ancha
5. Rio Grande riverine wetlands
6. Springs, wetlands, and Rio Grande tributaries from Caja del Rio (a multi-party planning project for this landscape which started in 2023 is underway at the time of this writing)

Mapping

In 2009, the SWQB Wetlands Program began a statewide wetland mapping effort that has since included large portions of Santa Fe County's wetlands (see Figures 1 and 3; (https://gis.web.env.nm.gov/oem/?map=wetlands). These maps offer a look at the locations and types of wetlands across parts of the County, describing the linear hydrogeomorphic extent of riverine systems and, for some wetlands, polygons labelled with the hydrogeomorphic (HGM) classification system. The need remains to develop a map of all existing and historical wetland resources in Santa Fe County with details on exact wetland locations and dimensions, ecological conditions, wetland functions, protected status, ownership, restoration work performed, wetland acreage, buffer zones, surrounding land use, planned land use in the area, and potential need and feasibility of restoration and protection. This WAP also further recommends an expanded mapping of the SF County WAP area that includes portions of the watersheds included in this WAP that fall outside of county boundaries to give a more complete view of the interconnectivity of the ecosystems of watersheds and water source areas across county boundaries (Figure 1).

Interested parties who filled out the survey contributed to the understanding of gaps in ability or knowledge for each agency, organization, or Pueblo. A short synopsis of each agency, organization, acequia, or Pueblos contributions is outlined in Table 4.1. This list is a living account of information received to date and must be updated as new information becomes available.

Table 4.1. Gaps in Ability or Knowledge for Agencies, Organizations, and Pueblos

Agency/org./ Pueblo	Gaps in ability or knowledge
NMED-SWQB	Restoration capacity: additional proposals required to conduct restoration projects in Wetlands of Concern
Ducks Unlimited, Santa Fe	Public involvement, legal issues, restoration capacity: would like to see more wetland habitat created and greater public access to wetland areas
Santa Fe County Open Space	Public involvement, legal issues, restoration capacity, initial data and analysis, ongoing monitoring, wildlife habitat improvement and monitoring
NMED-Wetland Program	Soils and botany: the wetlands program managed primarily by geologists and hydrologists. Will be hiring people with botany and soils backgrounds
Animal Protection NM	Worked to help promote beaver protection in past, interested in opportunities to promote the benefits of beavers again

5. Goals and Desired Conditions

5.1. Goals

WAP Goal: Protect and restore wetlands and springs to achieve and maintain wetland health conditions, functions, and values, and to minimize the risk and the impacts of wetland degradation on the integrity of the surrounding landscape and on the wellbeing of downstream communities.

To meet this overarching goal, the 2023 WAP Update proposes that the following operational goals and objectives, to be realized by 2033, include the achievement of:

Goal 1: **An effective enabling environment for wetland restoration and protection in Santa Fe County.**

Objectives for this goal are to:

a. Encourage all wetland restoration projects and initiatives to support Surface Water Quality Bureau's (SWQB) statewide wetland restoration and protection goals[8].
b. Further wetland assessments, research, and mapping.
c. Sharpen standards and regulations when experience and data show where this is necessary.
d. Enhance public educational outreach about wetland stewardship to raise awareness and understanding of the importance of wetlands and springs in the area.
e. Grow financing options and strategies.
f. Provide effective technical assistance for restoration and stewardship projects.
g. Improve and share monitoring and evaluation protocols for restoration and stewardship activities.
h. Ensure in all county and city urban planning and development protocols that, according to existing regulations:

[8] See https://www.epa.gov/system/files/documents/2022-02/2021-new-mexico-wetlands-program-plan-2021-to-2025.pdf. SWQB wetland goals for 2021-2025 include: 1. Promote wetland protection and restoration as a goal of established watershed groups and other partnerships. 2. Increase wetland area (no net loss) as well as restore wetland functions and ecological services and develop a system for tracking gains and losses by wetland type. 3. Assist communities, agencies, tribes, stakeholders, local governments and others with wetlands technical information, project design and planning, training and other guidance. 4. Develop protection, adaptation and mitigation strategies for wetland resources threatened by the effects of a drying climate in the west, including drying of wetlands in the landscape, loss of mountain snowpack, increased large-scale catastrophic fires and subsequent flooding, scour and sediment delivery. Wetlands Program Plan for New Mexico Submitted for EPA Approval May 2021 2 5. Develop and refine narrative water quality standards for wetlands and for specific wetland types and use these standards to promote more effective CWA §401 Certification. 6. Develop a toolbox of successful restoration techniques that are specific to wetland types and ecoregions.

i. Developers implement high-quality stormwater management and infiltration, especially on floodplains and on alluvial soils, and in (ex/sub)urban, industrial, and rangeland areas and along infrastructure corridors and resource extraction areas;
ii. Stream channels are restored to protect riverine wetlands from dewatering and erosion;
iii. Buffer zones are developed to protect wetland functions and conditions along all riparian areas and wetlands across the landscape;
iv. Connective ecological linkage systems across the landscape are maintained, developed and / or protected in buffer zones and along the stream network;
v. Natural fire regimes and wildlife communities are restored in forests, woodlands, and rangelands;
vi. Wetlands continue to receive adequate water through aquifer recharge and groundwater discharge and from effluent and gray water systems.

Goal 2: **Integration of wetland restoration and protection in landscape-scale initiatives of state and federal agencies and collaborative partnerships.**

Objectives for this goal are to:

a. Coordinate wetland and stream restoration activities with and in the context of landscape-scale initiatives of the U.S. Forest Service, NM Forestry Division, NM Department of Game & Fish, Rio Grande Water Fund, NGO conservation groups, Santa Fe County Open Space and Trails Program and the county's Transfer of Development Rights (TDR) program, regional water supply management programs, and regional land conservation programs.

b. Emphasize the importance of (re)establishing surface connectivity of wetlands with WOTUS and ecological linkages at a landscape scale to maintain or restore federal wetland protection and associated wildlife habitat.

c. Establish protection of wetlands in New Mexico without a surface connection to WOTUS by working with state agencies to create and/or promote new legislation.

d. Realize and document cultural and economic community benefits of landscape-scale conservation of wetlands and streams for the perpetuation of Native American and traditional agricultural practices, ways of life, and access to land.

Goal 3: **Wetland restoration and protection projects that maintain or increase the acreage of functioning wetlands in Santa Fe County (no net loss),** including

projects that leverage restoration and protection benefits from non-specific wetland restoration initiatives, such as those for long-term water supplies, forest health and wildfire risk reduction, flood management, soil health, wildlife habitat improvement, watershed planning, and land conservation and open space preservation.

Objectives for this goal are to:

a. Implement site-specific wetland and spring protection and restoration projects as well as comprehensive landscape restoration and conservation initiatives to address landscape-wide stressors.

b. Ensure high-quality surface and groundwater discharge into wetlands.

c. Protect wetland vegetation from environmental stressors (e.g., related to climate change impacts) and human-induced damage and removal (e.g., related to urban development and individual land use practices).

d. Ensure that wetland habitats remain connected by maintaining and protecting ecological linkage systems across the landscape for the flow of water, the movement of wildlife, and the dispersal of native plants.

e. Protect wetland soils from pollution, erosion, massive siltation, and drying.

Goal 4: Active groups that support wetland stewardship and advocate strategies and landscape-scale water policies that support wetland health, restoration and protection.

Objectives for this goal are to:

a. Engage interested parties in formulating and implementing on-the-ground restoration and protection projects (including demonstration sites), project monitoring and evaluation, and small hands-on training workshops.

b. Reach out and engage Native American communities, land grant and acequia, and other traditional communities, and other groups that are interested and may conduct work on their own lands but are not currently “at the table” in broader initiatives that support wetland conservation and restoration.

c. Engage interested parties in other initiatives that indirectly support wetland restoration, such as regional climate change mitigation activities, water policy and conservation, wildfire prevention, (re)establishing ecosystem linkages (corridors) in association with wetlands, soil health and other improvements

related to increased stormwater infiltration, storage and flood management, and sustainable urban development.

Goal 5: **Data to action reports, educational outreach media, and data repositories** based on quantitative and qualitative monitoring (including photography and testimonials from beneficiaries) about the achievement of above goals and specific wetland health within the WAP area.

Objectives for this goal are to:

a. Create a data repository and/or directory of wetland restoration information and institutions to improve access to wetland information for the WAP area.

b. Document and publish success stories and lessons learned.

5.2. Desired Conditions

The desired conditions of wetlands in Santa Fe County can be defined as meeting wetland health and integrity standards expressed in the New Mexico Rapid Assessment Method (NM RAM) for Montane Riverine Wetlands (or other wetlands as appropriate), as developed by NMED SWQB (www.env.nm.gov/surface-water-quality/wetlands-rapid-assessment-methods/). More specifically, in terms of the NM RAM, the desired future conditions of wetland sites, areas, or complexes can be defined as each wetland Sampling Area (SA) meeting the highest Ecological Condition Ranking (ECR) in NM RAM wetland assessments for Montane Riverine Wetlands. This assumes that wetland SAs must be representative for each entire wetland area and that all abiotic, biotic, and landscape context conditions are performing optimally toward reaching wetland health and integrity (Muldavin et al. 2022).

5.3. Success Definition and Benchmarks

Each wetland restoration and protection project would need to develop its own site-specific success definition and benchmarks to enable effective monitoring of project progress toward achieving desired conditions and goals.

Using the project Restoring the Rio Quemado Riverine Wetland on Los Potreros Open Space, in Chimayo, NM, as an example, the definition of success for wetlands restoration projects in Santa Fe County may include the following indicators (success definitions) which, in turn, serve as benchmarks (key achievements realized at a certain moment in time) for the realization of project goals.

i. The measurable raise in channel bottom elevation to the design level.

i. The measurable change in channel cross section type from a Rosgen stream type at the start of the project to a desired Rosgen stream type, using cross sections (for elevation measurements) a longitudinal profile in the channel (Rosgen and Silvey 1996).
ii. Implementation monitoring of successful installation of grade control structures and implementation of vegetation treatments (measured using for example visual inspection and photo documentation).
iii. Identification of the presence of vigorous riparian buffers of native plants.
iv. Identification of the presence of vigorous floodplain vegetation of native plants.
v. The measurable, relatively even distribution (cover percentage and variability in avg. distance between debris objects) of organic and woody debris across the floodplain (e.g., using the monitoring protocols of the New Mexico Rapid Assessment Method (NM RAM) for Montane Riverine Wetlands (www.env.nm.gov/surface-water-quality/wetlands-rapid-assessmentmethods/).
vi. Identification of the absence of unmanaged livestock and human access and impacts on the riparian and wetland areas (targets are 0 occurrences and 0 sq ft affected, tally occurrences and area affected).
vii. Implementation monitoring of the realization of riparian buffers of desired width and stream shading effect (canopy cover with stream shading capacity).
viii. Implementation monitoring of the realization of improved amphibian habitat as per design specifications (all measured using visual inspection and photo documentation).

Besides the stream morphological improvement, vegetation and aquatic habitat improvements, and achievement of implemented wetland restoration and protection, monitoring could track wetland gains, losses and conditions (acreage and function), protection of wildlife linkages, and restoration of bird and other wildlife habitat for listed species, culturally sensitive species, and keystone species or indicator species for wetland ecosystem health and resilience. Finally, socio-economic surveying may indicate whether community or individual landowner values of wetlands remain ensured or have been enhanced or not and what the quality is of institutional, community or landowner stewardship of wetlands in the county or any part of it.

5.4. Monitoring

Monitoring wetland restoration and protection work helps identify wetland stressors and signs of degradation and measures success of implemented wetland restoration and protection projects. Additionally, monitoring data can be analyzed to be used in data to action reports for educational purposes, for adaptive management, and in future wetland restoration and protection actions.

Monitoring indicators may include the success measures listed as examples in the previous section. Future wetland monitoring should specifically include tracking of wetlands gains, losses, and conditions throughout Santa Fe County, as part of a response to the urgent statewide need to track wetlands gains, losses, and conditions. SWQB will partly address this need by further

implementing the NM RAM program and by working directly with Santa Fe County and individual project partners for the restoration and protection of specific wetlands in the county. Tracking wetland gains and losses also affects other initiatives, such as the creation and protection of wildlife linkages across Santa Fe County and beyond and the restoration of bird (especially waterfowl) habitat along the Rio Grande corridor.

6. Wetlands Action Planning

6.1. Action Plan

This section clarifies the goals and objectives described in Section 5 by providing more details on the suggested time frame and partners associated with each objective. Table 6.1 summarizes objectives, time frames, and suggested partners for each goal. This section also addresses the strategies and actions to restore and protect wetlands. Many of the listed strategies and actions apply to multiple goals and objectives. Strategies and associated actions are, therefore, described separately from goals and objectives. In the context of this WAP, strategies comprise pathways that can achieve the greatest outcomes toward our goals at the least cost and within the shortest time. Strategies can help develop and leverage societal and ecological functions that increase the scale, effectiveness, and durability of intended outcomes. In addition to wetland management goals objectives, this WAP will specify public outreach actions and priority actions for wetland restoration and protection, identified for individual wetlands or stream reaches as demonstrated in Table 6.1.

6.2. Strategies and Actions

Key strategies and associated sample actions in support of the goals and objectives are listed below. Subsequent sub-sections will clarify these strategies with narrative about selected action examples.

A. Landscape-scale planning, including:
    a. Clustering project areas
    b. Partnerships and collaborative initiatives
    c. (Re)establishing and preserving ecological linkages and corridors
    d. Regional water supply research, management, and conservation
    e. Reestablishing natural wildfire regimes

B. Restoring keystone ecosystems and habitats and helping them adapt to future conditions, including:
    a. Snow accumulation areas and Wetland Jewels in mountain headwater areas
    b. Stream restoration for water spreading, infiltration, and flood control
    c. Soil health improvement and erosion control
    d. (Re)establishing buffer zone along streams and wetlands
    e. Beaver reintroduction in suitable areas and beaver habitat protection
    f. Managing invasive plant species and encouraging restoration of diverse native plants adapted to future climate conditions
    g. Managing or removing grazing from wetland areas

Table 6.1. Goals and Objectives for Wetland Restoration in Santa Fe County for the next decade and beyond.

Goal 1: An effective enabling environment for wetland restoration and protection in Santa Fe County.			
#	**Objective**	**Time Frame**	**Lead and Partners**
1.1	Encourage all wetland restoration projects and initiatives to support SWQB's statewide wetland restoration and protection goals.	Ongoing	NGO Partners and supporting agencies and tribes
1.2	Further wetland assessments, research, and mapping[9].	Ongoing	NGO Partners, SWQB, U.S. FWS, and universities
1.3	Sharpen standards and regulations when experience shows where this is necessary.	Ongoing	Santa Fe County, City of Santa Fe, SWQB, agencies, and NGO partners
1.4	Enhance public educational outreach about wetland stewardship to raise awareness and understanding of the importance of wetlands and springs in the area.	Ongoing	NGO Partners, agencies, and universities
1.5	Grow financing options and strategies.	Ongoing	Agencies, NGO Partners, and universities
1.6	Provide effective technical assistance for restoration and stewardship projects.	Ongoing	Agencies, universities, and NGO Partners
1.7	Improve and share monitoring and evaluation protocols.	Ongoing	NGO Partners, agencies, and universities
1.8	Ensure wetland protection according to all county and city planning & development protocols and regulations.	Ongoing	Santa Fe County, City of Santa Fe

[9] Mapping tools for consideration: Upper Rio Grande riparian mapping tool (https://univofnm.maps.arcgis.com/apps/webappviewer/index.html?id=49a0c9a57d934bcb9ff41d555e6b0b3f) created by Natural Heritage New Mexico (NHNM), in collaboration with the National Wildlife Federation on this project which is part of the larger Upper Rio Grande Riparian Connectivity project (https://www.nwf.org/ribbons-of-life); and the riparian mapping tool created by NHNM in partnership with NMDGF and USFS for the entire state (https://nhnm.unm.edu/riparian/nmripmap/).

Goal 2: Integration of wetland restoration and protection in landscape-scale initiatives of state and federal agencies and collaborative partnerships.			
#	**Objective**	**Time Frame**	**Lead and Partners**
2.1	Coordinate wetland and stream restoration activities beyond county boundaries with and in the context of landscape-scale initiatives of the U.S. Forest Service, NM Forestry Division, NM Department of Game & Fish, Rio Grande Water Fund, NGO conservation groups, Santa Fe County Open Space and Trails Program and the county's TDR program, regional water supply management programs, and regional land conservation programs.	Ongoing	all partners
2.2	Emphasize the importance of (re)establishing surface connectivity of wetlands with WOTUS and ecological linkages at a landscape scale to maintain or restore federal wetland protection and associated wildlife habitat; seek state legislative wetland protection for wetlands that cannot be reconnected to WOTUS.	Ongoing and in context of each project's time frame	all partners
2.3	Realize and document cultural and economic community benefits of landscape-scale conservation of wetlands and streams for the conservation of Native American and traditional agricultural practices, ways of life, and access to land.	Ongoing	NGOs and all other partners

Goal 3: Wetland restoration and protection projects that maintain or increase the acreage of functioning wetlands in Santa Fe County (no net loss)			
#	**Objective**	**Time Frame**	**Lead and Partners**
3.1	Implement site-specific wetland and spring protection and restoration projects as well as comprehensive landscape restoration and conservation initiatives to address landscape-wide stressors.	Ongoing	NGOs and all other partners
3.2	Ensure surface and groundwater discharge into wetlands.	Ongoing	Landowners and surface managers
3.3	Protect wetland vegetation from environmental stressors (e.g., related to climate change impacts) and human induced damage and removal (e.g., related to urban development and individual land use practices).	Ongoing	Santa Fe County, City of Santa Fe, and landowners and surface managers
3.4	Ensure that wetland habitats remain connected by maintaining and protecting ecological linkage systems across the landscape for the flow of water, the movement of wildlife, and the dispersal of native plants.	Ongoing	Santa Fe County, City of Santa Fe, and landowners and surface managers, NMDGF, and NGOs, universities, tribes
3.5	Protect wetland soils from pollution, erosion, massive siltation, and drying.	Ongoing	Santa Fe County, City of Santa Fe, and landowners and surface managers, NMDOT, NGOs, universities, and tribes

Goal 4: Active groups of interested parties that support wetland stewardship and advocate strategies and landscape-scale water policies that support wetland health, restoration and protection.			
#	**Objective**	**Time Frame**	**Lead and Partners**
4.1	Engage interested parties in formulating and implementing on-the-ground restoration and protection projects, demonstration sites, project monitoring, and hands-on training workshops.	Ongoing	NGOs and all other partners
4.2	Reach out and engage Native American communities, land grant and acequia and other traditional communities, and other groups that are interested and may implement actions on their own lands but are not currently "at the table" in broader initiatives that support wetland conservation and restoration.	Ongoing, and before new projects get started	NGOs and all other partners
4.3	Engage interested parties in other initiatives that indirectly support wetland restoration, such as regional climate change mitigation activities, water policy and conservation, wildfire mitigation, (re)establishing ecosystem linkages (corridors) in association with wetlands, soil health and other improvements related to increased stormwater infiltration and flood management, and sustainable urban development.	Ongoing	NGOs and all other partners

Goal 5: Data to action reports, educational outreach media, and data repositories			
#	**Objective**	**Time Frame**	**Lead and Partners**
5.1	Create a data repository and/or directory of wetland restoration information and institutions to improve access to wetland information for the WAP area[10].	2023-2032	NGOs, agencies, and universities
5.2	Document and publish success stories and lessons learned.	Ongoing, after each project or initiative	NGOs, Santa Fe County, and SWQB

[10] Information on completed wetland restoration actions statewide could possibly in the future be included in the New Mexico vegetation treatment mapping database: https://nmfwri.org/gis-projects/nm-vegetation-treatment-mapping/.

C. Building capacity in communities and institutions, including:
    a. Create support mechanisms for planning and implementation
    b. Establishing collaborative partnerships to share the burden and leverage resources from a broad network of participating entities

D. Public involvement and engagement
    a. Establishing equitable public engagement initiatives and strategies by which participants feel fairly represented.
    b. Building trust among interested parties by sharing accurate wetland management procedures and shortfalls.
    c. Expressing specific localized wetland concerns and solutions in the context of the larger landscape in Santa Fe County and beyond.
    d. Identifying funding sources for projects that allow for mutual understanding and common goals among interested parties to drive projects
    e. Expanding public education opportunities through local NGOs
    f. Identifying actions that mobilize community support and enthusiasm
    g. Including youth in wetland restoration and protection activities

E. Prioritizing actions (described in a separate section)

6.2.1. Landscape-scale Planning

The impetus for choosing the entire area of Santa Fe County as the WAP area of interest for the initial 2012 WAP originated from the realization that large-scale trends, such as climate change impacts and urban development pressure on surface- and groundwater supplies require large-scale response strategies. Moreover, around 2012, Santa Fe County was completing its Sustainable Growth Management Plan and the Sustainable Land Development Code. The County Planning and Public Works Departments and the Open Space and Trails Program experienced growing stewardship needs for the Santa Fe River and several wetlands on county properties that required county-wide management planning. The county and city were also engaged in long-term water supply and conservation studies that required a collaborative, regional approach. All these concerns affected wetlands at a county-wide level and called for landscape-scale responses.

In the last decade, the reasons for landscape-scale planning for wetland restoration have held and been bolstered by an increasing number of landscape-scale initiatives across the state that affect wetlands in Santa Fe County. The pace of climate change impacts, the recent uptick in urban development, and changes in protective regulations for wetlands call for comprehensive wetland restoration planning at a county scale rather than a piecemeal approach. The ongoing and looming degradation of wetlands requires expediency and coordinated action among many players. In addition, various entities in Santa Fe County, such as the County Planning Division and Open Space and Trails Program, the Santa Fe Watershed Association, and the Pojoaque-Santa Fe Soil

and Water Conservation District, have the capacity to work at a landscape scale on wetland restoration and protection activities.

Also in the last decade, the vision of greater collaboration on water security issues has been accomplished by the establishment of cooperative plans for a regional water future between Santa Fe County and the City of Santa Fe and by the establishment of the Rio Grande Water Fund, the state's Strategic Water Reserve, and several landscape-scale forest management programs. All these initiatives look at large landscape processes, such as water basin flow projections; aquifer infiltration; and the need to prevent landscape-wide, high-severity wildfires and aim to increase surface- and groundwater supplies and improve water quality.

These collaborative, landscape-scale initiatives at an institutional level have gradually built significant capacity in authorities, financing mechanisms, regulatory procedures, and learning networks that enable more robust actions for wetland restoration and protection in Santa Fe County. The further advancement of electronic information management, precipitated in part by the need for ongoing electronic communication during the COVID pandemic, the increased inclusion of Native American communities, and greater emphasis on broad involvement of interested parties have expanded the foundation for shared knowledge systems on wetland restoration and protection.

Going forward, strategies and actions for wetlands must benefit from these broad, landscape-level capacity improvements and the increased awareness among institutions of the importance of comprehensive, landscape-level planning. A WAP for the Santa Fe County area is, therefore, still relevant, and perhaps more relevant than before, as it provides the opportunity to address wetland restoration and protection at a landscape scale.

In the next ten-year planning time frame, strategic capacity needs that must be addressed at a regional level include:

a. Clustering project areas
    - Creating clustered wetland restoration projects increases efficiencies in working with partners, producing educational outreach media, and affecting policies for specific areas or jurisdictions. Recent examples of clustered projects include the Wetland Jewels project of mountain lakes and wetlands initiated by Amigos Bravos, wetlands restoration in the Galisteo Basin by Earth Works Institute and Ecotone Landscape Planning, several wetland restoration projects on Santa Fe County's Los Potreros Open Space in Chimayo, and the restoration of the Santa Fe River on city and county land.
    - Similar clustered projects could possibly be initiated for wetlands in the Santa Cruz River watershed, wetlands along the Santa Fe River below the WWTP, and playas in the southern part of the county, among other options.
b. Partnerships and collaborative initiatives

- Projects for wetland restoration that are embedded in larger initiatives associated with forest and watershed restoration, County Open Space programming, or wildlife habitat and corridor rehabilitation initiatives have a chance to cover more acreage and be more durable, while leveraging landscape-wide strategies for water conservation, erosion control, and buffer zone or wildlife corridor development.

c. (Re)establishing and preserving ecological linkages, corridors, and buffers
    - In order to reduce or mitigate fragmentation of habitat and to provide for continuous flood zones, wetlands and riparian areas must ideally be connected across the landscape. Where possible, such stream and wetland linkage zones must be developed and protected with buffer zones. Ecological connectivity is important to maintain genetic flow and diversity within species, offer species safe passageways across the landscape, and allow wetlands and riparian areas to expand with increased availability of water in the system. Ecological linkage areas will also contribute to increased flood control and safety, increased visual quality of the landscape, and low impact outdoor recreation opportunities.
    - Land conservation (Conservation Easements (CEs), TDR, Open Space designations, etc.) and ecological restoration and protection of ecological linkage areas and known or potential wildlife corridors that include and connect arroyos, rivers, and wetlands are important for the long-term protection of wetland and riparian habitat and biodiversity. Such linkage areas and corridors also ensure continued free roaming opportunities for wildlife and proliferation of native plants. Linkage areas often serve as buffer zones for wetlands and opportunities for the protection and restoration of surface flow paths to WOTUS that maintain federal protections for the wetlands (in view of the new regulations and interpretations for wetland protection in the wake of the May 2023 SCOTUS ruling).
    - Ecological linkages are particularly important in the urbanizing areas (SDA-1), such as along the Arroyo Hondo, around State Road 14, around La Cienega and La Cieneguilla, and in the western part of Santa Fe.

d. Regional water supply research, management, and conservation
    - Partners in water supply research and conservation are encouraged to discern how water supply management could benefit wetlands, since wetlands could contribute to aquifer recharge, permanent flows of water for acequia agriculture, and other benefits of water supply management that are compatible with wetland conservation.
    - More research is needed to better understand the aquifer recharge process in relation to mountain front infiltration and infiltration in streams, arroyos and alluvial soils in the upper and central parts of Santa Fe County watersheds. Additionally, more research is needed to increase the understanding of the relationships between aquifer recharge due to infiltration in the upper and central

parts of the County and aquifer discharge in springs, seeps and wetlands downstream, in the western parts of the County.

- Concerning wetland mitigation with imported water, research must be undertaken about the use of treated effluent and gray water to recharge valuable wetlands in an artificial way, as is currently happening in wetlands along the Santa Fe River below the Wastewater Treatment Plant. Specifically, research will have to assess the effectiveness and feasibility of these water sources to keep wetlands watered while not negatively impacting local wildlife and benefiting from water purification functions of wetlands to improve water and habitat quality downstream.

e. Reestablishing natural wildfire regimes

- Where possible, natural fire regimes must be restored in forests, woodlands, and rangelands to prevent catastrophic wildfire and allow for low to the ground, natural ("cool") fires. Natural fire regimes will encourage optimal ground covering by understory vegetation for soil stabilization and ecological resilience. In turn, these ecological conditions will optimize conditions for maximum storm water infiltration across the landscape.

6.2.2. Restoring Key Ecosystems and Habitats

Wetlands play an essential role in water retention, spreading, purification, storage, and ground infiltration in the landscape. Their water management functions can be enhanced if wetlands are kept wet. Under the stressors of more variable water inflows due to climate variability and urban development impacts, wetlands will benefit from activities that ensure more sustained inflows of water. This can be accomplished when stormwater in upstream watershed areas is harvested and infiltrated in healthy soil rather than allowed to evaporate, sublimate, or run off in concentrated volumes. This process ideally starts with snow accumulation in cool, shaded parts of forested headwaters of watersheds (Moeser et al. 2020, Mankin et al. 2022, Barnard et al. 2023). This must be followed by effective stormwater management and infiltration at lower elevations, including soil health improvements and stream channel restoration that allows for enhanced connection to the floodplain and infiltration in alluvial sediment beds. These mountain headwaters, water holding soils, and stream channels are key ecosystems for future support of wetlands and will aid in offsetting expected evaporation losses due to climate change impacts and rapid runoff from ongoing urbanization.

As described above, in the past decade, great progress has been made in northern New Mexico and Santa Fe County to ensure the restoration of such important ecosystems. Stormwater infiltration techniques are promulgated and realized throughout Santa Fe County (Santa Fe County 2016) and are essential to increase infiltration of water in the shallow aquifer and support gradual discharge downstream in arroyos and the Santa Fe River. Additionally, storm water infiltration in arroyos and the Santa Fe River is likely to increase recharge of alluvial aquifers and discharge in downstream spring areas, such as those in La Cienega (McGraw and Jansens 2012). Water

harvesting may also offset the need for the use of drinking water for landscape irrigation, and thus, reduce people's dependence on groundwater reserves. Upland and headwater vegetation planting, and upstream water retention, spreading, and infiltration will also reduce risks of damaging impacts to downstream wetlands from flash flooding and related erosion or mass deposition of sediment. Restored streams and floodplain areas that allow a dynamic stream to access its entire natural floodplain will help attenuate high peak flood volumes and associated scouring energy. Restored floodplains typically lead to increased infiltration capacity, water retention, and alluvial storage (Zeedyk and Clothier 2009).

There are several methods that can be employed for restoring key ecosystems and habitat that lead to wetland restoration at a landscape scale. Such potential wetland restoration methods include:

a. Snow accumulation areas and Wetland Jewels in mountain headwater areas
    - Managing mountain headwater forests, meadows, and wetland areas to increase snow accumulation and a prolonged melt out date of snow by creating many small forest gaps that provide shade and wind shelter in forested areas on gentle slopes and in mountain meadows (mimicking openings created by fire that accumulate snow).
    - Expanding the restoration of high mountain Wetland Jewels based on the experience of similar projects in past years.
b. Stream restoration for restoration of flood plain connectivity, infiltration, and flood control: Stream channels and floodplain areas can be restored using some of the following practices, as appropriate for site specific conditions:
    - Abandoning old, entrenched channels and rerouting channels/rechanneling the stream (Figures 7a and 7b).
    - Removing old (natural or man-made) levees and connecting old floodplain areas and oxbows to the channel (Figure 7b).
    - Opening multiple (old) channels across alluvial fans and broad floodplains to accommodate floods of different magnitudes (Figure 8a).
    - Replacing the standard one or two culverts under roads with a battery of smaller culverts, broad, bottomless culverts or, ideally, a bridge to accommodate broader flood flows under roads (Figure 8b).
    - Working with NM DOT and other road management institutions to widen bridge spans and increase the design volumes of bridge structures.
    - Building grade controls in incised channels to lift the water level and improve flood plain connectivity (Figures 9a and 9b).
    - Restoring natural meandering patterns.
    - Building small grade control structures to retain stormwater across floodplains. Often a series of structures is needed to maintain the grade over a certain distance (Figure 9b). Drop structures are typically best located and designed in association with natural grade controls ("nick points") and are needed also to bridge grade

differences to downstream areas that are not treated. Such structures are now common and widely used across Santa Fe County (see also Figures 10a-11b).

c. Soil health improvement and erosion control
    - The 2019 New Mexico Healthy Soil Act (HB204, 2019) has paved the way for increased attention to the importance of healthy soils in ecosystem regeneration, water infiltration and storage, and improved agricultural productivity, especially in the face of climate change impacts. Healthy soil serves as a sponge in the landscape that absorbs water, reduces evaporation, and builds microbial communities in the soil that have water purifying and plant productivity (fertility) benefits.

Figure 7a. (Left): Example of an entrenched meander channel that undermined and dewatered a wetland upstream of the Arroyo de los Angeles in the Galisteo Basin (viewing upstream).
Figure 7b. (Right): View of the same channel after rerouting the channel, building a new bank and terrace on river right (left in the picture) and widening the floodplain.

Figure 8a. (Left): Natural levees on river right were removed along the Cañoncito Arroyo (Eldorado Community Preserve) to allow flood waters to flow through a wider passage, thus reducing degrading scour in the channel and increased access of flood waters to the floodplain.
Figure 8b. (Right): The City of Santa Fe installed a battery of culverts in the Arroyo de la Piedra to allow for broader flood passage and reduce channel degradation.

- Additionally, mycorrhizal communities ensure water and nutrient movement among plants. Healthy soil also helps prevent soil loss from wind and water.
- Applying soil health principles across the landscape and in wetland ecosystems will enhance wetland functions.


Figure 9a. (Left): A series of rock cross vanes in Cañoncito Arroyo (Eldorado Community Preserve) wetlands raised the grade of the stream and made point bars, the floodplain and adjacent riverine wetlands accessible to lower level (more frequent) floods.
Figure 9b. (Right): A series of rock cross vanes and one-rock dams more downstream in Cañoncito Arroyo (Eldorado Community Preserve) wetlands raised the grade of the stream and made the floodplain accessible to lower-level floods and enlarged the wetland acreage in the area.

b. (Re)establishing buffer zone along streams and wetlands
   - Buffer zones are of great importance to reduce impacts from disturbances and pollution from neighboring areas on wetlands and riparian areas. Presently, few wetlands and riparian areas in Santa Fe County are protected by buffer zones. Policies must be developed to provide buffer zone protection along all riparian areas and wetlands across the landscape in Santa Fe County. Besides through policy and planning, buffers could also be developed through voluntary land protection agreements (a.k.a. conservation easements) on public and private lands (Objective 5.3).
   - Wetland buffers will enable local communities to protect themselves from known hazards associated with climate change, such as extreme runoff and flood events from heavy storms, by altering the infiltration and conveyance capacity of stormwater in and around natural wetland systems. Buffers could also moderate the effects of drought and protect private and public property. Buffers serve as wildlife corridors, helping animals reach other areas, especially in times of ecological change (Environmental Law Institute 2008). Buffers may also help in capturing sediment and ashes after forest fires followed by high runoff events.

Figure 10a. (Left): One-Rock-Dam and rock rundown in Arroyo Saiz in Santa Fe (looking upstream). Photo by Earth Works Institute 2010.
Figure 10b. (Right): Cross vane with A-brace in the Arroyo de los Pinos at the Santa Fe Botanical Garden site on Museum Hill (looking upstream).

- The City of Santa Fe and Santa Fe County do not have explicit policies or ordinances regarding buffers. This WAP again recommends the City and County to develop wetland and riparian area buffer ordinances. The publication "Planner's Guide to Wetland Buffers for Local Governments" (Environmental Law Center 2008) describes in detail what elements such ordinances may include and offers case studies to help local governments identify details and experiences to craft the best suitable ordinance for their community.


Figure 11a. (Left): Large filter dam in the Cañoncito Arroyo in the Eldorado Community Preserve (looking upstream). Photo by Earth Works Institute 2011.
Figure 11b. (Right): Large cross vane (background) and on-rock-dam (foreground) in the San Marcos Arroyo wetlands (looking upstream). Photo by Earth Works Institute 2011.

- Reasons for developing wetland buffer ordinances besides natural resource protection and ecosystem conservation may include hazard avoidance and public

health and safety concerns. Specific purposes relevant to the Santa Fe County community may include water pollution prevention (preservation of water quality), wildlife habitat improvement (protecting and improving habitat connectivity and biodiversity and mitigating undesirable wildlife-human interactions), enhancing opportunities for natural infiltration and groundwater/aquifer recharge, and creating a safe buffer between development and the source of potential flood risks related to rapidly increasing and unforeseen cumulative storm water runoff effects due to climate change and urban development (a contingencies buffer in urban planning). Important for the Santa Fe County community may also be that buffers could contribute to maintaining the scenic beauty of the landscape (Environmental Law Institute 2008), thereby preserving the character of the community, the quality of life for and health of residents and visitors in Santa Fe County, and corresponding property values.

- Buffer size necessary to provide a particular level of function depends on the functions of the wetland, the wetland's relative sensitivity (as influenced by water retention time and other factors), the characteristics of the buffer, the intensity of adjacent land use, and watershed characteristics (Environmental Law Institute 2008). Buffer distances for water quality improvement should be greater in areas of steep slopes and high intensity land use, or where the chance of serious impacts from urban runoff or forest fire is higher than normal. Buffers of 50 feet and larger tend to show fewer signs of human disturbance. Buffer effectiveness increases with increasing buffer width while relative maintenance costs decrease with increasing buffer width. Buffers for pollution prevention vary for different kinds of pollutants. Buffers for sediment or phosphorus pollution prevention are typically most effective between 30-100 feet or more; for nitrogen pollution buffering, areas of 100-164 feet or more are most effective. Therefore, generally, buffers should be at least 50 feet wide, and buffers of 100-300 feet or more are preferred. For wildlife habitat purposes, buffer width of up to 600 feet may be desirable for mammals. For certain reptiles and amphibians core habitat and buffer areas of up to 950 feet are reported desirable or at least the core habitat size plus a 164–foot buffer zone. Buffer zones for birds are highly variable by bird species and habitat type, but these areas may range from 49 feet and up to 5,000 feet or more for certain birds (Environmental Law Institute 2008).

c. Beaver reintroduction as appropriate and beaver habitat protection
    - The re-establishment of beaver in wetlands will offer natural solutions to habitat and ecosystem restoration in a holistic manner. It is important to consider whether there is suitable food present to sustain beavers and to consider any needed mitigation for potential local human-beaver conflict. Human movement of beavers on the landscape must be permitted by NMDGF. Restoration activities may be needed to restore sufficient food sources and encourage beaver movement to an

area on their own. Many ecological functions can be addressed at the same time by beaver presence, as has been shown with the return of beaver at the Los Potreros Open Space in Chimayo (the companion project to this WAP-SFC Update). Beaver dams lead to filtering and accumulation of sediments, which enhances and stabilizes the channel grade and helps retain, spread, and store stormwater in the wetland ecosystem. Subsequently, slow releases of water from the wetland lead to more permanent, attenuated flows in the downstream stream system, which provides a more steady and prolonged flow of clean water for acequias and for municipal and domestic water diversions. Beaver dams and associated ponds also promote the growth of wetland plants, which provide habitat for many wetland-dependent wildlife species. Examples of the successful effect of beaver on wetland functions can be found at the Los Potreros Open Space in Chimayo, at Two Mile Pond in the Santa Fe River (see Figure 12), and in the Santa Fe River downstream from the Wastewater Treatment Plant.

- For information on regulations on beaver reintroduction and Furbearer Rules, visit: https://www.wildlife.state.nm.us/download/publications/rib/2023/furbearers/RIB-FBR-2023-24-FINAL_English_Online.pdf

d. Managing invasive plant species and encouraging restoration of diverse native plants adapted to future climate conditions.
    - The removal of water intensive, invasive and exotic hydrophytes (e.g., Russian olives, saltcedars, and Siberian elms) and the revegetation of stream areas with suitable native species, including those that are adapted to projected future climatic conditions, is an important stream channel restoration technique that benefits streamside wetlands and any streams and wetlands downstream from the area of eradication of invasive plants. Depending on the vegetation composition of restored areas, it can also benefit wildlife. Stump treatment with herbicide or stump removal is often essential for the long-term success of hydrophyte removal and to prevent resprouting. It should be noted that it is important for lasting results to have a plan for replanting, mulching (providing soil cover), and maintenance in place for the area where invasive plants have been removed.
e. Managing or removing grazing from wetland areas.
    - Excessive grazing in wetland and riparian areas can greatly reduce plant cover and degrade the overall habitat. Closely monitoring/managing livestock to ensure wetland and riparian areas are rested and not overgrazed within a growing season is important for restoration purposes.
    - In some instances, wetland or riparian areas are severely degraded and require total exclusion from livestock in order to recover to proper functioning condition. For example, one of the reasons the Los Potreros Open Space in Chimayo was a successful wetland restoration project is because cattle were excluded from grazing on the land, allowing wetland vegetation to recover and regrow.

6.2.3. Building Capacity in Communities and Institutions

Implementation of the recommendations of this 2023 WAP Update will require initiative from local communities, NGOs, and local governments. Ideally, these entities will work in collaboration with each other and with state and federal agencies and tribal entities. As mentioned before, capacity among many of these entities has increased in the last decade. Yet, ongoing capacity building in terms of knowledge, staffing, networking, collaboration, and financing remains important to effectively implement the goals of the WAP. Key strategies include:

Figure 12. Reestablishing and maintaining beaver colonies in Santa Fe County wetlands (such as in the Two Mile Pond – this photo from 2012) may considerably boost the adaptive capacity of wetlands, offering natural solutions to grade control and stormwater retention, spreading, and infiltration.

a. Creating support mechanisms for planning and implementation
    - Maintaining and expanding the SWQB Wetland Roundtable gatherings
    - Sharing and organizing training seminars and on-the-ground training workshops on wetland restoration techniques, monitoring techniques, etc.

- Creating incentives and financial programs (in county, state, and federal government programs and with charitable funding sources) for more wetland research, assessments and wetland monitoring
- Ongoing coordination of financing options for wetlands between the different government levels and funding sources
- Development of narrative water quality standards for wetlands and for specific wetland types and the use of these standards to promote more effective CWA §401 Certification
- Initiating and continuing research on the feasibility of In-Lieu-Fee Services programs with the Army Corps of Engineers, NMDOT, and other agencies, and expanding work with the Rio Grande Water Fund and other partners on the further development of appropriate Payment for Ecosystem Services schemes
- Identifying existing barriers and threats to success that must be addressed first in a timely way

b. Establishing collaborative partnerships to share the burden and leverage resources from a broad network of participating entities
   - Ongoing development of knowledge systems, including knowledge of Native American and traditional agricultural communities, mechanisms for inclusion of stakeholders, training of new, young professionals, and continuation of exchange networks through roundtables, conferences, field gatherings, etc.
   - Creating partnerships for clustering projects and / or including wetland restoration projects in landscape-scale restoration and regeneration initiatives (see above)
   - Strengthening transparent, adaptive, and culturally-literate governance structures and funding mechanisms to foster community trust and enable long-term project success.

6.2.4. Public Involvement and Engagement

Strategies and activities described in this section directly respond to Goal 4 of the 2023 WAP Update. The strategies and recommendations are informed by feedback on the WAP during public meetings, a report on stakeholder engagement by the SFWA, and community feedback obtained in the course of the Rio Quemado wetlands restoration project.

From 2020 to 2022, the Santa Fe Water Association, Utah State University, and GeoSystems Analysis, Inc. conducted a survey for stakeholders within the Santa Fe River Watershed. This is a US Bureau of Reclamation funded effort to better understand the stakeholders and their continuum of perspectives on management priorities. The effort informs water managers on how to tailor outreach on the important issues raised by key stakeholders (government entities, businesses, local civic interests, and environmental groups).

Although the survey only represents a sample of stakeholder groups specifically from the Santa Fe River Watershed and not the overall county, Ecotone has opted to use some of the general findings to inform our suggestions within this WAP on outreach. Any entities, organizations, or agencies who utilize this document are encouraged to do further outreach and information gathering from local communities before implementing the WAP's findings.

The common goals stitched throughout the individual ones were responsible management and community benefit. Interviews consisted of deep care for the Santa Fe River and the watershed. Participants raised several, similar issues such as climate change, ongoing drought, stormwater management, erosion, wildfire threats, the impacts of water infrastructure on riparian habitats and social well-being, etc. These issues were also coupled with more locally specific concerns. According to the methods used to sort, in general the highest priorities overall were planning for climate change, protecting native species, ensuring city compliance with pollution standards, greater emphasis on ecological justice and social equity, and fire management and planning in the Upper Watershed.

Along with environmental obstacles, barriers also existed for the stakeholders interviewed. Lack of funding was a seamless concern across all groups, but what to prioritize varied. Assumptions of opposition also existed in terms of other groups or actors within the watershed who present obstacles within the watershed functioning. There were concerns about who has a "seat at the table" to hold power and make decisions. Many voiced needing a plurality of voices and more stakeholder participation that is taken seriously.

In general, the survey found that there were five groupings of stakeholders based on a priority sorting process. However, the groups are not homogenous in their make-up, but rather a variety of individuals from different stakeholder sectors in terms of future goals and interests. The groups are:

- multi-use, equity;
- urban, technological management;
- ecocentric management;
- traditional, cultural management;
- lower watershed, collaborative management

Using the Santa Fe River Watershed Assessment results, this Santa Fe County WAP can draw a few conclusions:

1. Responsible management and community benefit of a watershed is the essence of most stakeholder goals. These goals stem from deep care and should be kept in mind when organizing across individuals, groups, agencies, and coalitions.
2. General concerns surrounding water issues and the environment (climate change, drought, invasive species, etc.) will likely exist for many stakeholders throughout Santa Fe County,

but particular concerns will exist in terms of historical, geographic, social, or current issues surrounding the smaller watersheds. It is best to have both a broad and specific view when doing outreach.

3. Priorities between stakeholders will likely contradict one another, and barriers will exist. It is important to find funding for projects that allow for mutual understanding and common goals to drive projects.
4. Continued outreach, conversation, listening, networking, and coalition building must be conducted across stakeholders to help identify misconceptions about groups or actors within a watershed. Sharing perceptions, obstacles, and goals is important to develop relationships.
5. Concerted efforts must be made to have different voices at the table rather than treating outreach as a performative act. One survey comment described being invited to the table but it already being set, meaning they had no power or say but served only to fill a role. Government entities, businesses, organizations, and communities must work to institute equality within creating and directing projects and making decisions.
6. Identify stakeholder groupings (can be individualistic) in order to focus exchange of information and organizing.

The various sources of information that inform public outreach and education strategies can be interpreted to generate the following strategies in support of wetland assessment, stewardship and monitoring in the upcoming years:

a. Establishing ongoing, equitable public engagement initiatives and strategies by which participants feel fairly represented, laying the foundation for community-centered and participatory wetland assessments, stewardship activities, and monitoring.
b. Building trust among stakeholders by sharing accurate wetland management procedures and shortfalls.
c. Expressing specific localized wetland concerns and solutions in the context of the larger landscape in Santa Fe County and beyond.
d. Identifying funding sources for projects that allow for mutual understanding and common goals among stakeholders to drive projects
e. Expanding public education opportunities through local NGOs
    - Organizing continued outreach, conversation, listening, networking, and coalition building across stakeholder groups to help identify misconceptions about groups or actors within a watershed.
    - Organizing tours, workshops, and volunteer days in collaboration with multiple partners to attract diverse audiences and maintain a living dialogue about wetlands
    - Sharing of perceptions, obstacles, and goals to develop relationships
    - Ensuring that different voices are represented “at the table”; failing to do so will damage public trust and therefore long-term success of any project.

- Ensuring that government entities, businesses, organizations, and communities institute equity within creating and directing projects and making decisions

f. Identifying actions that mobilize community support and enthusiasm
   - Including activities of sharing stories, celebrating successes, organizing events, identifying and recognizing success models, and documenting and widely sharing lessons learned
   - Developing products, services, and/or recurring activities related to the wetland and their restoration that represent success (e.g., river cleanups, series of educational tours, annual or seasonal school and youth programming, bird counts, invasive species removal days, highlighting "wetlands of the year" in Santa Fe County, etc.)
   - Working with institutions (NGOs, schools, and government entities) that offer public outreach and education and specific student-oriented programs that can help grow people's affinity for and connection with Santa Fe County wetlands in the future
   - Maintaining continuity in a community-based dialogue about wetland restoration, protection, and monitoring, by ensuring continued funding, an community-based networking organization that can carry the dialogue, and rotating leadership to share the burden and broaden local capacity.

g. Including youth in public involvement for wetland restoration and protection

6.3. Prioritization, Timelines, and Priority Actions

6.3.1. Priority Criteria

All wetlands in Santa Fe County are important and deserve to be protected, and once protected to be restored if necessary. Wetland protection in Santa Fe County is essential as a first step because urbanization threatens to dry out or obliterate any wetlands that are currently not legally protected.

From a practical point of view, case by case and from year-to-year choices will have to be made about which wetland areas may need to get priority for restoration treatments. Such prioritization choices are most practically achieved by identifying (a) the diversity and intensity of stressors that impair the natural functioning conditions of individual wetlands, (b) actions that are urgent and important because they address broadly supported values and will reduce possible future expenses, (c) project feasibility to mobilize short-term spin-off effects, enthusiasm, and learning opportunities through monitoring, training workshops, and demonstrations, and (d) the practical feasibility of implementing certain restoration and protection measures. A feasibility ranking process could be based on the process developed for the Galisteo WAP (SWQB 2010a) and the Galisteo Watershed Conservation Initiative (Jansens et al. 2011). Table 6.2 lists some key feasibility criteria for ranking wetland sites by order of priority for treatment.

Table 6.2. Primary Feasibility Criteria for Ranking Wetland Sites in Order of Priority for Treatment (to be expressed in high-medium-low).

Criteria	Description
1. Threat of wetland degradation	Risk and severity of impact of potential wetland degradation
2. Legal wetland protection	Level and effectiveness of legal wetland protection (federal, state, or municipal regulations protecting wetlands)
3. Cultural significance	Risk and severity of impact on ancestral domain value to Native American communities of wetland degradation
4. Wetland function (i.e., level of degradation)	Restoration and/or protection will enhance key wetland functions and potential for longevity of the restoration investment in the face of changing climatic conditions
5. Wetland ecosystem services	Estimated wetland value to society and to specific Native and local communities, neighborhoods, and downstream residents
6. Cumulative, landscape wide value	The impact value of any local wetland restoration and protection work on connective habitats linkages across the landscape
7. Wilderness functions	Contributing role of wetlands to designated Wilderness areas and Outstanding Natural Resource Waters and associated values
8. Open space protection and buffer zone development	Presence or potential of leveraging open space protection and buffer zone development (e.g., through conservation easements or a local government ordinance) in ways that wetland protection expands existing open space, corridors, and buffer zones
9. Landowner interest and support	The project site is under ownership of landowners or under stewardship or management of land managers who are willing and able to support the implementation and long-term stewardship of the proposed restoration and/or protection project, are willing and able to provide a matching contribution to the project (if necessary) by means of monetary or in-kind support, assistance with monitoring, public education, and demonstration and outreach functions
10. Clear ownership title	The project area has clear ownership title
11. Level of support by neighbors or nearby community members	The neighbors and nearby interested community members to the wetland/riparian area are supportive of the proposed project
12. Technical feasibility	The site offers technically feasible opportunities for planning, design and implementation of the project (e.g., the site is accessible, and site rehabilitation or protection is technically, financially, and legally feasible within the means of the project)

Criteria	Description
13. Maintenance and follow-up feasibility	The landowners and the physical site offer the possibility and/or likelihood of practical and affordable maintenance and follow-up
14. Financial self-sufficiency	The restoration and protection of the wetland and/or riparian areas and buffer zones has a great likelihood of contributing to the local economy and/or to the financial wellbeing of the landowner(s) over time in such a way that it is likely that the area will remain or can be kept in good ecological health and under sufficient protection

Priority Input by Stakeholders

Prioritization can also be achieved by polling stakeholders. In support of this 2023 WAP Update, stakeholders filled out a survey that asked them about the current status of wetlands as well as priorities and future work. Participants included the Animal Protection of New Mexico (APNM); Santa Clara Pueblo; Ducks Unlimited, Santa Fe Chapter (DUSF); NMED Wetlands Program (NMED-WP) and Surface Water Quality Bureau (NMED SWQB); and Santa Fe County Open Space, Trails, and Parks Program (SFCOS). Ecotone coupled this survey with a public meeting involving several other interested parties.

Timelines

This WAP has been developed simultaneously with the planning and implementation of wetland restoration along the Rio Quemado at Los Potreros Open Space in Chimayo. The timeline for the implementation of the WAP effectively will start in late 2023. It is envisioned that the WAP's lifetime is at least ten years (2023-2033). Given the rapid changes in urban development, climate change, and community capacity, the WAP must be reviewed and updated by 2033 to meet the needs and outlook of that time. The strategies listed above and the priority actions flowing from them, listed below, will be phased according to a ten-year time schedule.

6.3.2. Priority Action List of Restoration Projects

Table 6.3 describes a listing of wetland areas that could be considered for restoration and protection projects in the next ten years. The wetlands are grouped by one of the nine sub-watersheds in Santa Fe County. The listing is based on Ecotone's awareness of needed restoration work as a result of past site visits, input from interested parties during the WAP planning process, and feedback during a public meeting in support of the completion of the WAP.

Table 6.3. Listing of recommended priority projects by sub-watershed in Santa Fe County.

A. Rio Quemado-Rio En Medio-Rio Frijoles-Rio Santa Cruz Stream System

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
H	Rito Oscuro – Wetland Jewels	Lacustrine fringe and wetland restoration; protection of downstream values	Amigos Bravos; Santa Fe National Forest (SFNF)
H	Los Potreros Open Space	Ongoing wetland and beaver habitat care; invasive plant removal	Santa Fe County; Defenders of Wildlife; acequias
M	Santa Cruz River riverine and adjacent (palustrine) wetlands	Bank stabilization and overbank flows onto riparian wetlands	Local acequias and landowners
M	Santa Cruz River jurisdictional reach on Santa Clara Pueblo (from irrigation diversion to confluence with Rio Grande)	Wetland development and restoration; increasing riparian area connectivity with river along Rio Grande corridor	Santa Clara Pueblo; private landowners; local governments

B. Pojoaque-Tesuque-Nambe watershed (incl. Rio en Medio and Rio Chupadero)

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
M	Little Tesuque Creek Open Space	Erosion control; trail relocation; invasive plant species removal and replanting with native vegetation	Santa Fe County; SFCT; hikers
H	Lake Katherine (wetland jewels)	Lacustrine fringe and wetland restoration (due to visitor impacts); mining threats	Pueblos, UPWA, Amigos Bravos; Santa Fe National Forest (SFNF)
H	Santa Fe Baldy area wetlands and lakes (wetland jewels)	Lacustrine fringe and wetland restoration (due to visitor impacts); protection of downstream values	Pueblos, UPWA, Amigos Bravos; SFNF

H	Wetland Jewels in Rio en Medio, Pacheco Canyon	Riverine and slope wetland assessment and restoration; post-fire and flooding stabilization; protection of downstream values	Pueblos, SFNF, private landowners, Amigos Bravos GSFFC, NGOs
M	Pojoaque River and lower tributaries	Invasive plant removal and replanting with native vegetation	SFCT; NMFD; San Ildefonso Pueblo
H	Rio en Medio Open Space	Impact mitigation from wildfire and flooding	Santa Fe County Open Space, local residents, trail users

C. Rio Grande: Black Mesa to Buckman

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
H	Caja del Rio Plateau and Canyons (incl. Rio Grande tributaries of Caja del Rio)	Inventory and restoration where needed as part of the current management plan efforts	Pueblos; SF National Forest, BLM; local residents

D. Cañada Ancha watershed

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
H	Caja del Rio Canyon / Canada Ancha / Diablo Canyon	Inventory and restoration where needed as part of the current management plan efforts	Pueblos, SFNF, BLM, Outdoor recreation groups, City of SF Water Division

E. Santa Fe River watershed

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
H	Santa Fe Lake (wetland jewel) and upstream SF River	Maintain and improve beaver habitat, restore floodplain and map slope wetlands	Pueblos; City of SF; USFS; Amigos Bravos

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
H	Two Mile Pond (incl. Randall Davey Audubon Center & Sanctuary)	Water security guarantee, beaver and bird habitat; protection of downstream values; ecological and engineering analysis	Upper CR Nb Assoc., TNC; City of SF; SFNF; Audubon; NMDGF
M	Santa Fe River below Two Mile Pond downtown and downstream to Frenchies Field	Raingardens and restoration projects	Pueblos; SFWA; City of SF; SFCT; Audubon
M	Arroyos in Santa Fe	Raingardens channel restoration projects	Pueblos; SFWA; City of SF
H	SF River below WWTP and around Calle Debra	Restoration of wetlands based on new flow regime; water quality protection; beaver habitat rehabilita-tion; protection of downstream values	Pueblos; SFWA; WEG; SFRTCC; SWQB; AWF; City of SF, SF County, BLM
H	Santa Fe River at La Cieneguilla Open Space	Flood risk to infrastructure, public safety hazards from construction debris, wild fire risk, erosion, and invasive plants	Pueblos; SF County Open Space, nearby residents
H	La Cieneguilla-La Cienega	Restoration of wetlands based on new flow regime; beaver habitat rehabilitation; ongoing monitoring	Pueblos; SFWA; SF County; BLM; La Cienega Valley Assoc.; private landowners; NGOs
L	El Peñasco Blanco Open Space (springs and arroyos)	Protection from trespassing and dumping	Santa Fe County Open Space, Acequia la Cienega
L	Lower SF River – Box Canyon	Assess conditions	Pueblos, Village of La Bajada, SF County, BLM SFWA
M	Upper Arroyo Hondo and Barbaria Canyon and Upper Arroyo de los Chamisos	WUI concerns; private landowner education; erosion control	Pueblos, City of SF, GSFFC, SF County; SFWA

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
L	Arroyo Hondo Open Space	Dog impacts; invasive plant species control;	Santa Fe County Open Space; trail users
M	Arroyo Hondo downstream from I-25	Erosion control; removal of invasive species and replanting with native vegetation	Pueblos; La Cienega Valley Assoc.; NMED-SWQB-Wetland Program
M	Upper Arroyo de los Chamisos	WUI concerns	SFWA
H	Cienega Creek	Erosion control; removal of invasive species and replanting with native vegetation	Pueblos; La Cienega Valley Assoc.; NMBGMR; SFWA; Agua Fria Village Assoc.

F. Galisteo Creek watershed

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
M	Wetland Jewels in Upper Apache Canyon	Assessment, restoration, monitoring	Pueblos; SFNF, private land-owners, Amigos Bravos, SFCT
M	San Cristobal Playa	Playa restoration; erosion; invasive plant removal	Pueblos; SF County
M	Galisteo Springs on GBP	Erosion control; removal of exotic plants and replanting with native vegetation	Pueblos; NMSLO; Commonweal Cons.; SFCT; Thaw CT
L	Cerrillos Hills springs and wetlands	Lead contamination research	Pueblos; SF County; NM State Parks; CHP Coalition
L	Galisteo Bosque	Russian olive removal and replanting with native vegetation	Pueblos; GCA
M	Galisteo Creek	Dam rehab on Cerro Pelon Ranch to prevent catastrophic erosion when dam fails	Pueblos; Cerro Pelon Ranch; NM OSE Dam Safety Bureau; SFCT

G. Upper Pecos River watershed

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
H	Headwater lakes (Wetland Jewels)	Inventory, protective measures, erosion control, recreation management	Pueblos; Trout Unlimited, Hermit's Peak WA; American Rivers; UPWA; NMWild; Amigos Bravos; SFNF; Audubon; acequias

H. Arroyo Tonque watershed (San Pedro Creek)

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
M	Various small springs in Arroyo Tuerto, Arroyo Tonque, and San Pedro Creek	Erosion control; removal of exotic trees and replanting with native vegetation	Pueblos; private landowners, Archaeological Conservancy; HPD

I. Estancia Basin

Priority	Wetland / Stream Segment	Work Purpose or Focus	Stakeholders
L	Big Playa Lake	Identification of status and needed improvement	Pueblos; private landowners, SWQB
L	White Lakes	Identification of status and needed improvement	Pueblos; private landowners, SWQB

7. Financial and Technical Assistance

Wetland restoration and protection work is usually undertaken in partnerships between government agencies, NGOs, and contractors with funding from federal or state grants or contracts or with internal funding from government agencies. At the time of this writing (late 2023), there is an unprecedented flow of funds becoming available in New Mexico for ecosystem restoration. One large part of this funding is directed toward research and innovation projects aimed at improving New Mexico's water security for years to come. Another considerable part of this funding is directed to forest restoration, which indirectly benefits wetlands if and when forest health improves water storage conditions in the landscape and reduces the impacts of wildfire and climate extremes on wetlands downstream. Furthermore, the State of New Mexico has recently allocated significant funds for ecosystem restoration in the Land of Enchantment Legacy Fund and the Conservation Legacy Permanent Fund. Funding from these funds will become available in 2025 while increased appropriations will finance ecosystem projects in existing authorization in the short term.

Also, since the 2012 WAP, Governor Michelle Lujan Grisham signed the "Protecting New Mexico's Lands, Watersheds, Wildlife, and Natural Heritage" Executive Order 2021-052. There are potential initiatives across New Mexico in protecting and restoring wetlands as a part of The Executive Order states, "WHEREAS**,** protecting and restoring forests, wetlands, and natural working lands will be necessary to achieve the goals I committed New Mexico to in Executive Order 2019-003 addressing climate change and energy waste prevention." The funding in place and authorized for coming years will support implementation of large parts of this WAP, especially in the context of landscape-scale initiatives, including the state's "30 x 30 initiative" as it pertains to Santa Fe County.

An alternative, potential future financing system for wetland restoration and protection may be found in developing payment for ecosystem services (PES) schemes. Currently, the most promising PES financing schemes for wetlands are based on wetland mitigation trading or banking (see below), water quality trading (based on NPDES permits; see Appendix D), and biodiversity trading (based on mitigation of habitat for listed species; see Appendix D). However, various institutional barriers are in the way of making such financing schemes successful in New Mexico at this time.

Finally, financing infrastructure to provide outlays of capital through specialized banks and loan funds is entirely absent but sorely needed in Santa Fe County. Many NGOs have experienced ongoing financing challenges for grants that require upfront cash outlays. Further investigations may be useful with the New Mexico Finance Authority and the New Mexico Water Trust Board and other financing infrastructure programs to identify possibilities for the development of special natural resource restoration and protection loan funds and capital management institutions that can facilitate the flow of funds among institutions specialized in wetland restoration and protection.

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APPENDIX A: LANDSCAPE CHARACTERISTICS OF SANTA FE COUNTY

A.1. Geology

Santa Fe County is located largely across the Española Basin, a sedimentary basin of the Rio Grande Rift, between the Santa Fe Block of the Sangre de Cristo Mountains to the east and the Jemez Mountains to the west. These geological features of the Española Basin have been shaped by tectonic activity (folding, faulting, and volcanic and seismic activity) that occurred during the Laramide Orogeny (Bauer et al. 1995), between 80 million and 35 million years B.P. (Figure A.1, Johnson et al. 2012, In: McGraw and Jansens 2012). The Santa Fe Block consists of a Precambrian core, the flanks of which are covered with outcroppings of younger material that was tilted during the Laramide Orogeny and of which most of the higher elevation materials have eroded away to form the sediments of the Española Basin. The Jemez Mountains, some of the eastern slopes of which are located in the northwestern parts of Santa Fe County, are of Pleistocene volcanic origin (as recent as approx. 1.4 million years B.P.).

On the western side, Santa Fe County is delineated by the Santo Domingo-La Bajada fault line that defines the eastern boundary of the Santo Domingo Basin of the Rio Grande Rift. On the southwestern side, Santa Fe County includes the Ortiz and San Pedro Mountain complex, which is of intrusive volcanic origin and considered part of the Cerrillos uplift. The southern part of the Española Basin includes the Galisteo Basin, a hydrogeological sub-basin of the Española Basin. The southern part of Santa Fe County includes part of the Estancia Basin, which is a side basin to the Española Basin, and a closed surface water basin. The southeastern part of Santa Fe County consists of the Glorieta Mesa uplift, which is defined on both sides by significant faults and synclines that define the Galisteo Basin to the west and the Pecos valley (largely in San Miguel County) to the east. Santa Fe County includes the far western headwaters of the Pecos Basin associated with Glorieta Creek which flows east from Glorieta Pass.

Geologic sediments in the Española Basin are collectively referred to as the Santa Fe Group. In central Santa Fe County (north of the Gallina Arroyo), the Santa Fe Group consists of the Tesuque Formation, formed in the Upper Oligocene and Miocene (25 million-13 million years B.P.), the Tuerto Gravels of the Pliocene to lower Pleistocene (13 million-2.5 million years B.P.), and the Ancha Formation of the lower Pliocene to Pleistocene (13 million-2.5 million years B.P.). The Tesuque and Ancha Formations are known as important aquifers in the area (Phillips and Grauch 2004).

In the Galisteo Basin, Oligocene and Lower Miocene volcanic intrusions, such as those of the Ortiz Mountains and Cerrillos Uplift have left clearly visible cones and volcanic dykes throughout the landscape, while intrusive activity has created tilted sandstone layers and rock sills that crisscross

the drainage systems (Figure A.2) and that are responsible for creating many of the seeps and springs found throughout the Galisteo watershed.

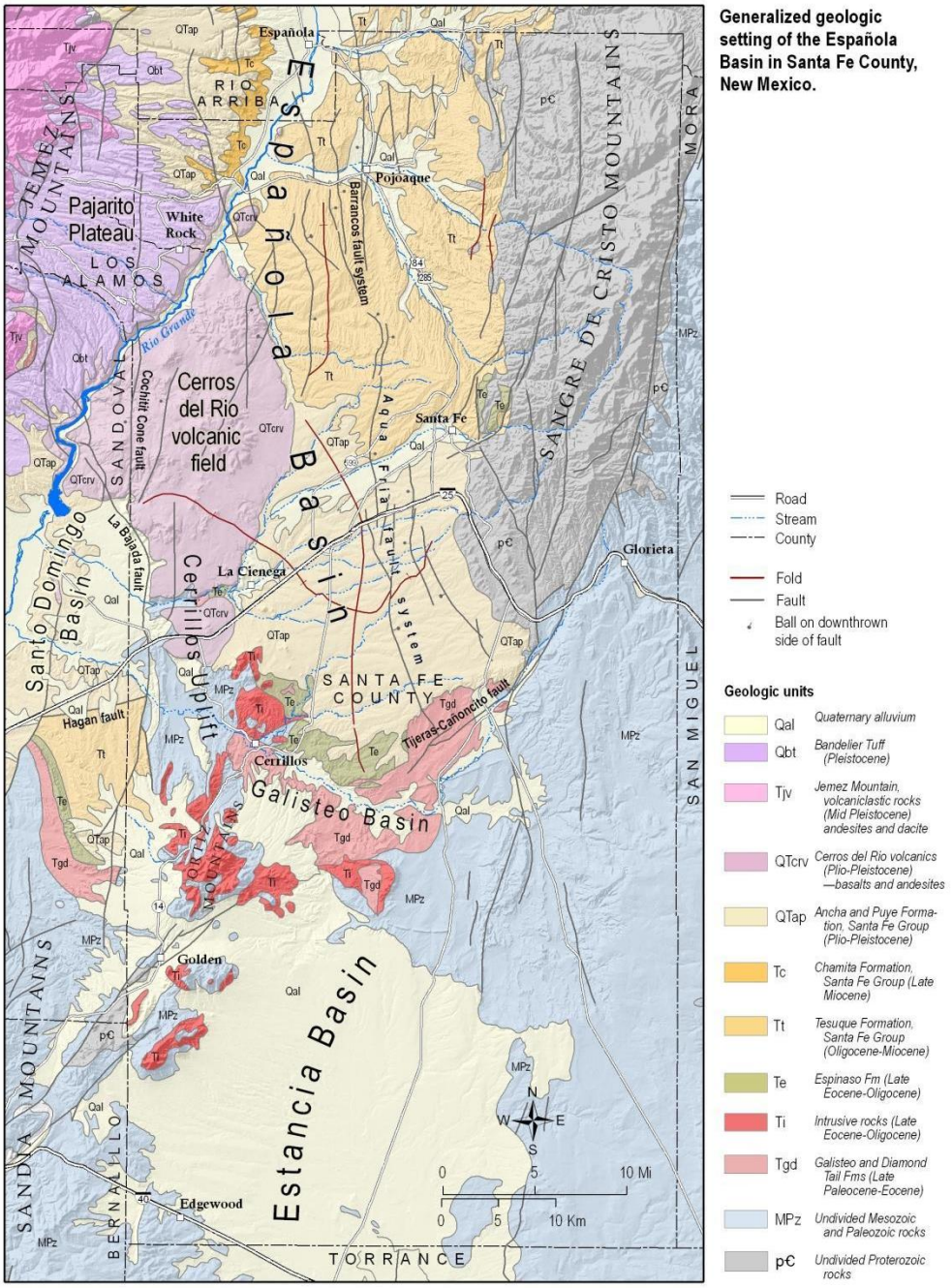


Figure A.1. Geologic Setting Map of Santa Fe County. Courtesy New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, 2012.

Figure A.2. View to the southeast across the hidden wetland of Escalante Springs in the intrusive volcanic hills of Cerrillos Hills State Park.

A.2. Hydrogeology

Research over the last 20 years compiled by the New Mexico Bureau of Geology and Mineral Resources has revealed that groundwater flow conditions in Santa Fe County show a segmented pattern in more or less parallel groundwater units (Johnson et al. 2012, In: McGraw and Jansens 2012). As a result of hydrostatic pressure in the Ancha-Tesuque Formation and the surfacing of the Ancha Formation in certain locations to the north and west of Santa Fe, discharge areas exist of aquifer flows that run generally from the mountain front to the northwest, west and southwest across Santa Fe County.

For example, the Tesuque Valley from approximately one mile downstream from the Village of Tesuque to 3 miles downstream from Tesuque Pueblo comprises a significant groundwater discharge zone with depth to groundwater at less than 20 feet. Groundwater flows in another unit trend west-southwest and largely converge in La Cienega. The Santa Fe River from La Cieneguilla down to La Cienega as well as the Arroyo Hondo, Cienega Creek, Guicu Creek, Alamo Creek and Bonanza Creek east of La Cienega comprise a vast groundwater discharge zone consisting of many

springs and seeps; hence the name La Cienega (Colonial Spanish for “marsh” or “bog”). Groundwater in a unit beneath the northern part of the Galisteo Basin flows west-southwest toward the Village of Cerrillos. Groundwater from this unit discharges in a series of arroyos with many small but locally significant spring and wetland areas in the Gallina Arroyo, Coyote Springs, San Marcos Arroyo, and a series of unnamed arroyos that run to the east and west of Highway 14 and downstream to Galisteo Creek (Figures A.3 and A.4).

Figure A.3. (Left): Aerial view in a canyon of the Gallina Arroyo with a hidden wetland.
Figure A.4. (Right): View to the southeast across San Marcos Arroyo wetlands, just west of State Highway 14.

Groundwater flows more to the south in the Galisteo Basin and the Estancia Basin are not well studied. However, it is likely that groundwater flows in the Galisteo Basin generally follow a westerly direction and converge in the streamside wetlands of the Galisteo Creek west of Cerrillos and in wetlands associated with the Galisteo Dam reservoir and the delta of the Galisteo Creek at Santo Domingo Pueblo. Additionally, there are many isolated springs, seeps and riverine wetlands across the Galisteo Basin in association with the complex geological underground of this basin (SWQB 2010a).

A.3. Climate and Climate Change

Hot, dry summers and clear, crisp winters are a consequence of the semiarid continental climate of Santa Fe County (U.S. Army Corps of Engineers 2006). Climate data compiled and analyzed by www.weatherspark.com indicate that the climate in Santa Fe County has four distinct seasons. The cold season (winter) includes 91 days and runs from late November through mid-February. A short spring season follows which can include snow fall throughout. The warm (summer) season lasts 111 days and starts in late May and lasts until mid-September. A short fall season runs from mid-September until late November. Based on climate data for the period 1972-2000, the NRCS Soil Survey for Santa Fe County shows an average winter temperature of 32.4°F, an average daily minimum of 20.2°F, and a record low of -17°F (on 12/23/1990) (USDA 2000). Because of predominantly clear weather, there is considerable daytime warming during the winter, although

the nights are usually cold and the temperature often falls below freezing. Cold weather periods are usually brief and are accompanied by brilliant sunshine and low humidity. Consequently, during the winter, snowfall melts soon after snow events and, except in the high mountains, does not have a chance to accumulate (SWQB 2010a).

The Soil Survey shows an average summer temperature of 68.8 °F, an average daily maximum of 83.9°F, and a maximum high of 99°F (on 6/29/1998). Related to what may be signs of climate change, the summer temperature extreme of 99°F was matched in July 2003 and in June 2012, while the winter minimum extreme was surpassed with a record low of -24°F during the extreme cold in February 2011 (http://weather-warehouse.com/).

The Soil Survey states that the average annual precipitation for Santa Fe County is 14.29 inches, of which 8.52 inches fall between May and September. Summer precipitation is mostly due to thunderstorms and light rainfall. Based on reports from local residents, precipitation extremes occur in local micro-bursts of 3 to 5 inches in a few hours. The measured heaviest 24-hour thunderstorm was 2 inches (8/21/1981) (USDA 2000). The Soil Survey reports that Santa Fe receives an average of 20.7 inches of snowfall a year. More recent snowfall data show record snowfall amounts for January-March 2005 (33.5") and 2010 (45.3") (http://weather-warehouse.com/).

Annual free water surface (FWS) evaporation and annual potential evapotranspiration (PET) exceed precipitation throughout Santa Fe County, except at the highest elevations. Although the annual FWS evaporation and PET may exceed annual precipitation, precipitation for a given storm may exceed the evaporation and PET during the same time period, thus potentially resulting in recharge (Duke 2001). The estimated annual FWS evaporation rate for the County is 45 inches/year. Average annual PET rates for Santa Fe County vary between 16 inches in the high mountain areas, to 18 to 22 inches in the foothills, 22 to 26 inches in most of the lower areas Santa Fe County, and 26 inches and more in the area of the east flanks of Caja del Rio Plateau and La Bajada Mesa, north of I-25 (Duke 2011). Wind speeds in Santa Fe County vary mostly between 0 and 21 mph, with 8 mph being an average low in August (http://weatherspark.com). Empirical wind and evaporation research revealed, however, that wind speeds of 4 to 6 miles/hr readily absorb all the scant moisture released by the earth (Jensen 1983). As a result, warm temperatures, moderate winds, large daily solar radiation, and dry air contribute to maximum evaporation rates and limit infiltration and recharge of stream flow in the summer period between May and September.

A.4. Surface Hydrology

A.4.1. Watersheds and Water Bodies

Santa Fe County overlaps with nine watershed areas (Santa Fe County 2010a; BLM 1994; Duke 2001; Figure 3). Seven watersheds drain to the Rio Grande. Glorieta Creek drains to the Pecos River. The Estancia Basin is a closed basin. Santa Fe County watersheds are listed in Table A.1.

Table A.1. Watershed areas and water bodies in Santa Fe County.

WATERSHED AREA	WATER BODIES	JURISDICTIONS	WATER-SHED AREA WITHIN SF COUNTY	ELEV-ATION	ANNUAL PRECIPITAT-ION AND PET
Rio Cundiyo-Rio Santa Cruz watershed	Rio Santa Cruz*, Rio Cundiyo, Rio Frijoles, Rito Gallina, Rio Medio, Rio Quemado, Santa Cruz Lake	Santa Clara Pueblo, USFS, City of Espanola, Santa Fe County, Private	191 sq miles	6,100 – 8,500 ft	Precip: Approx. 19”; PET: 19.1”
Pojoaque-Tesuque-Nambe watershed	Rio Pojoaque, Rio Tesuque (Big and Little Tesuque* Creek), Rio Nambe, Rio en Medio, Rio Chupadero*, Nambe Lake (2,023 af)	Pojoaque Pueblo, Nambe Pueblo, Tesuque Pueblo, San Ildefonso Pueblo, USFS, Santa Fe County, Private	318 sq miles	5,494 – 12,621 ft	Precip: 14-22” PET: 21.1-21.8”
Rio Grande* and tributaries between Black Mesa and Buckman	Garcia Canyon, Chupadero Canyon, Contrayerba Canyon, Guaje Canyon*, Los Alamos Canyon*; and three small unnamed arroyos on the east bank of the Rio Grande	San Ildefonso Pueblo, Santa Clara Pueblo, BLM, USFS, NPS (Bandelier), Private	Approx. 58 sq miles (or less)	5,400 – 7,000 ft	Precip: Approx. 12” PET: approx. 21”
Cañada Ancha watershed and Rio Grande tributaries of Caja del Rio	Cañada de Cochiti, Arroyo Eighteen, Arroyo Montoso, Thirtyone Draw, and several other arroyos	USFS, BLM, State Land Office, Private, Cochiti Pueblo	Approx. 126 sq miles (or less)	5,250 – 7,395 ft	Precip: Approx. 12” PET: 26”

WATERSHED AREA	WATER BODIES	JURISDICTIONS	WATER-SHED AREA WITHIN SF COUNTY	ELEV-ATION	ANNUAL PRECIPITAT-ION AND PET
Santa Fe River watershed	Santa Fe River*, Arroyo Hondo, Arroyo de los Chamisos, Cienega Creek, Alamo Creek, Arroyo Calabasas, McClure Reservoir, Nichols Reservoir	USFS, BLM, City of Santa Fe, Cochiti Pueblo, Santo Domingo Pueblo, State Land Office, Santa Fe County, Private	279 sq miles	5,220-12,408 ft	Precip: 12.4" PET: 24"
Galisteo Creek watershed	Galisteo Creek*, San Cristobal Arroyo, San Marcos Arroyo, Arroyo de la Jara, Arroyo Chorro, Galisteo Reservoir, Galisteo Rodeo playa	USFS, BLM, SLO, NPS, Army Corps of Engineers, Santo Domingo Pueblo, Santa Fe County, Private	620 sq miles	5,700-10,000 ft	Precip: 10"-13" PET: 24"
Upper Pecos River watershed	Doctor Creek, Indian Creek, Macho Canyon, Dalton Canyon, Alamitos Canyon, La Cueva Canyon, Hagen Creek, Glorieta Creek*	USFS, NPS, Private	Approx. 67 sq miles (or less)	6,900 – 10,200 ft	Precip: >19" PET: 16-20"
Arroyo Tonque watershed	Arroyo Tonque (San Pedro Creek), Canon del Agua, Arroyo Cuchillo, Arroyo Tuerto, Arroyo Valverde	BLM, Santa Fe County, Private	Approx. 40 sq miles (or less)	6,400 – 8,000 ft	Precip: 10"-15" PET: 20-22"
Estancia Basin	Several short spring-fed drainages; Big Lake, White Lakes	USFS, BLM, SLO, Santa Fe County, Town of Edgewood, Private	Approx. 436 sq miles	6,000 – 7,200 ft	Precip: 13.8" PET: 22-26"

NOTE: Streams marked with * are listed as Category 5 "Impaired Surface Waters" in the 2010-2012 State of New Mexico Clean Water Act 303(d)/305(b) Integrated Report (Appendix A) List of Assessed Surface Waters (SWQB 2010b) (see also Section A.5).

A.4.2. Wetlands

A combination of factors associated with groundwater hydrology and surface water hydrology in Santa Fe County have contributed to the original existence of many wetlands smaller than one acre throughout the County. Most wetlands are riverine (streamside) wetlands along the major rivers and creeks flowing from the mountains. Additionally, various volcanic intrusive formations and the surfacing of the aquifers of the Ancha and Tesuque formations support the existence of slope wetlands in the form of springs and seeps. Depressional wetlands (playas) occur in the Galisteo watershed and in the northeastern part of the Estancia Basin in Santa Fe County.

A.5. Water Quality

The SWQB tracks water quality of water bodies in Santa Fe County in its 2022-2024 State of New Mexico Clean Water Act 303(d)/305(b) Integrated Report (Appendix A) List of Assessed Surface Waters (SWQB 2022). SWQB also provides an open ArcGIS map of these impaired streams (NMED 2022). For the period 2022-2024, the streams in Santa Fe County which SWQB identified as impaired include:

In HUC 13020101 (Upper Rio Grande):

- Los Alamos Canyon (NM4 to DP Canyon)
- North Fork Tesuque Creek (Tesuque Creek to headwaters)
- Pojoaque River (San Ildefonso bnd to Pojoaque bnd)
- Pueblo Canyon (Los Alamos Canyon to Los Alamos WWTP)
- Rio Chupadero (from U.S. Forest Service boundary to headwaters)
- Rio Frijoles (Rio Medio to Pecos Wilderness)
- Rio Medio (Rio Frijoles to headwaters)
- Rio Nambe (Nambe Pueblo bnd to headwaters)
- Rio en Medio (Aspen Ranch to headwaters)
- Rio Quemado (Santa Cruz River to Rio Arriba Cnty bnd)
- Santa Cruz River (from Santa Clara Pueblo bnd to Santa Cruz Dam)
- Santa Cruz River (Santa Cruz Reservoir to Rio en Medio)

In HUC 13020201 (Rio Grande-Santa Fe)

- Galisteo Creek (several perennial reaches)
- Rio Grande (Cochiti Reservoir to San Ildefonso boundary)
- Santa Fe River (various reaches)

In HUC 13060001 (Pecos Headwaters)

- Doctor Creek (Holy Ghost Creek to headwaters)

- Glorieta Creek (Perennial prt Pecos R to Glorieta Camps WWTP)
- Glorieta Creek (Perennial prt 2.2 mi above Lamy to headwaters)
- Indian Creek (Pecos River to headwaters)

Data on the impact of water quality impairments on wetland functions for wetlands in Santa Fe County is nearly absent. Limited data exist for Galisteo Creek about the impact of water quality impairments on wetland functions. In 2002, it was determined from SWQB fish surveys that the Galisteo Creek Assessment Unit does not contain a coldwater fishery and is misclassified as a High Quality Cold Water Fishery according to fisheries data. A Use Attainability Analysis (UAA) from SWQB, instead of a TMDL, was used to determine the appropriate classification for the assessment unit. The UAA proposes to reclassify perennial reaches downstream of the confluence of the Galisteo Creek and "unnamed arroyo" described within the document into a new segment with cool water aquatic life use while all other criteria from the existing segment should be retained except for specific conductance criterion.

The website for National Pollutant Discharge Elimination System (NPDES) lists nine permits for the Santa Fe County area as of June 2023 (https://www.epa.gov/npdes-permits/new-mexico-npdes-permits). The permits and potentially affected wetlands immediately downstream are listed in Table A.2.

Redefining of the Waters of the United States

On May 25, 2023, the United States Supreme Court reversed a large portion of the 1972 Clean Water Act regulating authority used by agencies. This decision strips environmental protections from several waterways, including nearly half of the 118 million acres of wetlands in the nation. After this decision, federal law declares that the waters protected under the CWA must meet two nexus tests: a) those that are those that are relatively permanent (*i.e.*, big lakes, big rivers, oceans), or b) wetlands that are immediately adjoining to and indistinguishable from these major bodies of water. In other words, ephemeral and intermittent streams are no longer protected under CWA. The EPA and Army Corps of Engineers as of June 2023 still need to interpret this decision.

Fifty-eight percent of all waterways in the United States, which provides drinking water to one-third of the population, are temporary or headwater streams, including the Rio Grande. In New Mexico, 90% of the stream and river miles do not flow year around, making them increasingly vulnerable to pollutants, destruction or development, and loss of federal funding (Dahm, 2018). The ecological health of rivers in New Mexico is under severe threat; and with the new ruling, wetlands could become more isolated as restoration projects lose federal funding. This also largely applies to the wetland conditions in Santa Fe County. In essence, the Supreme Court has rewritten almost fifty-year-old federal laws with little knowledge of the ecological concerns connected to the diverse waterways across the country.

It must be noted that Santa Fe County and the State of New Mexico still define wetlands in alignment with the definitions provided by Cowardin et al. (1979), as described Section 2.1 of the WAP.

Table A.2. List of NPDES permit titles and potentially affected streams and wetlands in Santa Fe County.

NPDES Permit Titles	NPDES No.	Potentially Affected Streams and Wetlands
Buckman Direct Diversion (BDD) Project	NM0030848	Rio Grande below BDD Project
Glorieta Camps	NM0028088	Glorieta Creek below Conference Center WWTP, Pecos River (outside WAP area)
LAC Minerals, Inc./ Cunningham Hill Mine	NM0028711	Cunningham Creek, Dolores Creek, and Galisteo Creek below confluence with Arroyo Chorro
Oshara Village Water Reclamation Facility	NM0030813	Arroyo Hondo below Oshara Village Water Reclamation Facility, and downstream wetlands in La Cienega
Pojoaque Terraces Mobile Home Park	NM0028436	Pojoaque River
Ranchland Utility Company	NM0030368	Bonanza Creek Ranch, and downstream wetlands in La Cienega
Santa Fe, City of/WWTP	NM0022292	Santa Fe River below WWTP
Pojoaque Terraces Mobile Home Park	NM0028436	Pojoaque River below outfall of Terraces Mobile Home Park
Tesuque Pueblo Waste-water Treatment Plant	NM0031224	Tesuque Creek

A.6. Soils

The USDA Natural Resources Conservation Service's 2009 Soil Survey for Santa Fe County determined that there are approximately 172 different kinds of soils in a survey area that comprises a total of 182 individual map units (Santa Fe County 2010a; USDA 2009). However, areas under management of the U.S. Forest Service are not included in the 2009 Soil Survey for Santa Fe County (Aaron Miller, pers. comm. July 2, 2012). The soils vary widely in their texture, color, natural drainage, slope, and other characteristics. The soils in the northern portion of the survey area are at the lowest elevations; gently sloping to rolling with steep breaks occurring in some areas. The soils in the eastern region of the survey area exist at higher elevations and are generally steeply sloping and high in rock fragments (Santa Fe County 2010a; USDA 2009). Upon request of Santa Fe County, soil data for Santa Fe County (other than Forest Service lands) were mapped at a rather detailed scale of 1:12,000 (USDA 2009). NRCS is available to offer staff capacity to assist local and state government agencies to conduct detailed field assessments and delineations for wetlands (A. Miller personal communication, July 2, 2012).

A.7. Ecoregions and Vegetation Communities

A.7.1. Ecoregions

Santa Fe County includes four Level III ecoregions, which encompass twelve Level IV ecoregions (Griffith et al. 2006). An ecoregion is a recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterize that region. Areas within an ecoregion exhibit spatial coincidence in geographical characteristics associated with differences in the quality, health, and integrity of ecosystems. Geographical characteristics include geology, physiography, vegetation, climate, hydrology, terrestrial and aquatic fauna, soils, and the impacts of human activity (e.g., land use patterns, vegetation changes) (Santa Fe County 2010a). Table A.3 provides an overview of Santa Fe County's ecoregions and Figure A.5 shows a map of ecoregions in Santa Fe County.

A.7.2. Vegetation Communities

Vegetation types in Santa Fe County are controlled by elevation and available water. Vegetation communities that define different landscapes vary from ponderosa pine forests at elevations of 7,500 feet, piñon/juniper woodlands on mesas and hillsides, plains with grassland, and riparian and wetland areas along rivers and streams. Low elevation native vegetation includes alkali sacaton, blue grama, fourwing saltbush, galleta, Gambel oak, Arizona fescue, muttongrass, mountain muhly, and sedge, which cover the broad, lower mountainous to semi-arid landscape across the County (Santa Fe County 2010a).

Detailed wetland assessments in Santa Fe County are still ongoing. The Galisteo Basin is best studied concerning wetlands and wetland vegetation communities. In 2006, Steve Vrooman conducted a study of wetlands in the Galisteo Basin for Earth Works Institute and SWQB (Vrooman 2006). This study identified seven clusters of wetland areas across the Galisteo Basin, and included detailed vegetation assessments, wetland condition assessments, mapping, and suggestions for wetland restoration and protection. The seven wetland clusters included Glorieta Mesa, Cañoncito/Apache Canyon, Galisteo Basin Preserve, Galisteo Main Stem around the Village of Galisteo, San Marcos Arroyo, Cerrillos Hills, and Galisteo Dam area.

In 2009, the University of New Mexico's Natural Heritage New Mexico Program conducted an inventory of wetlands and riparian resources and vegetation communities within the Galisteo Basin (Milford et al. 2009). This study primarily used Geographic Information Systems (GIS) techniques supported by ground-truthing and included all but the far northeast corner of the Galisteo Basin, which was not covered by color-infrared photography. In addition to the location of wetland resources, dominant vegetation was described and high-quality wetland sites were identified.

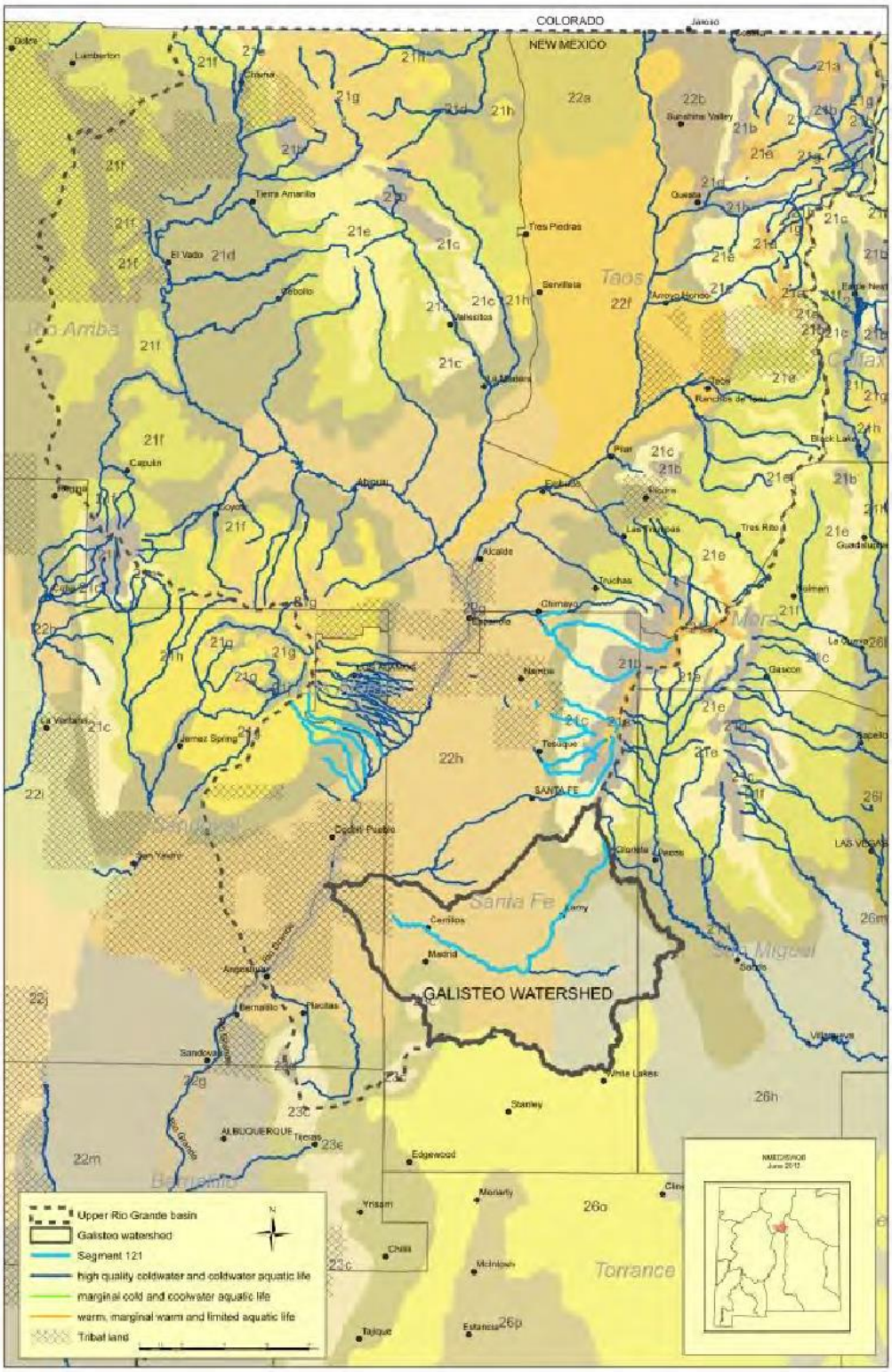


Figure A.5. Ecoregion map of Santa Fe County and surrounding areas with an emphasis on the Galisteo Basin. (Map Courtesy SWQB 2012; Source: SWQB 2012 Draft).

Table A.3. Ecoregions of Santa Fe County with Landscape and Wetland Features (Griffith et al. 2006).

Level III Ecoregions	Level IV Ecoregions	Landscape Features	Wetland Features
Southern Rockies (#21)	Alpine zone (21a)	Mostly glaciated; high, rocky mountain peaks, ridges, and slopes above timberline; alpine meadows, bristlecone pine, Engelmann spruce.	Some wetlands and glacial lakes; high gradient headwater streams with boulder, cobble and bedrock substrates.
	Crystalline Subapline Forests (21b)	High mountains with steep slopes; spruce-fir-aspen forest; alpine meadows; timber, seasonal grazing, and wilderness uses.	High gradient headwater streams with boulder, cobble and bedrock substrates. (Probably few wetlands).
	Crystalline Mid-Elevation Forests (21c)	Low mountain ridges, slopes and outwash fans; ponderosa pine forest type; wildlife habitat, timber, grazing, recreation.	Moderate to high gradient perennial streams with boulder, cobble and bedrock substrates. (Probably few wetlands).
	Foothill Woodlands and Shrublands (21d)	Hills, ridges, and foot-slopes; piñon-juniper woodlands, mixed shrubs, grasses; woodland uses and grazing.	Moderate to high gradient perennial streams with boulder, cobble and bedrock substrates. (Probably few wetlands).
	Sedimentary Subalpine Forests (21e)	High mountains with steep slopes; spruce-fir-aspen forest; timber, recreation, wildlife, grazing, hunting.	High gradient perennial streams with boulder, cobble and bedrock substrates. (Some riverine wetlands).
Arizona/New Mexico Plateau (#22)	Rio Grande Floodplain (22g)	River channel and floodplain; low terraces and levees; cottonwood and willow bosque.	(Some riverine wetlands).
	North Central New Mexico Valleys and Mesas (22h)	Mesas, valleys, piedmont slopes, deep canyons; Espanola and Galisteo Basin area; piñon-juniper woodland and juniper-grass savanna; grazing and urbanization.	Perennial and intermittent streams. (Few wetlands, except those related to discharge zones, springs, and stream sides).
	Albuquerque Basin (22m)	Plains and piedmonts with alluvial fans and some scattered hills (below La Bajada Hill); sand scrub/ desert grass-land; mining/ (ex)-urban.	Mostly intermittent streams. (Few wetlands, except a few riverine wetlands of Galisteo Dam, Galisteo Creek, SF River).

Level III Ecoregions	Level IV Ecoregions	Landscape Features	Wetland Features
Arizona/New Mexico Mountains (#23)	Conifer Woodlands and Savannas (23e)	High hills, low mountains, numerous canyons; piñon-juniper woodland; grasses; yucca and cacti; grazing, wildlife habitat, recreation.	Moderate to high gradient intermittent streams with bedrock, cobble, gravel, sandy substrates. (Probably few wetlands).
	Rocky Mountain Conifer Forests (23f)	Open, low mountains, and high mountains, steep slopes, many canyons; ponderosa pine, piñon, oak, dense understory; recreation, wildlife, grazing, mining.	Moderate to high gradient intermittent streams with bedrock, cobble, and gravel substrates. (Probably few wetlands).
Southwestern Tablelands (#26)	Piñon-Juniper Woodlands and Savannas (26h)	Thin soils of weathered limestone, sandstone, or shale; rock outcrops; wildlife habitat, woodland, and rangeland.	Spring-fed and ephemeral intermittent streams. (Few wetlands).
	Central New Mexico Plains (26o)	Broad, rolling plains, tablelands, piedmonts; Estancia Basin; short-grass prairie and scattered juniper; farming/ranching.	Ephemeral drainages (Few wetlands).

Milford et al. (2009) recognized seven wetland communities based on vegetation including Closed Woodland, Open Woodland, Sparse Woodland with Shrubs, Sparse Woodland with Grasses, Shrubland, Herbaceous Wetland, and Herbaceous. The seven wetland communities are principally distinguished by percent canopy cover of trees relative to total vegetative cover.

Shrublands comprise the greatest amount of area delineated (416 ha or approximately 916 acres) (Figure A.6); while Herbaceous Wetland had the least (12 ha or approximately 27 acres) (Figure A.7). Much of the Shrubland community is dominated by salt cedar, with lesser amounts of coyote willow and minor amounts of rubber rabbitbrush (*Ericameria nauseosa*). Herbaceous Wetlands often occur near impoundments or, in rare cases, as seeps such as within the Cerrillos Hills State Park outside of the town of Cerrillos (Milford et al. 2009). Exotics dominate the mapped riparian and wetland areas. Exotic-dominated stands comprise approximately 57% of the total vegetative cover with mixed and native at 29% and 13%, respectively. Salt cedar-dominated stands are the most common exotic type, comprising 81% of the total exotic-dominated area, followed by Russian olive-dominated stands at 19%. Less than 1% of the exotic-dominant area is categorized as Herbaceous Exotic. Among native-dominated stands, cottonwood was the most common dominant, comprising 50% of the total native area. Less commonly dominant were Herbaceous (35%), Coyote Willow (8%), and Herbaceous Wetland (7%) (Milford et al. 2009).

Figure A.6. (Left): A shrubland wetland in the Santa Fe County Arroyo Hondo Open Space Area.
Figure A.7. (Right): An herbaceous wetland in the Cañoncito Arroyo in the Eldorado Community Preserve.

A.8. Wildlife Habitat

Wetlands and riparian areas provide critical habitat for several species of wildlife in New Mexico. Approximately 80% of vertebrate wildlife in the state use riparian areas during at least some part of their lives (Hubbard 1977), and roughly 50% of breeding land birds in the Southwest are riparian or wetland obligates, meaning they rely on riparian and wetland habitats to survive (Johnson et al. 1987). The same is true in Santa Fe County, which as an ecological transition zone, Santa Fe County constitutes a landscape-wide wildlife corridor across the "spine of the continent," as described in the Southern Rockies Wildlands Network Vision to the north and the New Mexico Highlands Vision to the south (Foreman et al. 2003, Benedict and McMahon 2006). Especially the Galisteo Basin with the Galisteo Creek and its tributaries and wetlands serve as an important functional wildlife pathway between the different ecoregions across the County and as part of a large wildlife linkage area between the Southern Rocky Mountains to the north and the New Mexico Mountains to the south, termed the Galisteo Wildway. Additionally, wetlands in the Galisteo Watershed constitute a series of steppingstones for migratory waterfowl in an alternative eastern flyway route parallel to the Rio Grande corridor (SWQB 2010a). The NMDGF identified the conceptual locations of corridors needed to connect major habitat patches in Santa Fe County in support of the Western Governors' Association's wildlife corridors initiative (Figure A.8). However, suitable habitat and connective corridors for wildlife in Santa Fe County are under stress due to habitat encroachment and land fragmentation as a result of residential and infrastructure development for human habitation (Jansens et al. 2011) (Figures A.9–A.12). Therefore, information and initiatives to support the restoration and protection of wetland and riparian areas as part of wildlife habitat and connective wildlife linkages are becoming increasingly important.

Santa Fe County's unique location at the convergence of multiple ecoregions is expressed in a relatively high level of biodiversity. The County's natural features provide an abundance of native

plants and wildlife despite significant urban development and related land fragmentation due to roads, subdivisions, fences, and other anthropogenic barriers (Santa Fe County 2010a).

Landscape-scale species richness, based on the number of terrestrial vertebrate species, has been evaluated by New Mexico State University (NMSU), as a part of the Southwest Regional Gap Analysis Project (SWReGAP) (Prior-Magee et al. 2007). Gap analysis is a method of "identifying gaps in representation of biological diversity in areas managed for long-term maintenance of populations of native species and natural ecosystems" (Scott et al. 1987, 1993, 1996). “Plant communities and terrestrial vertebrate species under-represented in the existing system of areas managed for biological diversity are identified as *gaps* and serve as a focus for conservation evaluation and future habitat management decisions” (Scott et al. 1993, Boykin 2010 Draft). In 2010, a NMSU study refined the SWReGAP analysis for Santa Fe County by assessing and mapping total vertebrate richness and focal species richness in Santa Fe County (Boykin et al. 2009) as well as for Santa Fe County and 8 other surrounding counties in northern New Mexico (Boykin 2010 Draft). Riparian and wetland habitats received the highest ranking in the conservation prioritization model for this study.

In New Mexico, the Biota Information System of New Mexico (BISON-M) was developed for use by biologists and the public by the NMDGF and the U.S. Fish & Wildlife Information Exchange (www.bison-m.org/) to compile biological information for both vertebrate and invertebrate species that occur in New Mexico. The BISON-M database lists 392 species in Santa Fe County of amphibians, reptiles, fish, birds and mammals, only 14 of which meet one or more of the criteria of being (1) NM or federal Endangered or Threatened and/or (2) NM Species of Greatest Conservation Need (NM SGCN) (BISON-M 2023). For additional information, readers are encouraged to access the NM Crucial Habitat Assessment Tool (CHAT; http://nmchat.org/) and the State Wildlife Action Plan (SWAP; https://nmswap.org/).

There are a number of federal and state protected species that are known in Santa Fe County. Among them are the bald eagle, whooping crane, Southwestern willow flycatcher, spotted bat, and the meadow jumping mouse. The 1973 Endangered Species Act, through federal action and by encouraging the establishment of state programs for the conservation of ecosystems, authorizes the determination and listing of species as endangered and threatened (SWQB 2010a). The Act and the state program open the way for species and (wetland) habitat protection, restoration, and mitigation initiatives.

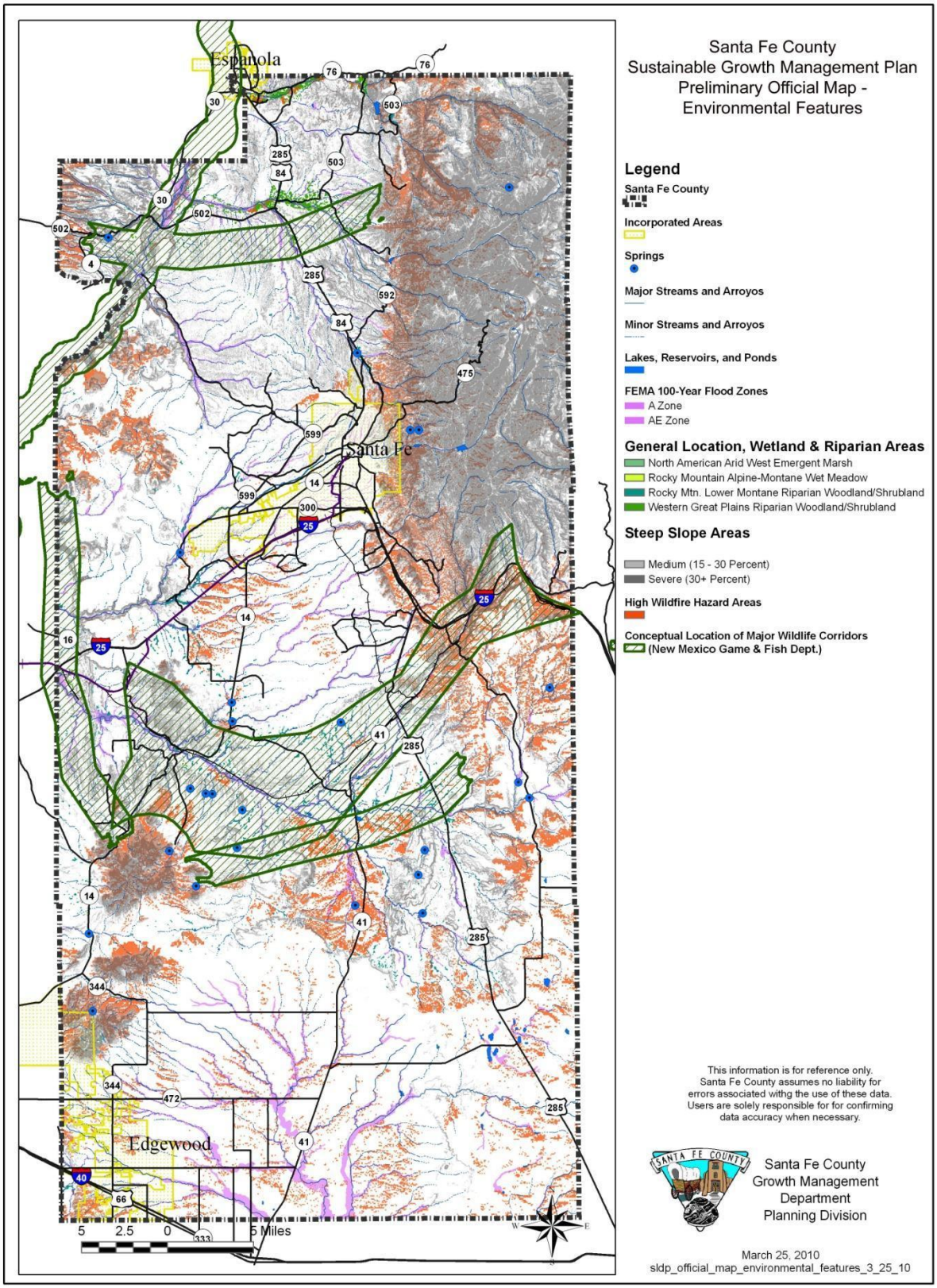


Figure A.8. Santa Fe County Environmental Features Map with some of the most important wetlands, streams, springs, and wildlife corridors (as per NMDGF) in Santa Fe County.


Figure A.9. (Top Left): I-25 and Old Las Vegas Highway cause significant landscape fragmentation and constitute a serious barrier for the continuity of riparian areas and wetland habitat and for wildlife movement between the foothills of the Sangre de Cristo Mountains and the Galisteo Basin to the south.
Figure A.10. (Top Right): Box culverts, such as this one for the Apache Canyon Arroyo are the only connective pathways for wildlife and for floodwaters in riparian ecosystems across the I-25 corridor.


Figure A.11. (Bottom Left): The former Atchison, Topeka, and Santa Fe Railroad bisects the Galisteo Creek floodplain, creating separated riparian areas on both sides of the railroad grade. Only one side remains wet due to the Galisteo Creek; the other side has dried up since rail line construction in 1880.
Figure A.12. (Bottom Right): State Highway 14 cuts across geologic features and streams, wetlands and spring areas east of the Cerrillos Hills in the "Garden of the Gods" area.

A.9. Occupational History

Santa Fe County has a rich and complexly layered history of human population. Research indicates that people may have lived in the area 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 landscape of Santa Fe County has been a land of many wandering people. Highly variable water resources, disease, and conflicts

of various kinds may have been major reasons for the historical fluctuations in the area's populations (SWQB 2010a).

In the 1200s and 1300s, the area experienced a rapid growth of settlements in the form of multi-story room blocks around a plaza. Most settlements were close to natural water sources, such as springs and permanent streams. Most remarkable of this era was the development of about 18 permanent Puebloan settlements in the Galisteo Basin, each with hundreds of homes, which probably 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 (Jansens et al. 2011).

Spanish settlement continued throughout the 1700s. These settlements led 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 (Earth Works Institute 2005).

The character of Santa Fe County's diverse settlement patterns is best defined by a variety of criteria such as geographic setting, proximity to sources of fresh water, land use, culture, economy, community services, and proximity to transportation corridors. Dispersed among the County's settlements are large expanses of public lands such as national forest, BLM, and State Trust Lands. Additionally, traditional community centers on large holdings of tribal lands from San Ildefonso, Santa Clara, Pojoaque, Nambe, and Tesuque Pueblos are located within Santa Fe County. Santo Domingo and Cochiti Pueblos also have portions of land at the western border of the County. However, the natural resource base in Santa Fe County is relatively sparse, limiting economic activities, coupled with finite water supplies. Despite these resource limitations, traditional communities were able to flourish thanks to an intricate combination of Native American survival strategies and Spanish settlement and irrigation procedures and techniques (Arellano 2012).

Historical Spanish settlements were largely dependent on irrigation technology based on gravity flow by way of earthen irrigation canals (*acequias*), which closely followed the contours of the sloping landform. Acequias were fed by streams with reliable surface flows, such as the Santa Fe River, or from springs with reliable groundwater discharge, such as in La Cienega (Santa Fe County 2010a). Acequias in the upper Rio Grande area have supported human subsistence for hundreds of years. The community-based acequias in Santa Fe County are one of the oldest water management institutions in the United States. Acequia irrigation systems date back to Middle-Eastern agricultural techniques brought by the Spanish colonists and to Indigenous irrigation practices (Arellano 2012). The Spanish expanded the acequia system as more colonizing settlements began to occur. Spanish colonization policies required that officials of the crown, and settlers from the central valley of Mexico must locate their communities in the vicinity of water

resources essential to permanent occupation (Arellano 2012). Figure A.13 presents a schematic of the topographical relationships of acequias in the surrounding landscape and in relation to wetlands (Santa Fe County 2010a).

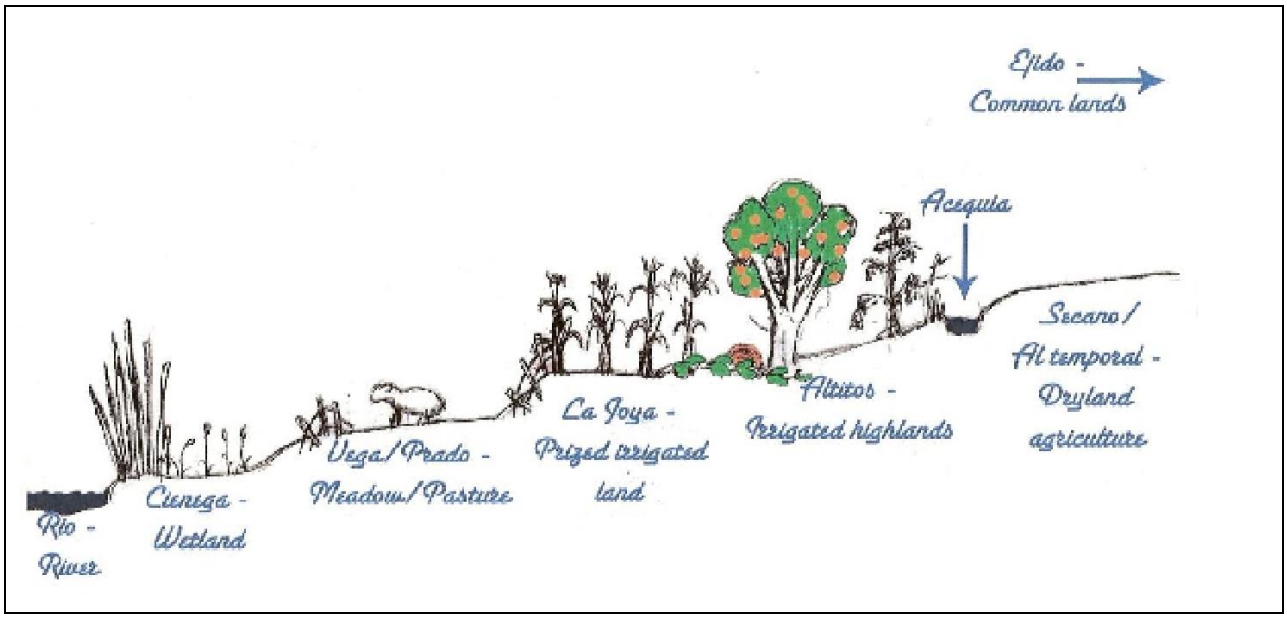


Figure A.13. Cross-section of landscape types traditionally associated with acequia agriculture (Santa Fe County 2010a).

As in the past, acequia communities today are still in charge of day-to-day acequia governance and collectively maintain and repair their irrigation works and diversion structures when necessary (Santa Fe County 2010a). Many acequia communities are very concerned with water source areas, such as springs and wetlands, and traditionally remove all woody plants from springs, wetlands, and nearby riparian areas to reduce transpiration by plants and optimize water availability for agriculture (Jan-Willem Jansens, personal observation).

Each irrigated acre is estimated to use approximately 2 acre-feet/yr (afy) of water. The primary areas of acequia-irrigated acreage within Santa Fe County are Santa Cruz, Nambe, Cundiyo, Chimayo, Tesuque, Pojoaque Valley, Agua Fria, La Cienega, and La Bajada. The southern areas of the County such as Stanley, Edgewood and Cañoncito mainly use groundwater for irrigation purposes (Santa Fe County 2010a).

A.10. Land Use, (Ex)Urban Development and Water Diversion

In the 20th Century, Santa Fe County experienced significant urban growth. Most of the urbanization is concentrated in the Santa Fe Watershed. Other (sub)urban centers include Española and its outskirts in the Santa Cruz watershed in the northern part of Santa Fe County, the small, urbanized part of the Pueblo of Pojoaque in the Pojoaque watershed, the small sub-urban center of Eldorado in the Galisteo watershed, and the Town of Edgewood in the Estancia Basin. Additionally, significant ex-urban development can be found in the Nambe Watershed, in the

central Tesuque valley, in the Santa Fe Watershed in the outskirts of Santa Fe, in most of the northern parts of the Galisteo watershed (Cañoncito, Eldorado, Sunlit Hills, Lamy, San Marcos District, Silverado, Goldmine Road, and Mailbox Road), and in smaller villages, such as La Cienega, Galisteo, Stanley, Cerrillos, and Madrid.

Groundwater wells continue to play an important role as sources of water for residents and businesses in Santa Fe County. As a result, wetlands, streams, and groundwater flows in Santa Fe County are likely to be impacted by groundwater withdrawals from County and City well fields and thousands of domestic wells. Groundwater withdrawals are used for municipal water supply in the City of Santa Fe (Buckman and City of Santa Fe well fields), Los Alamos County (Los Alamos, Guaje, Pajarito Mesa, and Otowi well fields – which may impact downstream riparian areas in Santa Fe County), the City of Española well field, and well fields for smaller communities, such as Eldorado.

Average annual withdrawal between 1990 and 1997 for Española was 1,170 afy and for Los Alamos 4,418 afy. Between 1990 and 1999, the City of Santa Fe measured a withdrawal of 7,177 afy, and in 1999, the community of Eldorado measured a withdrawal of 500 afy (Jemez y Sangre Water Planning Council 2003). Total annual municipal groundwater withdrawal up to 2000, therefore, was around 13,000 afy, with a peak in 1996 of 14,138 afy. In the Buckman Direct Diversion (BDD) Service Area alone, which encompasses the area around the City of Santa Fe – with its outer edges including the communities of Cañada de los Alamos, Lower Cañoncito, the San Marcos District, La Cienega, La Cieneguilla, the developments along Hwy 599, La Tierra, Tesuque, and Cerros Colorados – 9,176 households were served by domestic wells with an estimated water demand of 2,294 afy (i.e., 0.25 af/household) (Karen Torres, personal communication 2012; see also Figure A.14). However, the total amount of ground water diversion (i.e., extraction) by domestic wells in Santa Fe County is largely unknown because in 2010 only approximately 2,000 domestic wells were being monitored, while informal estimates of the number of operating domestic wells varied between 12,000 and 16,000 (Laurie Treviso, personal communication 2010).

In order to address the complex water need and scarcity problems in Santa Fe County in a proactive manner, both the City of Santa Fe and Santa Fe County follow a conjunctive use principle in water supply planning. Both local government entities prioritize the use of surface water, combined with rainwater capture, the BDD project (water from the Rio Grande), and water conservation measures. Groundwater will thus be saved as a backup for years of special or additional need, such as in years of droughts when surface water sources are inadequate (City of Santa Fe 2011b, Santa Fe County 2010a). For example, in 2010 and 2011, the BDD project helped the City of Santa Fe and Santa Fe County to reduce its dependence of groundwater supplies dramatically. In 2012, however, the City needed to use its wells in the aquifer again to provide sufficient drinking water (Julie Ann Grimm, The New Mexican July 4, 2012).

Figure A.14. Density of domestic wells in the BDD Service Area in central Santa Fe County. The outline of the City of Santa Fe is visible in the open void surrounded by well areas just northeasterly of the center of the map. (Source: Santa Fe County Public Works, 2012).

APPENDIX B: WETLAND RESOURCE ANALYSIS

B.1. Santa Fe County Wetlands

The SWQB uses the Cowardin et al. (1979) definition of a wetland. This definition is the Federal standard for classifying and mapping wetlands as determined by the Federal Geographic Data Committee. It is a two-part definition:

Wetlands *are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.*

*For purposes of this classification wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly un-drained, hydric soil; and 3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year***.**

The upland limit of a wetland is the boundary between land that supports predominantly hydrophytic cover, soil types that are predominantly hydric, and evidence of hydrology that supports wetlands and land with predominantly mesophytic or xerophytic cover, soil that is non-hydric and land that is not saturated or flooded sometime during the growing season. The lower boundary between wetlands and deeper water habitat associated with riverine and lacustrine systems lies at 2 meters (6.6 feet) below low water, or the maximum depth at which emergent plants normally grow (SWQB 2010a).

Riparian Areas *are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics: 1) distinctly different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetland and upland* (US Fish & Wildlife Service 2009).

Riparian ecosystems are characterized by phreatophytic and mesophytic vegetation and habitats associated with bodies of water and dependent on existence of perennial, intermittent or ephemeral surface and subsurface drainage. The strict water requirements of wetlands are not as drastic in riparian areas. However, they occupy the same areas of the landscape, may contribute to the same functions within the landscape, and are interdependent, and, therefore, are considered together with wetlands during the assessment phase of WAP development (SWQB, 2010a).

Buffers *are non-disturbance areas where natural vegetation is maintained to protect wetlands and riparian areas from the impacts of stormwater floods, pollutants, and solid waste from adjacent terrain* (Kusler et al. 2003).

For purposes of long-term protection of wetlands, wetland assessments and Wetlands Action Plans must identify wetland buffer zones. Local government interests in wetland buffer lands often include concern for management of stormwater, avoidance of hazards from flooding, protection of water supplies, and protection of property from future hazards that may be associated with climate change (Environmental Law Institute 2008).

Wetlands form part of the natural system of land and water that helps to make human communities livable. In combination with riparian areas and buffer zones, wetland ecosystems have beneficial functions such as flood control, water storage, ground water recharge, and water purification. They also offer habitat for wildlife and recreational opportunities for humans. Attention to these functions (or "ecosystem services") is essential to governance of the community's land use, public health, safety, and welfare (Environmental Law Institute 2008).

Wetlands in Santa Fe County have been poorly studied and documented, except to some extent those in the Galisteo watershed (Vrooman 2006, Milford 2009).

Based on estimates by Mitsch and Gosselink (2000b), we may expect watersheds to include wetlands across 3%–7% of their area. In dryland regions such as Santa Fe County, the proportion of wetland area is probably at the lower end of, or below, this range. Wetlands in Santa Fe County are scattered, and most wetlands seem to be in functional decline. At the end of this chapter, an examination of wetland functions, values, and relative vulnerability will help us identify priorities for wetland protection and restoration, which form the basis of the action plan component of this WAP.

B.2. Classification of Local Wetland Types

Wetlands can exhibit great variability in terms of their structural characteristics and processes (Mitsch and Gosselink 2007). The objective of classification is to identify groups of wetland types that are relatively homogeneous in structure, process, and function (Smith et al. 1995).

The SWQB Wetlands Program uses Brinson's Hydrogeomorphic (HGM) wetland classification (Brinson 1993) for the Wetlands Action Plan process. The HGM classification is based on three fundamental factors that influence how wetlands function: geomorphic setting, water source, and hydrodynamics. At the highest level of hydrogeomorphic classification, wetlands are grouped into hydrogeomorphic wetland classes. Six hydrogeomorphic classes (depressional, lacustrine fringe, slope, riverine, mineral flat, and organic flat) occur in New Mexico (SWQB 2010a). Based on current inventory knowledge, at least four classes are represented in Santa Fe County.

- **Depressional wetlands** occur in topographic depressions that allow accumulation of surface water (e.g., the San Cristobal Playa, Big Lake, and the White Lakes). On a topographic map these wetlands would occur within a closed elevation contour. Dominant

sources of water are precipitation, groundwater discharge, and inflow from adjacent uplands (see Figure B.1).

Figure B.1. A Depressional Wetland: San Cristobal Playa (a.k.a. Galisteo Rodeo Playa) south of the Village of Galisteo (Photograph by Maryann McGraw, 2010).

- **Lacustrine fringe wetlands** are adjacent to lakes where the water elevation of the lake maintains the water table in the wetland. Significant natural lakes in Santa Fe County include high mountain lakes such as Lake Katherine, Nambe Lake, and Santa Fe Lake. Several man-made reservoirs, such as Nambe Reservoir, Two Mile Pond, and Galisteo Reservoir support lacustrine fringe wetlands (see Figure B.2).

- **Slope wetlands** normally are found where there is discharge of groundwater to the land surface. They normally occur on sloping land; elevation gradients may range from steep hillsides to slight slopes. Hydrodynamics are dominated by down-slope unidirectional water flow. Slope wetlands can occur in nearly flat landscapes if groundwater discharge is a dominant source to the wetland surface. Headwater wetlands and cienégas are examples of slope wetlands. Flowing seeps and springs that support wetland vegetation are also included in this broad class of wetlands. In Santa Fe County, such wetlands are found in the Sangre de Cristo Mountain headwaters of many streams, on Glorieta Mesa, in La Cienega, and as springs in many hills and low mountains, such as the Cerrillos Hills (see Figure B.3).

Figure B.2. A Lacustrine Fringe Wetland: Nambe Lake, below Lake Peak in the Sangre de Cristo Mountains.

- **Riverine wetlands** occur in floodplains and riparian corridors in association with stream channels. Dominant water sources are overbank flow from the channel or subsurface hydraulic connections between the stream channel and wetlands. Perennial flow is not required. There are numerous examples of riverine wetlands along the Rio Grande, Santa Fe River, Galisteo Creek, and Tesuque Creek (see Figure B.4).

Mineral soil flats are most common on interfluves, extensive relic lake bottoms, or large floodplain terraces where the main source of water is precipitation. Organic soil flats differ from mineral soil flats, in part, because their elevation and topography are controlled by vertical accretion of organic matter. They occur commonly on flat interfluves but may also be located where depressions have become filled with peat to form a relatively large flat surface. Water source is dominated by precipitation. Neither mineral soil flats nor organic soil flats have been recognized in Santa Fe County.

Figure B.3. A Slope Wetland: The Leonora Curtin wetlands of El Rancho de las Golondrinas in the Cañorita de las Bacas are part of a large system of slope wetlands in the La Cienega Area caused by groundwater discharge in springs and seeps (Photograph by Maryann McGraw, 2012).

Figure B.4. A Riverine Wetland: The Galisteo Creek south of the Village of Galisteo.

In addition, there are examples throughout Santa Fe County of human-made wetlands (Figures B.5 and B.6). In some areas, these artificial wetlands replace, impair or compromise the natural hydrologic regime and associated water and wetland resources. Although these wetlands are the result of anthropogenic activities, such as water pumping, impoundment and diversions, they still provide some valuable ecological services in an overall arid environment. Examples include wetlands developed or expanded at golf courses and those developed or expanded as a result of dams, levees, sumps and irrigation ditches (acequias), cattle tanks, and mill sites (e.g., Santa Cruz Lake, Nambe Reservoir, Two Mile Pond, Arroyo Hondo Reservoir, Finger Lakes, and Galisteo Dam/Reservoir) (SWQB 2010a).


Figure B.5. An Artificial Wetland (Left): The Galisteo Dam Reservoir includes several wetland patches.
Figure B.6. An Artificial Wetland (Right): The Arroyo Hondo Reservoir supports a wetland area with significant biodiversity.

B.3. Wetland Functions

Scientific investigations have shown that wetlands unquestionably perform important environmental functions (Mitsch and Gosselink 2007) and that different types of wetlands perform different functions or the same functions to various degrees (Johnson 2005). Wetland functions are defined as a process or processes that take place in a wetland (Novitski et al. 1993). Wetland ecosystem functions are processes that are necessary for the self-maintenance of a wetland ecosystem. In a wetland, these functions maintain and sustain the wetland and are essential to the existence of the wetland. Examples of wetland ecosystem functions are primary production and nutrient cycling (Kleindl 2005).

Wetland ecosystem functions also influence adjacent ecosystems. For example, riverine wetlands can modify flooding along a river's course, or nitrogen, sulfur, methane, and carbon cycles in wetlands can affect air quality. Wetlands can also exhibit variability because of climatic conditions, species composition, soil type, biogeochemistry, and other factors. However, regardless of how they are defined, wetlands within a class (or type) share most common functions.

In 2006, the "Planning for Wetlands in the Galisteo Watershed" Steering Committee conducted a review of wetland functions common to classes of wetlands in the Galisteo Watershed. Of the many functions that wetlands provide, the wetland functions determined by the committee to be the most important in the Galisteo Watershed (SWQB 2010a) can readily be assumed to apply also across entire Santa Fe County. They are the following**:**

Hydrologic Functions:

1. Maintenance of runoff volume
2. Energy dissipation
3. Surface water storage
4. Groundwater recharge

Water Quality and Biogeochemistry Functions:

5. Sediment retention
6. Phosphorus retention
7. Nitrogen removal
8. Heavy metals and hydrocarbon removal
9. Carbon cycling and sequestration

Biological Functions:

10. Vascular plant production
11. Macro-invertebrate and fish production
12. Wildlife habitat
13. Habitat diversity and complexity
14. Biodiversity

B.4. Wetland Values and Ecosystem Services

B.4.1. Linking Wetland Functions to Ecosystem Services

Wetlands and wetland functions are of value to people and society. Each wetland function and/or the aggregate of functions can constitute specific values for humans (e.g., recreational values, agricultural production values, micro-climate buffering values, or spiritual values), because wetland ecosystem functions deliver a wide range of valuable ecosystem services that contribute to human well-being. The SWQB strives to identify linkages between wetland functions and ecosystem services in relation to wetlands in Santa Fe County. Currently, SWQB is modeling wetland functions with their mapping data, which has informed Amigos Bravos in generating a story map for Santa Fe National Forest Wetland Jewels. It remained beyond the scope of this WAP Update to conduct an assessment of wetland ecosystem conditions or a detailed assessment of ecosystem functions for each wetland area identified in Santa Fe County.

B.4.2. Wetland Ecosystem Services and Values

Mitsch and Gosselink (2000b) argue that wetlands "have value because many of their functions have proved to be useful to humans." In earlier publications, Mitsch and Gosselink (1993 and 2000a) wrote that "the reasons that wetlands are often legally protected have to do with their value to society, not with the abstruse ecological processes that occur in wetlands… Perceived values arise out of the functional ecological processes… but are also determined by human perceptions, the location of a particular wetland, the human population pressures on it, and the extent of the resource."

However, placing a monetary value on wetlands as a function of the services they provide is a challenging and controversial task, and economists have often been criticized for trying to put a "price tag" on nature (http://www.ecosystemvaluation.org/essentials.htm). Many of these goods and services are traditionally viewed as free benefits to society, or "public goods", including, for example, wildlife habitat and diversity, watershed services, carbon storage, and scenic landscapes. Lacking a formal market, these natural assets are traditionally absent from society's balance sheet; their critical contributions are often overlooked in public, corporate, and individual decision-making. As a result, both in Santa Fe County and in the United States, resource challenges associated with globalization and urbanization and the impacts of climate change, pollution, over-exploitation, and land use on ecosystems, leading to habitat loss and/or the degradation of wetland functions and their values, are poorly translated into monetary losses (http://www.fs.fed.us/ecosystemservices/).

At a county level and state level, it is important to consider how government spending decisions and allocating resources for protecting and managing wetlands could potentially be justified to the community and stakeholders that benefit from these resources and that "pay" for the protection and management of these resources through taxation. These types of decisions are based, either explicitly or implicitly, on society's values, as Mitsch and Gosselink (2000b) have argued. Therefore, economic valuation can be useful by providing a way to justify and set priorities for programs, policies, or actions that protect or restore wetlands and their functions and ecosystem services. Such values can in some cases be expressed in a dollar amount, while in many cases they do not constitute marketable or monetary values, but rather personal, social, and spiritual ones.

In specific markets and market circumstances, wetland functions and their values can be expressed as marketable ecosystem services. "Ecosystem services" are natural assets that offer a full suite of goods and services that are vital to human health and livelihood. The "2005 Millennium Ecosystem Assessment" (http://www.maweb.org/en/index.aspx, Watson et al. 2005) a four-year United Nations assessment of the condition and trends of the world's ecosystems, categorizes ecosystem services as:

- **Provisioning Services** *or the provision of food, fresh water, fuel, fiber, and other goods;*

- **Regulating Services** *such as climate, water, and disease regulation as well as pollination;*
- **Supporting Services** *such as soil formation and nutrient cycling; and*
- **Cultural Services** *such as educational, aesthetic, and cultural heritage values as well as recreation and tourism.*

How people value these ecosystem services depends on people's awareness and use of these ecosystem services and on the functionality of each wetland in performing these ecosystem services. The population in Santa Fe County appears to be aware of only certain wetland functions as expressed in their use of the wetland areas and water resources and as expressed in behavior, stewardship, and protective measures. Clearly, the presence of cattle tanks near springs and the (often primitive) protection of the spring head areas (e.g., with sumps), the association of acequias with springs, and the development and protection of public open space areas around wetlands for recreational, educational, and scientific activities in connection with historical and cultural preservation[12] and scenic or night-sky appreciation activities express people's values of the wetlands that provide these services. In some cases, government agencies and landowners have also made use of flood control functions of wetlands, of wildlife habitat and pathway conservation functions, or of groundwater infiltration and storage capacities of wetlands. Comments in recent public meetings about infrastructure projects, such as the highway bridges in Galisteo, have also shown that communities and individuals are concerned about impacts on wetlands for reasons of property values and spiritual and other personal or community values.

However, the lack of protective County regulations for wetlands and ongoing human-caused wetland degradation seem to indicate that many people in Santa Fe County are poorly aware of most regulating and supporting services of wetlands. This is not surprising, because the wetland functions that drive these ecosystem services, such as flood or erosion control and carbon or phosphorus cycling, operate on the scale of ecosystems or bioregions. Mitsch and Gosselink (2000b) observe that most of these services of wetlands accrue to the public at large. Thus, wetland protection for these ecosystem services and values is, they argue, properly, the domain of a representative government working in concert with private landowners. In Santa Fe County, such values may include the potential for communal and individual cost savings and other benefits related to ecological and damage regulating functions, such as stream flow maintenance, erosion control, flood control, groundwater recharge, sediment retention, water purification, carbon sequestration, local climate management, and values associated with biodiversity (genetic diversity) and biological population maintenance (ecological stepping stones), which are related to ecological resilience and buffering of catastrophic events.

[12] Please see Appendix E for a letter from the Agua Fria Village Association recounting the historical wetlands and bosques along the Santa Fe River.

Furthermore, wetlands could be viewed as "canaries in a coal mine" regarding the general health of ecosystems and atmospheric conditions, e.g., in relation to climate change impacts. Through wetland assessments, such as the recently developed New Mexico Rapid Assessment Method (NM RAM) for Montane Wetlands (Muldavin et al. 2011a, 2011b, and 2019), wetland stressors are identified that cumulatively and regionally could serve as a warning system about ecosystem health at a larger scale. A Stressors List developed for Santa Fe County based on Muldavin et al. (2019) is included in Appendix C. In this way, monitoring of wetlands could offer valuable information (i.e., educational services) as part of the category of cultural services of wetlands under the definitions of the 2005 Millennium Ecosystem Assessment.

Wetlands may also represent ecosystem services that are considered of negative value. For example, during public meetings and in personal conversations, County residents have often expressed their apprehension of undesirable aspects of wetlands. In the course of several wetland restoration projects, the author of this WAP has experienced that county residents have raised concerns about the nuisance that wetlands cause as breeding grounds for mosquitoes and other insects, as habitat for undesirable wildlife, or as proliferation areas of undesirable plants (these include non-native invasive plants and native wetland plants that are considered undesirable by certain people). Certain groups of residents have also expressed concern that wetlands and their restoration and protection lead to water losses for beneficial uses on adjacent farmlands because of water uptake by plants and evaporation from surface water. Other concerns include that, in dry years, wetlands contribute to local wildfire risk, especially if woody wetland vegetation has dried out and died, and that wetlands are a barrier to accessing certain pieces of land that could be used more profitably if access were not hampered by the physical limitations and regulatory protections associated with the wetlands.

Therefore, valuing wetlands is a complicated matter because wetland values are variable and transient. The functional marginal value of wetlands, expressed as a product of population times functional value per capita (Mitsch and Gosselink 2000b), typically increases with population growth when wetlands are becoming rare (due to wetland destruction caused by population pressure) but are not yet degraded. At some level of population density, however, wetland functions become degraded with pollution, lost corridors, etc., and marginal functional value drops precipitously for additional population increase. Therefore, Mitsch and Gosselink (2000b) conclude that, all things being equal, a wetland in a region with moderate but not excessive urban development will have the greatest value because an adequate human population is present to benefit from those values, but the population is not so large as to overwhelm the wetland functions.

In Santa Fe County, the current population density combined with urban development projections and climate projections may suggest that we have reached a tipping point in the Santa Fe Watershed and the populated headwaters areas of the Galisteo Basin, and perhaps also in the Pojoaque and Tesuque watersheds and the Estancia Basin. With increased population growth and the resulting urban development, agricultural impacts, and water diversion, wetland functionality

in these watersheds will probably decrease, and the functional marginal value of wetlands may precipitously decline, if Mitsch and Gosselink's (2000b) projections apply to this geographic area. Further research would be useful to clarify the threat to irreversible wetland degradation in the Santa Fe County area and to express whether or when this projection will bear out.

There are several other ways to calculate the value of wetlands. Costanza (1997) uses global averages expressed on the basis of annual values of all ecosystem services taken together for freshwater swamps, river floodplains, and wetlands. Alternative calculations may consider the development or replacement costs of wetland after their destruction, for example due to an urban development or infrastructure construction project. Such costs are typically related to wetland mitigation programs financed by Wetland Mitigation Banking or In-Lieu Fee Services Programs administered by the U.S. Army Corps of Engineers (see Appendix D). A third method for estimating the value of wetlands involves the calculation of an average of restoration costs of degraded wetlands in a certain area. A fourth way of calculating wetland values is to estimate regional values based on national averages of publicly traded wetland ecosystem service offsets in international wetland banking schemes. A fifth way is to evaluate the average value of conservation easements for wetlands and buffer areas, combined with the value of water rights traded in a certain area. Sixth, one can consider the substitution costs of engineered solutions for all ecosystem services wetlands provide. Such calculations, however, have to be calibrated for a specific service area. It would extend beyond the scope of this WAP to conduct these calculation exercises for Santa Fe County.

B.5. Wetland Sensitivity to Climate Change

If outside forces gradually or suddenly eliminate all three basic characteristics of a wetland area (a prevalence of hydric saturation conditions, hydrophytes, and/or un-drained hydric soils), such a wetland ecosystem ceases to exist. As a result, by their very definition wetlands are inherently susceptible–or sensitive–to losing the characteristics of being saturated with water or covered by shallow water at some time during the growing season of each year. Additionally, regardless of the hydric saturation conditions, wetlands are also sensitive to permanently losing hydrophytes and to disturbance of the un-drained hydric soils.

Climate change studies project that temperature would increase, and that related increases in evaporation, wildfire, early stream flow volume and duration, and declines in plant and animal species are the key factors in landscape vulnerability to climate change in the Southwestern United States (Robles and Enquist 2010, DeBuys 2011, Gangopadhyay and Pruitt 2011, Gutzler 2012, Lewis et al. 2012 Draft). Wetland ecosystems are particularly sensitive to these ecological trends resulting from a changing climate in the Southwest.

In 2010, The Nature Conservancy published a climate vulnerability assessment of landscapes across the Four Corners States with map details for each 6-HUC code watershed in this area (Robles and Enquist 2010), which poignantly clarifies the climate change vulnerability of wetlands

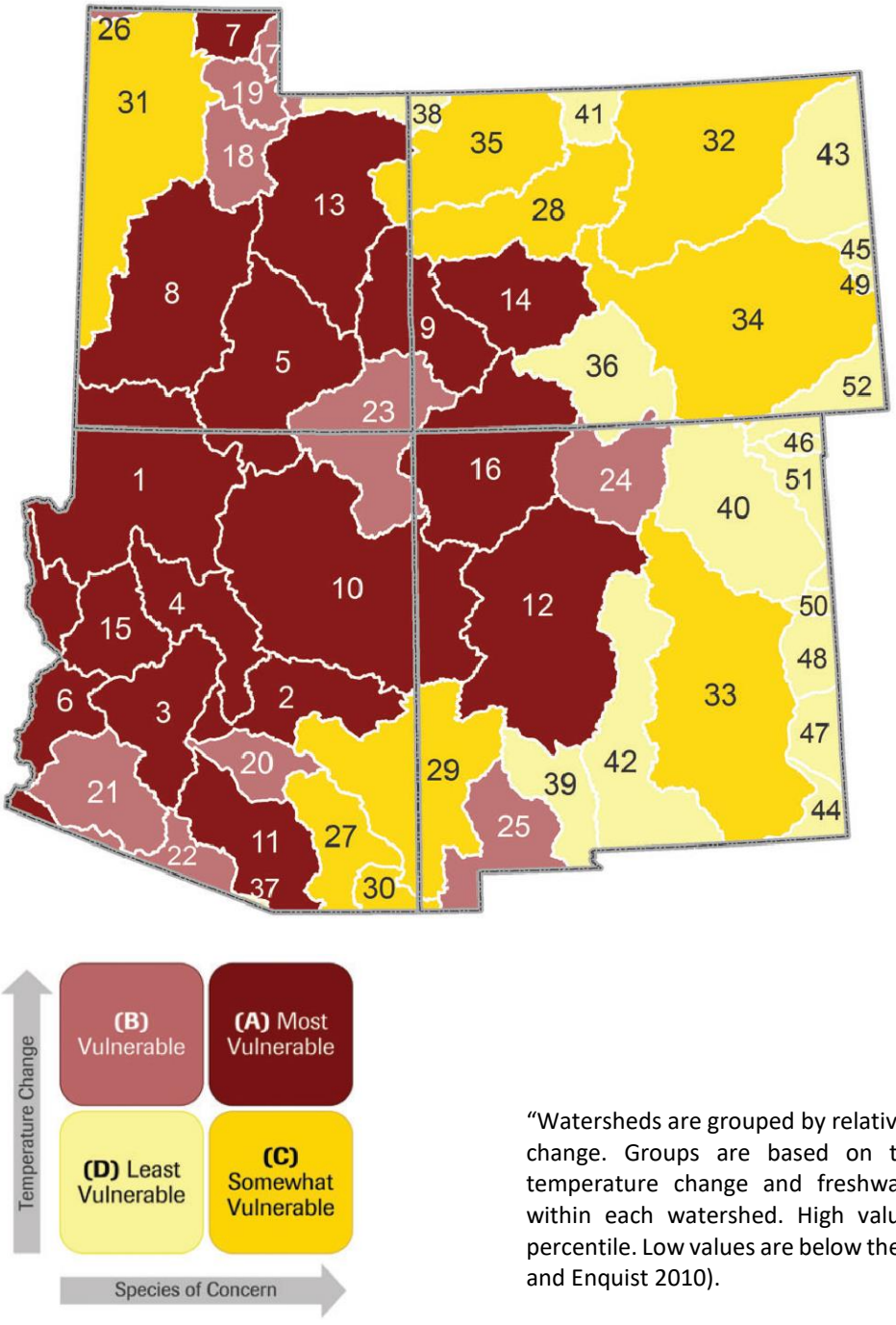
in Santa Fe County (see Figure B.7). The study identified that the part of Santa Fe County encompassing the Española Basin (Rio Grande-Elephant Butte watershed (#12)) falls in the category of "most vulnerable" to climate change due to the impacts of temperature increases and species decline. The Montane Forest area and the Upper Pecos watershed area (#33) are categorized as "somewhat vulnerable" and the Shortgrass prairie in the Estancia Basin (Rio Grande Closed Basins (#42)) is categorized as "least vulnerable" (Robles and Enquist 2010) (see Figure B.7). Table B.1 offers a comparative overview of the projected sensitivity of landscapes in Santa Fe County to documented changes in the ecology and climate between 1951 and 2006.

Table B.1. Documented ecological and climate changes as indications for landscape vulnerability to anticipated change for five landscape types in Santa Fe County (Robles and Enquist 2010).

Landscape Type	Location in Santa Fe County	Temperature Change in °F	Number of Species of Conservation Concern	Documented Impacts
Subalpine Conifer Forest	High elevations in Sangre de Cristo Mountains	1.6	301	Timing Plants Animals
Two-needle Piñon/Juniper Woodland	Non-urban woodland areas of Española Basin	1.6	525	Plants
Intermountain Grassland	Grasslands between Pojoaque and Santa Cruz; central & northern Galisteo Basin; La Bajada Mesa	1.6	332	
Montane Forest	Mid- and lower elevations in Sangre de Cristo, Jemez, and Ortiz Mountains	1.4	428	Wildfire Timing Plants Animals
Shortgrass Prairie	Grasslands in eastern Galisteo Basin and Estancia Basin	0.8	81	Timing

Note: Landscape types (or habitats) are listed in descending order of their relative vulnerability to climate change, along with information about their location, area, temperature change (°F 1951-2006), the number of species of conservation concern, and documented ecological impacts. Temperature change and species are evaluated across the range of habitats in the Four Corners States. Observed ecological impacts associated with climate change include:

"Animals" = animal species population shift, change or decline
"Plants" = plant species population shift, change or decline
"Timing" = change in the timing of species events
"Wildfire" = uncharacteristic fire events



"Watersheds are grouped by relative vulnerability to climate change. Groups are based on the relative amount of temperature change and freshwater species of concern within each watershed. High values are above the 50th percentile. Low values are below the 50th percentile" (Robles and Enquist 2010).

Figure B.7. Map of vulnerability assessment results for different watersheds in the Southwest (from Robles and Enquist 2010). Santa Fe County comprises the northeastern part of the Rio Grande–Elephant Butte watershed (12), the most southern tip of the Upper Rio Grande watershed (24), the far northern tip of the Upper Pecos watershed (33), and the northern tip of the Rio Grande-Closed Basin watershed (42). Most of Santa Fe County is located in the Rio Grande–Elephant Butte watershed (12), which is classified as "Most Vulnerable" to climate change.

APPENDIX C: A WETLAND STRESSORS CHECK LIST FOR WETLANDS IN SANTA FE COUNTY

The following Stressors Check List and corresponding Summary Worksheet for Wetlands in Santa Fe County has been developed for the NM RAM for Montane Riverine Wetlands Field Guide, Version 2.4, 2019 (Muldavin et al. 2019).

SA CODE : **Date :**

SA Name : **Surveyor Initials :**

Worksheet 15. Stressor Checklist. Check off stressors by intensity category that may be affecting wetland ecological condition of the SA and WOI. Assign categories using direct evidence where available or your best professional judgement otherwise. If the presence of the stressor is uncertain, mark as "Unknown". Rank Major Stressors in Dominant Stressor column(Pick up to 3)

Major	Affect				Stressor Group/Stressor	Comments
	Major	Minor	Absent	Unknown		
					Adverse water management	
	☐	☐	☐	☐	Extended low flow dam releases	
	☐	☐	☐	☐	Timing of flow releases not concordant	
	☐	☐	☐	☐	Extended high flow dam releases	
	☐	☐	☐	☐	Agricultural flow diversion upstream	
					Adverse sediment management	
	☐	☐	☐	☐	Adverse sediment retention by dams	
	☐	☐	☐	☐	Sediment loss by dredging	
	☐	☐	☐	☐	Adverse sediment inputs(reservoir)	
					Artificial water additions	
	☐	☐	☐	☐	Sewer treatment effluent	
	☐	☐	☐	☐	Point source urban runoff	
	☐	☐	☐	☐	Factory, feedlot outfall	
	☐	☐	☐	☐	Agricultural irrigation ditch returns	
	☐	☐	☐	☐	Mining waste	
					Ground water pumping	
	☐	☐	☐	☐	Urban depletions	
	☐	☐	☐	☐	Fracking	
	☐	☐	☐	☐	Agriculture	
					Watershed alteration	
	☐	☐	☐	☐	Extensive recent fires in watershed	
	☐	☐	☐	☐	Extensive recent timber harvest	
	☐	☐	☐	☐	Extensive open pit mining in watershed	
	☐	☐	☐	☐	Livestock and wildlife grazing exceding	
					Low impacts	
	☐	☐	☐	☐	Evidence of excessive grazing (local)	
	☐	☐	☐	☐	Excessive noise affecting wildlife	
	0	0		0	Counts by Intensity	

Additional Comments

Version Date: 08/02/2019

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APPENDIX D: PAYMENT FOR ECOSYSTEM SERVICES SCHEMES

Wetland Banking and In-Lieu Fee Services Programs

The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) maintain primary jurisdiction of wetlands through the Clean Water Act (33 U.S.C. §1251 et seq. (1972)). The agencies maintain a "no net loss" policy regarding wetlands activities. As a result, any activity that results in loss of wetlands requires a permit and also requires compensation through wetland mitigation. Mitigation can be performed by the permittee, or through a third party.

One method of mitigating loss of wetlands is through wetlands mitigation banking. Under wetlands mitigation banking, a permittee needing to compensate for loss of wetlands due to development activities can purchase credits that provide funding to a third party to compensate for the loss of wetlands in another location. Mitigation activities can involve restoration, establishment or preservation of wetlands. In 2008, EPA and the Corps announced a new wetlands compensatory mitigation rule that creates new standards to improve wetland restoration and protection. The new standards clarify the mitigation sequence of "avoid, minimize and compensate." The rule emphasizes site selection; watershed needs assessments; ecological performance standards and monitoring; and aquatic ecosystem science in compensation measures (NACD 2009).

An opportunity for future financing of wetland restoration and protection is the development of an In Lieu Fee Services Program for wetland mitigation in Santa Fe County (SWQB 2011). An assessment of the long-term average number of CWA Section 404 permit applications in Santa Fe County and the associated monetary value for wetland mitigation activities may indicate the scale of a potential market for such a County-wide In Lieu Fee Service Program (ILF). The U.S. Army Corps of Engineers, which administers federally regulated wetland mitigation programs (The Conservation Fund 2009), offers several mitigation strategies, such as ILF and Mitigation Banking. Given the historical development trends in Santa Fe County, the development of an ILF program may be a more feasible option than the development of a Mitigation Banking program. The development of an ILF program requires the initiative of a non-profit entrepreneur who is able and willing to submit a proposal in the form of a prospectus to the U.S. Army Corps of Engineers for consideration of the collaborative development of a local ILF program. Upon approval of the proposal, a program plan and business plan must be developed and approved by an Interagency Review Team. However, given the current uncertainties of urban development and anticipated physical disturbances of wetlands that require subsequent mitigation action, the opportunities for establishing an ILF program in Santa Fe County are equally uncertain.

Water Quality Trading

U.S. EPA defines water quality trading as "…an approach that offers greater efficiency in achieving water quality goals on a watershed basis. It allows one source to meet its regulatory

obligations by using pollutant reductions created by another source that has lower pollution control costs" (EPA 2003).

Water quality trading is an innovative, market-based, cost-effective mechanism to help achieve local water quality improvements (EPA 2003). In water quality trading, sources with high costs of reducing pollution (also called abatement) can purchase equal or greater pollution reductions from sources with lower costs. This cost difference provides an incentive for trading to occur. Entities with lower abatement costs are able to economically lower their pollution discharges beyond permitted levels, enabling them to sell their excess reductions (EPA 2003). Entities with higher abatement costs benefit by meeting their abatement goals at a reduced price. Permits under the Clean Water Act drive a lot of the current activity in water quality trading, but it is also possible to have trading driven by local water quality needs (EPA 2003, EPA 2004).

CWA related permits are based on Total Maximum Daily Loads (TMDLs) and enforced through the National Pollution Discharge Elimination System (NPDES). Under a water quality trading system, impaired streams or watersheds are identified and targets are set for the amount of allowable pollution or a TMDL. Landowners can generate credits by implementing best management practices (BMPs) to reduce nonpoint source pollution in the impaired stream. Regulated point source entities needing to reduce pollution levels for such pollutants as phosphorus, nitrogen or sediment can purchase the credits generated by the landowner(s) as an alternative to costly technology upgrades to their facility. Water quality credit trading offers an innovative strategy with great potential to improve water quality and natural systems in both urban and rural settings (NACD 2009).

However, because water quality standards for wetlands have not yet been developed for New Mexico, and there is no State-wide or State-issued trading policy, guidance, or set of rules, water quality trading based on regulatory pollution controls and enforcement mechanisms is not yet practical in New Mexico. The nearest states that do have such systems and that could serve as models for New Mexico are Colorado, Idaho, and Oregon. Other states include several states of the Great Lakes area and on the East Coast from New York to Florida (Willamette Partnership 2012). However, voluntary mechanisms are conceivable if markets could be found.

Biodiversity Trading

Loss of ecosystems and species habitat nationwide has resulted in many species being listed as endangered or at risk of extinction. Emphasis is placed on protecting or restoring habitat for these species through the 1973 Endangered Species Act (ESA) (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.). A solution that is gaining momentum involves working with landowners to provide wildlife habitat through conservation banking.

The U.S. Fish and Wildlife Service (FWS) issued the first federal guidelines for conservation banks in May 2003 (NACD 2009). The FWS guidelines standardized establishment and

operational criteria for mitigation of wildlife habitat. Under these criteria, FWS utilizes conservation banks as a system of tradable credits based on desired species habitat, especially for at-risk and endangered species. Similar to wetlands mitigation banking, conservation banking works when developers or others are required to compensate for activities that adversely impact wildlife habitat. Lands used for ranching, farming, and timber can offset adverse impacts by selling habitat or species credits to those who need to compensate for impacts in return for an easement establishing specific wildlife management goals. Credits can be based on different sizes of land depending on the habitat needs of the species in consideration, but large tracts of land work best because of their ability to provide a functioning ecosystem and greater biodiversity. Conservation banking can create a win-win-win situation where developers are able to offset the impact of their activities with regulatory certainty, landowners gain income for managing land for the impacted wildlife, and wildlife benefit from protected open space and habitat (NACD 2009).

APPENDIX E: LETTER FROM AGUA FRIA VILLAGE ASSOCIATION AND SANTA FE RIVER TRADITIONAL COMMUNITIES COLLABORATIVE CONCERNING THE HISTORIC VIEW OF SF COUNTY WETLANDS

Agua Fria Village Association

2073 Camino Samuel Montoya
Santa Fe, NM 87507

January 27, 2022

Adrienne Rosenberg
Monitoring and Educational Outreach Coordinator
Ecotone Landscape Planning, LLC

Dear Ms. Rosenberg:

I would like to make a written statement for the Santa Fe County Wetlands Action Plan (WAP), to clarify the historic view of wetlands that might not reflect the "current conditions on the ground" for wetlands.

This is William Mee, President of the Agua Fria Village Association (AFVA), Acequia Agua Fria and the Agua Fria Wellowners' Association. We are members of the Santa Fe River Traditional Communities Collaborative.

In the Collaborative, we established a History Committee. One of our main charges was to figure out where the 47 mile long, now 46 miles because of Cochiti Dam, Santa Fe River had wetlands or Bosque.

The idea being that only those areas, that were historically wetlands or a Bosque, should continue to be forested and not every single mile of the River as over-development continues. That the water use of a 46-mile long Bosque would be unsustainable based on historic water production capabilities of the Santa Fe River watershed.

Pretty much what we figured out in our report is that the historic places of settlement along the river where the places that were a Bosque and people moved into them. Those places in geographic order going roughly east to west are: Santa Fe (which is three distinct springs), Cieneguitas (a village obliterated by city of Santa Fe expansion), Pueblo Quemado, Agua Fria Village, La Cieneguilla, La Cienega, La Bajada, Pena Blanca, Santo Domingo Pueblo (Kewa Pueblo), and Cochiti Pueblo.

So outside of these areas the Santa Fe River was pretty much kept barren by annual flooding.

Former N.M. State Historian and University professor, Hilario Romero, has documented 30 springs that existed along the Santa Fe River. These springs were noted in the historic journals of European explorers or travelers. Because of current hydrological conditions, water overuse, only six of the springs are active ephemeral springs. However, resting of the aquifer could have these springs surface again. Three of the springs were in Agua Fria Village. In fact, the 1693 Land Grant to Roque Madrid by Governor-Captain General Don Diego de Vargas mentions the Ojito Fresco as a boundary point.

At least three springs were in Cieneguitas. With this name actually describing a marshy place. The construction of Agua Fria Street, El Camino Real de Tierra Adentro, in the vicinity of Avenida de Cristobal Colon has a series of dips that were perpetual sinkholes from the original marsh.

Going into the City of Santa Fe itself, the present day Water Street in the City of Santa Fe, was actually an oxbow of the Santa Fe River. With a large flood in the 1700's cutting a straight channel that exists in the present day and bypassing the oxbow. In colonial Spanish times it was known as Rio Chiquito, possibly as early as 1607. At the intersection of Alameda and Cathedral Place, was the Archbishop's Carp Pond; a pond that was perpetually fed by the springs of the Santa Fe River.

The second water rights action of the Santa Fe River is on July 27, 1715 when Don Juan Ignacio Flores Mogollon, Governor-General and Captain-General of the provinces of New Mexico, establishes a committee of Lorenzo Madrid, Roque Madrid and Miguel Duran to *ascertain whether the pond just built by Captain Diego Arias de Quiros at the cienega interferes with the pond[i] at the convent and the rights of the irrigators and planters along the river and whether it interferes with the commons and the cabildo. Further, whether the cienega shall be adjudge as constituting land belonging to the villa, in order that the community may enjoy the benefit it has enjoyed up to the present time.* The river diversion of Captain Arias de Quiros was determined to interfere with downstream irrigators (as was the water rights law across the Kingdom), and his diversions were ordered to be removed. This is significant because it establishes the precedence of Agua Fria water rights over the Villa of Santa Fe.

I think this statement may evolve to include more information as the History Committee of the Santa Fe River Traditional Communities Collaborative continues its work.

The AFVA supports a Santa Fe County Wetlands Action Plan.

Sincerely,
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[i] This pond is seemingly Archbishop Lamy's carp pond featured in a number of Museum of New Mexico photographs. The pond and present-day Water Street (city street) were actually an oxbow of the Santa Fe River, which through a flood later changed the river's course and remains in this channel to this day. Quiros' diversion could have flooded and been dammed as a pond in the lower area that is present day Federal Circle.